Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

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Ph.D. Thesis

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A Thesis Submitted to the University of Dhaka in partial fulfillment for the Award of the Degree of Doctor of Philosophy in Education

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DEDICATION


I WOULD LIKE TO
DEDICATE THIS THESIS TO
MY RESPECTED PARENTS

DECLARATION

I, Md. Billal Hossain, hereby declare that the thesis entitled "Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study" being submitted to the University of Dhaka by me for the award of the degree of Doctor of Philosophy in education is my own research work done under the supervision of Professor M. Nazmul Haq, Institute of Education and Research, University of Dhaka. I also declare that the thesis has not formed the basis for the award of M. Phil or Ph. D degree or other similar title of any candidate of any university or institutions.

Place: Dhaka

Date: 08.07.2020

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CERTIFICATE

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I have the pleasure to certify that the thesis entitled "Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study" submitted by Md. Billal Hossain to the Institute of Education and Research at the University of Dhaka, Bangladesh for the degree of Doctor of Philosophy in Education is an original research work done by him under my supervision. To the best of my knowledge, this thesis has not been previously submitted for any diploma or degree to any other university or institute. Materials obtained from different sources have been duly acknowledged by the researcher in the relevant places of the thesis.

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ACRONYMS

ANOVA	Analysis of Variance
AMAS	Abbreviated Math Anxiety Rating Scale (AMAS)
BBS	Bangladesh Bureau of statistics
B. Ed	Bachelor of Education
DU	Dhaka University
DIU	Daffodil International University
DSHE	Directorate of Secondary and Higher Education
EFA	Exploratory factor analysis
HT	Head Teacher
IER	Institute of Education and Research
ISRT	Institute of statistical Research and Training
JU	Jahangirnagar University
KMO	Kaiser-Meyer-Olkin
LSI	Learning Style Inventory
MAS	Mathematics Anxiety Scale
MASYC	Math Anxiety Scale for Young Children
MAAS	Math Anxiety and Attitudes Scale
MATAS	Mathematics Teaching Anxiety Scale
MA	Mathematics anxiety
MAMTS	McAnallen Anxiety in Mathematics Teaching Survey
MAMTS-B	McAnallen Anxiety in Mathematics Teaching Survey-Bangla version
MATQ	Math Affect Trait Questionnaire
MARS	Mathematics Anxiety Rating Scale
MASST	Mathematics Anxiety in Secondary School Teachers
M ED	Master of Education
MOE	Ministry of Education
MRS	Mathematical Resilience Scale
MSEAQ	Mathematics self-efficacy and anxiety questionnaire

MT	Mathematics Teacher
MTA	Mathematics teaching anxiety
NAMP	National Mathematics Advisory Panel,
NCTM	National Council of Teachers of Mathematics
NCTB	National Curriculum and Textbook Board
PMA	Personal mathematics anxiety
Ph.D.	Doctor of Philosophy
SD	Standard deviation
SSRC	Social Science Research Council
SAVP	Senior Assistant Vice President
TAI	Test Anxiety Inventory
WB	World Bank

ABSTRACT

Secondary education considers as preparatory stage of life of any student and it prepare quality students for tertiary education. Like other country Bangladesh also wants to produce more productive and loyal citizens through its secondary education. Mathematics is one of the important subjects among other compulsory subjects at secondary level. Mathematics plays an important role in developing scientific knowledge and technological advancement. So, student's weakness in this subject is not expected. But Bangladesh has backward in respect of mathematics education and it is not up to the mark. To keep pace with the present world we have to build up our expertise in mathematics. Mathematics can consider as a gatekeeper for better employment. Mathematics education is needed for the safety of a nation and quality of life and even the prosperity of a nation. Mathematics anxiety has been an important and also a common problem in learning and teaching from elementary through university levels for the last three decades. Math anxiety is a kind of problem facing by students and teachers where the main cause of math anxiety is the teacher himself. On the other hand, the greatest prevention of math anxiety is the teacher himself. Highly anxious math teachers might unintentionally transfer their negative feelings, avoidance and fear of mathematics to students. To improve the quality teaching at first we should know about the existence of math anxiety among secondary math teachers. The general objective of the study is to explore the status of mathematics anxiety in secondary math teachers of Bangladesh.

This study was exploratory in nature and quantitative in method used to collect and analyze the data. The instrument was administered to check the validity and reliability after translation into Bangla out of the original sample area. Then data were collected from the participants by using the Bangla version (MAMTS-B) of original scale (MAMTS) with demographic questions. Exploratory factor analysis, pearson correlation coefficient, regression analysis, ANOVA and t-test were performed to analyze and interpret the data. The 4 divisions were selected considering regional variations and 2 districts from each division. Finally, 2 upazilas were selected conveniently from each district and 3 schools were selected from each upzila. Thus 48 schools and all of the teachers who taught mathematics of 48 schools were considered as sample. A total of 242 mathematics teachers (male 193 and female 49) were included as participants from 48 different schools.

The average age of the teachers was 40 years and majority (58.7%) of the teachers' age was up to 40. Again majority (70.7%) of the teachers experienced were within 20 years. 50.4% secondary math teachers did not have mathematics as a subject at their graduation level. 54.1% secondary math teachers did not have any training in mathematics. 82.2% secondary math teachers did not have any master degree or have master degree but in other subjects without mathematics and only13.6% were master degree with honors in mathematics. It was found that 12.8% secondary math teachers experienced low level of mathematics anxiety, 76% experienced moderate level and 11.2% experienced high level of mathematics anxiety. It was also found that 11.6% secondary math teachers experienced low level of mathematics teaching anxiety, 78.1% experienced moderate level and 10.3% experienced high level of mathematics teaching anxiety. Females had more anxiety than males for mathematics but not in mathematics teaching. The difference between urban and rural teachers in personal math anxiety and math teaching anxiety were not significant. The personal math anxiety score and math teaching anxiety score were slightly differed on professional education but the difference was not significant. There was a significant difference between the teachers who taken or not mathematics as a subject at their graduation level both on personal math anxiety and math teaching anxiety. Teachers who were trained in mathematics there personal math anxiety score and math teaching anxiety score were higher than who were not trained and it's were significant at 99% confidence level. Personal mathematics anxiety and mathematics teaching anxiety were highly associated ($r = 0.89$), where mathematics teaching anxiety was 79% dependent on mathematics anxiety.

The study recommended that only subject teacher should teach mathematics. Educational qualification for secondary math teachers may at least master degree in mathematics. All teachers are needed training in mathematics because subject based training can reduce ones anxiety level and improve confidence.

The study has been organized into five chapters. Chapter one describes introduction that includes background, statement of the problem, rationale of the study, objectives of the study, research questions and operational definition. Chapter two deals with literature review. Chapter three focuses on methodology. Chapter four presents data analysis and findings. Finally chapter five describes discussion and conclusions.

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INTRODUCTION

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INTRODUCTION

1.1 Background of the study

1.1.1 Secondary Education of Bangladesh

Secondary education is the next continuing stage of primary education and previous stage of higher education. Ali (1999) considers the level as preparatory stage of life of any student. Secondary education is regarded as very important stage for any student in the management of education for any country and for this reason the secondary education is called the backbone of educational management (Education policy of Pakistan 1970, Education commission of Bangladesh 1974). Secondary education is the 'gateway to life' according to the Report of International Education Commission formed for the education of 21st century (National Curriculum 2012, NCTB). One of the purposes of secondary education is to prepare quality students for tertiary education (Education watch, 2007). World Bank declared that Bangladesh is now a lower middle income country. Like other country Bangladesh also wants to produce more productive and loyal citizens through its secondary education system. Mathematics is one of the important subjects among other compulsory subjects at secondary level. So, students' weakness in this subject is not expected. But Bangladesh has backward in respect of mathematics education and the standard of teachers than many other countries in the world (International organization report as cited in The Daily Ittefaq 27.02.15).

Education watch (2007) reported that only 1.1% students of class X secured grade point 5 in mathematics, where 1.6% students in Bangla, 2.6% students in English and 2.4% students in Everyday science secured the same grade point 5. On the other hand maximum 53.1% students secured grade point 0 in mathematics where 35.5% students in Bangla, 40.1% students in English and 22.8% students in Everyday science secured the same grade point 0. DSHE (2014) reported that 65% students

studying in class eight and 82% of class six in Bangladesh have failed to reach the standard level of mathematics. According to the report of world economic forum (2013), the standard of mathematics education of Bangladesh is 113th out of 144 countries.

The committee formed to upgrade the standard of mathematics education of Bangladesh reported (2010) that the education of secondary level of Bangladesh is not up to the mark. Besides, the committee (Formed to upgrade the standard of mathematics education in the secondary level of Bangladesh) has suggested considering the present scenario of secondary mathematics education to identify the weakness and obstacles of development as well as to ensure the overall improvement. The notable weakness identified by the committee (Formed to upgrade the standard of mathematics education in the secondary level of Bangladesh in 2010) were the weakness of teachers qualification, teaching method and training affairs, also the weakness of curriculum and textbook affairs, large class size, students with different merit in a same class, weak primary base of the students etc. The same committee suggested that today's world is the world of science and technology and to keep pace with the present world we have to build up our expertise in mathematics.

The economic progress is closely related to math performance of the learners whose age level is 15 or more and who have passed from schools (Editorial column, The Daily Ittefaq, 27.02.15). It has always been mathematics that plays an important role in developing scientific knowledge and technological advancement. Mathematics can consider as a gatekeeper for better employment (Haciomeroglu, 2014). Application of mathematics is also found in the personal and social life as well, whereas the extent of joy of using mathematics in personal and social life largely depends on how a child learnt mathematics (NCTB, 2013). The final report of the National Mathematics

Advisory Panel, U.S. Department of Education, (NMAP, 2008) cited in Reed (2014) impasses to improve mathematics education are needed for the safety of a nation and quality of life and even the prosperity of a nation.

1.1.2 Mathematics Anxiety

According to the Merriam Webster Learner's Dictionary the meaning of anxiety is fear or nervousness about what might happen. On the other hand, according to the Oxford Dictionary, anxiety is a feeling of worry, nervousness or uneasy about something with an uncertain outcome. Richardson and Suinn (1972), cited by McAnallen (2010), who developed the Mathematical Anxiety Rating Scale (MARS), defined mathematics anxiety as — "feelings of tension and anxiety that interfere with the manipulation of mathematical problems in a wide variety of ordinary life and academic situations (p. 544)" and also they stated that mathematics anxiety may include dislike of mathematics, worry, and fear with specific behavioral manifestations that include tension, frustration, distress, helplessness, and mental disorganization. Fennema and Sherman (1976) cited by McAnallen (2010) also believe that mathematics-related distress is accompanied by symptoms, including dread, nervousness, and an increased heart rate. Mathematics anxiety has been an important and also a common problem in learning and teaching from elementary through university levels for the last three decades (Uusimaki & Nason, 2004; Vinson, 2001 cited as Haciomeroglu, 2014).

1.1.3 Teachers Mathematics Anxiety

Devine, Fawcett, Szűcs and Dowker (2012) found that mathematics performance of students is negatively correlated with math anxiety. Math anxiety is also found to hinder students' working memory (Perina, 2002 as cited in Smith, 2004). He noted that math anxiety is a kind of problem facing by students and teachers where the main

cause of math anxiety is the teacher himself. On the other hand, the greatest prevention of math anxiety is the teacher himself (Smith, 2004). Teacher's belief which is originated from his prior school experiences has a powerful impact on his practice of teaching (Uusimaki & Nason, 2004). They also revealed that according to teachers' opinion secondary school teachers were the major contributing factor for their learnt dislike of mathematics. Haciomeroglu (2014) stated that overall pre-service teachers had a low-level of mathematics anxiety and mathematics teaching anxiety but mathematics anxiety had a statistically significant effect on mathematics teaching anxiety.

1.1.4 Effect of teacher's math anxiety

Researchers (Sloan, 2010; Vinson, 2001 cited as Haciomeroglu, 2014) claimed that highly anxious math teachers might unintentionally transfer their negative feelings, avoidance and fear of mathematics to students since mathematics anxiety is related to how one teaches mathematics. Bursal and Paznokas (2006) found the negative correlations between pre-service teachers' math anxiety and their confidence to teach elementary mathematics, where personal math teaching self-efficacy scores were positively correlated. Mathematics methods course can reduce pre-service teachers' math anxiety. Harper & Daane (2012) showed that at the end of the methods course the reduction of the level of math anxiety of pre-service teachers was significant. High math anxiety of teachers affected the math performance and beliefs about the personal math ability of their students (Sparks, 2011, cited in Reed, 2014). So, to improve the quality teaching at first we should know about the existence of math anxiety among secondary math teachers. If it exis then to what extent and how it affects students and their achievement. For this reason researcher is interested to conduct a study on Math anxiety in secondary school teachers of Bangladesh.

1.2 Statement of the problem

The title of the study is "Mathematics Anxiety in Secondary School Teachers of Bangladesh**:** An Exploratory Study". As a teacher of mathematics, researcher always faced students' beliefs that mathematics is more difficult than other subjects. On the other hand, only 35 % students achieved relevant competencies in class 8 (DSHE report 2014). It should be determined why students in secondary schools feel tension and uneasiness, face difficulties in mathematics, therefore, they cannot achieve the relevant competency of mathematics. Math anxiety has an effect on teachers and students and it has an obstacle for math achievement (The final report of the National Mathematics Advisory Panel. U.S. Department of Education (NMAP, 2008), cited in Reed , 2014). Students are facing math anxiety where the main cause of math anxiety is the teacher himself (Smith 2004). How enjoyable or painful mathematics is mainly depending on suitable teacher (Editorial column, The Daily Ittefaq, 27.02.15). Therefore, the intent of the study is to explore the existence and level of mathematics anxiety even mathematics teaching anxiety in secondary schools teachers mainly who teach mathematics. This needs to be analyzed by an academic research and found out the math anxiety situation of secondary mathematics teachers in our country.

1.3 Rationale of the study

McAnallen (2010) claimed that math teachers need to understand all concepts deeply to reduce their own anxiety and not to transmit any anxiety to their students. Smith (2004) told that if the teacher has a bad attitude about mathematics, his students most likely will as well. So, the teacher can take many steps to reduce math anxiety. Therefore, the more a teacher understands math the more he will be able to remove anxiety from the students. Improving the quality of math teaching and learning, teachers has a key role. To change their belief and remove the causing factors math

teachers have to know the total situation of math anxiety. All the trainers, educators, resource person also have to know the total situation about math anxiety to help math teachers. Other researchers will apply the result of the research to analyze the different side of math anxiety.

To improve the effective learning at mathematics we have to minimize the math anxiety from the students. Therefore, it is necessary to analyze the teachers' math anxiety to minimize it. McAnallen (2010) stated that higher levels of mathematics anxiety led to decreased feelings of enjoyment about mathematics and personal mathematics attitude and teaching mathematics attitude are positively correlated. McAnallen (2010) also found that math teachers reported about their previous experiences that negative interactions of teachers regarded as embarrassing, humiliating and hurtful attitude contributed to their mathematics anxiety. Besides poor teaching practices is also an important cause of students' math anxiety. But one of the main causes of teachers' negative interaction with students and poor teaching practice is teacher's math anxiety. So, it is needed to measure and analyze the teacher's math anxiety to overcome the situation.

Hambree (1990) reported that as impact of math anxiety students avoid mathematics, their career options are reduced, eroding the countries resource base in science and technology. Fiore (1999) told that the roots of mathematics anxiety is in the teachers and teaching of mathematics then he suggested that mathematics anxiety results more from the way the subjects is presented than the subjects matter itself. Jackson and Leffingwell (1999) cited by McAnallen (2010) found that only about 7% of Americans have had positive experiences with mathematics from kindergarten through college. Therefore, if we want to remove math anxiety from our students at

first it should be removed from our teachers to improve our mathematics education. In that case this study will be very helpful.

1.4 Objective of the study

The general objective of the study is to explore the status of mathematics anxiety in secondary math teachers of Bangladesh.

1.5 Specific Objectives of the study

1) To measure the personal mathematics anxiety level of secondary math teachers of Bangladesh.
2) To know the effects of different demographic categories, i.e. gender, urban-rural, teachers' age, qualification, experience, and training on personal mathematics anxiety in secondary mathematics teachers.
3) To measure the mathematics teaching anxiety level of secondary mathematics teachers of Bangladesh.
4) To know the effects of different demographic categories (gender, urban-rural, teachers' age, qualification, experience, and training) on mathematics teaching anxiety in secondary mathematics teachers.
5) To know the relation between personal mathematics anxiety and mathematics teaching anxiety.

1.6 Research Questions

1) What are the levels of personal mathematics anxiety (PMA) in secondary mathematics teachers of Bangladesh?
2) What are the effects of different demographic categories (gender, urban-rural, teachers' age, qualification, experience, and training) on personal mathematics anxiety in secondary mathematics teachers?

3) What are the levels of mathematics teaching anxiety (MTA) in secondary mathematics teachers?
4) What are the effects of different demographic categories (gender, urban-rural, teachers' age, qualification, experience, and training) on mathematics teaching anxiety in secondary mathematics teachers?
5) What is the relation between personal mathematics anxiety and mathematics teaching anxiety?

1.7 Operational Definition

Secondary education level in Bangladesh: There are 3 types of secondary education such as junior secondary, secondary and higher secondary in Bangladesh. But grade 6 to 10 is considered as secondary education level in this research.

Secondary mathematics Teachers: Teachers, who teach mathematics at the level of six to ten of secondary schools of Bangladesh, are considered as secondary mathematics teacher.

Personal mathematics anxiety and mathematics teaching anxiety: Anxiety about mathematics as subject defined as personal mathematics anxiety (PMA) and anxiety about teaching in mathematics defined as mathematics teaching anxiety (MTA).

Rural and urban status of math teachers: Municipal area has considered as urban area and out of municipal area is considered as rural area for this study. Therefore, teachers who teach in urban area are considered as urban teacher and teachers who teach in rural area are considered as rural teacher.

CHAPTER 2
LITERATURE REVIEW

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LITERATURE REVIEW

2.1 Introduction

A comprehensive review of literature on math anxiety is provided in this chapter. The literature review includes ten sections. The second section is a review of the concept about mathematics anxiety. The third section provides a review of the instruments and measurement of mathematics anxiety. Section four and five provides review of teachers' personal mathematics anxiety and teachers' mathematics teaching anxiety respectively. The section six and seven provides a review of causes of mathematics anxiety and effects of mathematics anxiety respectively. Section eight provides a review of previous research about mathematics anxiety according to time duration. Section nine clears research gap for this study and finally section ten describes the conceptual framework with relevent variables.

2.2 Concept about mathematics anxiety

2.2.1 Definition of mathematics anxiety

Math anxiety is a feeling of acute helplessness about one's ability to do mathematics and it is an emotional response to participating in a math class, listening to a lecture, working through problems (Uusimaki & Nason, 2004). Again math anxiety is related to poor teaching or humiliation, which is not true for all because sometimes it comes from the math anxious teachers, parents, siblings or peers even it may link only to some operations (Uusimaki & Nason, 2004). Mathematics anxiety was defined by Richardson & Suinn (1972), who developed the Mathematical Anxiety Rating Scale (MARS), as "feelings of tension and anxiety that interfere with the manipulation of mathematical problems in a wide variety of ordinary life and academic situations" (p. 544). It is also characterized as worry, stress, weakness or general ineffectiveness of an individual when he/she required to manipulating numbers and shapes (Richardson & Suinn 1972; Tobias, 1978). Fennema & Sherman, (1976) stated that mathematics

related distress is accompanied by symptoms such as dread, nervousness, and it increased heart rate (Reed, 2014). Hendel & Davis (1978) described mathematics anxiety as intentional avoidance of mathematics and the inability to learn mathematics skills. Tobias & Weisbrod (1980) defined mathematics anxiety as "the panic, helplessness, paralysis and mental disorganization that arises among some people when they are required to solve a mathematical problem" (p. 63). Zettle & Raines (2002) said that the distress can result in a negative attitude toward mathematics. Zettle & Raines (2002) also defined mathematics anxiety as a state of discomfort that involves with mathematical tasks and can create a negative attitude toward the subject.

Preis & Biggs (2001) as cited in Reed (2014) claimed that some math myths is the another source of mathematics anxiety such as women can't do math, some people can do math, others can't; my father/mother couldn't do math, I'm good at English that's why I'm so bad in math. According to various definitions of mathematics anxiety it can result in fear, distress, shame, inability to cope, sweaty palms, nervous stomach, difficulty in breathing, and a loss of ability to concentrate (Reed, 2014). Gresham (2004) cited in Reed (2014) described mathematics anxiety as a lack of applied understanding and an irrational dread of mathematics, often leading to avoidance of the subject. Mathematics anxiety has been defined by different researchers in many different ways, such as a fear of mathematics that usually stems from unpleasant experiences in mathematics either at school or home (McAnallen, 2010).

Wigfield & Meece (1988) agree to include different characteristic as dislike of mathematics, worry, and fear with specific behavioral manifestations, tension, frustration, distress, helplessness, and mental disorganization. Tobias (1978) cited in

McAnallen (2010) described mathematics anxiety as "sudden death" for some individuals. Harper & Daane (1998) defined math anxiety in teachers as fears from past experiences with mathematics. When someone use mathematical algorithms, discuss about math, even talk about math test they feel math anxiety (Tobias, 1990). “Math anxiety is a loathing of mathematics” (Vinson, 2001) and “a condition of distress that occurs when someone is asked to perform mathematics” (Wood, 1988). Gresham (2007) defined math anxiety as “a mild to extreme feeling of uncertainty regarding mathematics”.

Ashcraft & Moore (2009) described person’s negative affective reactions involve with numbers, and calculations and these reactions could manifest through feelings of panic, discomfort, avoidance, fear of failure, a blank mind, and helplessness (Bekdemir, 2010). Hembree (1990) concluded mathematics anxiety as “learned condition more behavioral than cognitive in nature” (p. 45). Math anxiety has been defined as "an inconceivable dread of mathematics that can interfere with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations" (Buckley & Ribordy, 1982, p. 1), cited in Smith, (2004).

Mathison (1977) defined math anxiety as an irrational fear of mathematics from simple discomfort to total avoidance of mathematics classes. Ashcraft & Faust (1994) described mathematics anxiety as mental disorder, desperation, and feelings of tension about manipulation of mathematical problems, numbers, and figures. Lazarus (1974) considered mathematics anxiety as an interaction of many factors, such as mathematics itself, educational and curriculum related issues, parental attitudes, values, and expectations toward mathematics. Shodahl & Diers (1984) concluded that inadequate preparations, attitudes of the mathematics teachers, inadequate

mathematics textbooks, and the students' level of thinking are the sources of mathematics anxiety. Ashcraft (2002) defined math anxiety as a feeling of tension, apprehension, or fear that interferes with math performance and also explain math anxiety is a predictor of math-related outcomes and the avoidance of math coursework.

2.2.2 History of mathematics anxiety

"The emergence of the study of mathematics anxiety started with the observations of mathematics teachers in the early 1950s" cited as Alexander (2010). In 1957, Dreger and Aiken published the article "The identification of number anxiety in a college population" in the Journal of Educational Psychology, thereby introducing 'Mathematics Anxiety' as a new term for students' attitudinal difficulties with mathematics then they defined it as "the presence of a syndrome of emotional reactions to arithmetic and mathematics" (p. 344) **.** They hypothesized that number anxiety was distinct from general anxiety, which is not related to intelligence and the higher number anxiety is related to have lower grades of a person in mathematics. Then Dreger and Aiken defined math anxiety as an "emotional disturbance in the presence of mathematics" (p. 344). In 1954 after seeing her students struggle with math, elementary school teacher Gough published "Mathemaphobia: causes and treatments".

Hembree (1990) mentioned that in the early 1970s, mathematics anxiety was selected as an area of research in North American Society and also it affects both teachers and students. Over the last decade researchers are trying to understand when and how math anxiety develops (Ganley & McGraw, 2016). Researchers have been developing instruments to investigate mathematics attitudes and anxiety since the early 1950's (Fennema & Sherman, 1976). Different researchers have concluded that if teachers

hate math or have math anxiety, their negative feelings could be contagious and spread to the children they teach (Kelly, 2015).

Hembree (1990) claimed that studies on mathematics anxiety in the past 30 years have not only examined its commencement , dimensions and causes but have also investigated its relationship with other constructs, such as test anxiety and self-efficacy. Different studies were conducted for primary students (Ma & Cartwright, 2003), secondary school students (Khatoon & Mahmood, 2010) and from pre-service teachers (Liu, 2008) to in-service teachers (McAnallen, 2010). The research investigating mathematics anxiety dates back over 40 years (Uysal & Dede, 2016). Wigfield & Meece (1988) have found that anxiety with other affective variables is strongly related to learning mathematics.

2.2.3 Types of mathematics anxiety

Ferguson (1986) classified mathematics anxiety into three categories, such as mathematics test anxiety, numerical anxiety and abstraction anxiety. While test anxiety is related to success in mathematics tests, numeral anxiety is related to the manipulation of numbers and abstraction anxiety is related to abstract mathematical contents (Uysal & Dede, 2016). Trujillo & Hadfield (1999) classified mathematics anxiety into three major categories as intellectual, environmental and personality factors. They also explained three factors firstly, the intellectual factors consist of students' attitudes, lack of self-confidence in mathematical skills, mismatched teaching and learning styles. Secondly, the environmental factors include use of traditional teaching method, conventional classroom environment, parental demands, feeling helpless and negative teaching - learning classroom experiences. Thirdly, personality factors involve being reluctant to ask questions in the classroom by reason of low self-esteem, shyness and for females perceiving mathematics as a male

domain. Math learning anxiety and math evaluation anxiety are the two different components of math anxiety (Hopko et al., 2003).

2.3 Instruments and measurement of math anxiety

Chavez and Widmer (1982) measured elementary math teachers' anxiety. They prepared a Math Attitude Inventory and administered to 230 elementary teachers and found that only 17% of the female and 8% of the male were identified as math anxious but the difference was not statistically significant. They conducted a survey of elementary pre-service teachers and series of follow up interviews. Kelly & Tomhave (1985) used Mathematics Anxiety Rating Scale (MARS) to determine the level of anxiety toward mathematics in pre-service elementary teachers and suggested that a high proportion of the female teachers were math anxious. Wigfield & Meece (1988) assessed math anxiety in 6th-grade to 12th-grade children *(*respondents, 564) as part of a comprehensive longitudinal investigation of children's beliefs, attitudes, and values concerning mathematics. Exploratory factor analyses provided evidence for two components of math anxiety, a negative affective reactions component and a cognitive component. The MAQ was developed in several steps. Initially, Meece (1981) cited in Wigfield & Meece (1988) defined six possible dimensions of anxious or negative reactions to mathematics for assessment: dislike, lack of confidence, discomfort, worry, fear and dread, and frustration. Items were constructed or adapted from existing math anxiety scales to assess these different dimensions. The 19 items were incorporated into the SAQ. Each item was answered on a 7-point scale. The Student Attitude Questionnaire (SAQ) has been used and refined in two major studies of children's beliefs and attitudes about mathematics (Eccles et al., 1984; Eccles et al., 1986). Allen, Florida Institute of Technology James Carifio, UMASS at Lowell (1999), developed the Math Affect Trait Questionnaire (MATQ) for the investigation

of affect during mathematical problem solving is presented. Anxiety, math interest, and self-esteem under problem solving conditions are the main constructs measured by the MATQ. The Math Affect Trait Questionnaire (MATQ) is a 25 item instrument designed to measure various affect traits during mathematical problem solving.

Haycock (2001) also found that many pre-service, primary, or early childhood teachers have anxiety about mathematics. Recent studies have suggested that pre-service teachers with high levels of mathematics anxiety have demonstrated low confidence to teach elementary mathematics (Bursal & Paznokas, 2006) and low teacher efficacy about teaching mathematics (Swars, Daane, & Giesen, 2006). American researchers (Ellsworth & Buss, 2000; Silva & Roddick, 2001; Trujillo& Hadfield, 1999 cited in McAnallen, 2010) traced the source of mathematics anxiety in pre-service teachers, finding that most students indicated the powerful role of the teacher in the development of mathematical understanding, placing them on a continuum from enabling to disabling. The researchers also found other factors that contributed to the development of mathematics anxiety, such as the ways mathematics was presented and taught as self-perceptions; family influences, and mathematics test anxiety. Vinson (2001) stated that he used the *Mathematics Anxiety Rating Scale* (MARS) developed by Richardson & Suinn (1972) with 98-items. It was a self-rating scale with 5 point likert-type, which may be administered either individually or to groups. In the same study the author Vinson (2001) has found the changes in the levels of mathematics anxiety among the pre- service teachers after and before the intervention by using different materials and methods. It was a quantitative study. The sample included 87 pre service teachers enrolled in mathematics methods courses. The multivariate analysis of variance (MANOVA) was used. The t-test was used to comparisons of pre-test and post-test raw scores. Uusimaki & Nason (2004) selected

eighteen participants (17 female and 1 male) from a pool of forty-five self identified math-anxious students, who volunteered for the study from 300 third-year pre-service primary student teachers enrolled in a mathematics education in Eastern Australia. Semi-structured interview schedule were used as instrument. The interviews were audio-recorded for later transcription. The eighteen participants were invited to attend a 20 minute semi-structured interview. Then transcripts were read more closely. Emerging themes were identified and listed for each of the three issues being investigated namely the origins of math-anxiety, situations causing math-anxiety and types of mathematics causing math-anxiety. The following four questions were designed for the semi-structured interview such as (1) when did you learn to dislike mathematics? (2) Why did you learn to dislike mathematics? (3) What causes your math-anxiety? (4) What mathematical concepts cause your math-anxiety?

Smith (2004) investigated the role of teachers in secondary school students' (grades seven through twelve) math anxiety. He selected two seventh grade mathematics teachers for 2 classes named class A (10 females of 21 students) and class B (8 females of 19 students). Students' attitudes towards mathematics were assessed by the Mathematics Attitude Inventory (MAI), which was prepared by the researcher. The MAl was designed to measure six different areas of mathematics attitude such as perception of the mathematics teacher, anxiety toward mathematics, value of mathematics in society, self-concept in mathematics, enjoyment of mathematics, and motivation in mathematics .The inventory consists of 48 questions using 4 point Likert type scale. A shortened version of the MAl prepared by the researcher was used to measure the teacher's anxiety toward mathematics, the value of mathematics in society, enjoyment of mathematics, and motivation in mathematics. Four questions were then added to measure the teachers' contentment in teaching mathematics, the

number of years they have taught mathematics, and their college background in mathematics. It was a survey. The teacher of Class A indicated that she had either a Master's or Bachelor's degree in mathematics and had been teaching mathematics for 31 years. The teacher of Class B indicated that she did not have either a Master's or Bachelor's degree in mathematics. She had been teaching mathematics for seven years. Testing for both classes occurred on the same day. The students and teachers were not given a time limit. They were instructed to be truthful on the inventory and read each question carefully. Of the 48 items on the inventory, only 38 were used to determine the various attitudes. Following are the equations used to determine the attitudes in the different areas. The researcher first determined each individual student's score in these six areas, then separated the students by class and found the mean, median, mode, range, minimum, and maximum values for the class in each area. To score the teachers' responses, the researcher used the same formulas given in the MAl for the students' responses. The formulas differed in the fact that not all the questions that were used to determine the students' scores were on the inventory for the teachers. Therefore, the actual score for the teachers is not fully comparable to those of the students. For example, to score a students' enjoyment of mathematics, seven of the items were used. One of those items was not applicable to the teachers, so only six items were used in the formula.

Uusimaki & Nason (2004) found that 66% of the participants perceived that their negative beliefs and anxiety towards mathematics emerged in primary school. Out of 12 participants who traced their negative beliefs and anxieties back to negative mathematical experiences in primary school, two of the participants identified specific mathematics content, such as learning the multiplication table in grade 2 and abacus, as the cause for their math anxiety. One of the participants traced her negative beliefs

about mathematics back to her mother. Significantly, the remaining 9 participants specifically identified primary school teachers for their learnt dislike and fear of mathematics. The analysis also revealed that 22% of the participants identified secondary school as a time when they learnt to dislike mathematics. Like the 12 participants who identified primary school experiences, where their negative beliefs and anxiety towards mathematics originated, all four of these participants specifically identified secondary school teachers as the major contributing factor for their learnt dislike of mathematics. Petra's comment about one of her secondary school mathematics teachers exemplified the type of comments made by these four participants about some of their secondary mathematics teachers.

Bursal & Paznokas (2006) found the negative correlations between pre-service teachers' math anxiety and their confidence to teach elementary mathematics, where personal math teaching self-efficacy scores were positively correlated. Malinsky, Ross, Pannells & Mark (2006) used Mathematics Anxiety Rating Scale - Revised (MARSR), a 24 item and 5 points self-rating scale, developed by Plake and Parker in 1982 based upon the original 98 item MARS rating scale (Richardson & Suinn, 1972). Prieto & Delgado (2007) used math anxiety scale to measure math anxiety of Spanish secondary education students. It was a Spanish version of one of the Fennema-Sherman Mathematics Attitudes Scales with 18 items describing various psycho-physiological reactions, beliefs and behaviors related to the daily and academic use of mathematics, where 6-point Likert-type scale were used. They have taken an achievement test composed of 30 multiple choice items and distributed as 10 items for arithmetic, 10 items for geometry and 10 items for problem solving both from arithmetic and geometry. In this study, they found that high-anxiety students get

poor achievement and show more negative attitudes toward mathematics than low-anxiety ones and also female students scoring higher anxiety than male ones.

Zakaria & Nordin (2008) used three instruments to obtain the data, such as Mathematics Anxiety Scale (MAS), Effectance Motivation Scale (EMS) and Mathematics Achievement Test (MAT). The MAS and the EMS is a 12-item instrument, six worded positively and six worded negatively (Fennema & Sherman, 1976). The instrument used a 5 point Likert scale with a range of strongly agree to strongly disagree. A total score is calculated by assigning a value of 1 (strongly disagree) to 5 (strongly agree) to each item and then adding the values. Possible scores range from 12 to 60. Here low score on the MAS indicates a high level of mathematics anxiety. The instrument used for measuring mathematics achievement was the Mathematics Achievement Test (MAT). The MAT is a 12 questions open ended test with a 2 hour time limit. The study involved 88 students (73 females and 15 males). The study investigated the effects of mathematics anxiety on matriculation students as related to motivation and achievement. The ANOVA results showed that the mean achievement scores and motivation scores of low, moderate and high anxiety groups were significantly different. According to the Tukey's HSD tests, the mean differences in achievement test between the low and high anxiety groups were found to be statistically significant. Elizabeth Jackson (2008) used a questionnaire to explore the existence of mathematics anxiety of trainee of a training course of British initial teacher education institution. The questionnaire was prepared carefully by Cohen, Manion & Morrison (2000). The factors were incorporated into the questionnaire but the reliability and validity was not declared here. It was mentioned 31 were returned from the distributed 50 questionnaire, which was sufficient to take forward in analysis. It was exploratory investigation and a small-scale quantitative

study. The using questions were generated from a review of literature. The intention was to elicit student teachers attitudes towards mathematics and explore how their learning for primary math teaching might be affected.

Bai, Wang, Pan, & Frey, (2009) developed a theoretically and methodologically sound bi-dimensional affective scale measuring mathematics anxiety with high psychometric quality. A 14 item Mathematics Anxiety Scale-Revised (MAS-R) adapted from Betz's (1978) 10 item Mathematics Anxiety Scale with five-point scale. Seventyeight (36 males and 42 females) undergraduate students selected from different disciplines, where 64% of the sample between ages of 18 and 24 and 36% of the sample over the age of 25. To justify the bi-dimensionality of MAS-R, the chi-square model-fit indices for the one-factor measurement model and the two-factor measurement model were compared using the Analysis of Moment Structures (AMOS) , (Arbuckle, 2006 cited in (Bai, et al. 2009) . Validity and reliability was checked in favour of bi dimentional, positive & negative affect even model was also fit. Internal consistency reliability, parallel item consistency, item total correlation, and factor structure were analyzed by using the Statistical Package for the Social Sciences (SPSS). An exploratory factor analysis was conducted to identify factor structure using a principal axis factoring extraction method, and the final factor solution was estimated by using principal components. The Kaiser-Meyer-Olkin measure of sample adequacy was .87, greater than the minimally accepted level 0.50, indicating that the sample was adequate for the factor analysis (Kaiser & Rice, 1974).

Diana (2009) developed a questionnaire that explores the relationship between college students' mathematics self-efficacy and mathematics anxiety. This study was conducted with three groups of students such as 61 students took an online version of the questionnaire, 109 students took a paper version of the questionnaire, and 13

students were interviewed, while filling out a paper version of the questionnaire where no student participated in more than one group. The exploratory factor analysis was introduced to extract the factors. Cronbach's alpha 0.93 for the 13-item self-efficacy scale of the MSEAQ, and 0.93 for the 15-item anxiety scale of the MSEAQ. Note that the anxiety items on the MSEAQ are reverse scored. Exploratory factor analysis was used to examine the dimensions along which the students conceptualized their mathematics self-efficacy and mathematics anxiety. Using principal axis factoring and a promax rotation, items from the MSEAQ loaded onto five factors: General Mathematics Self-Efficacy, Grade Anxiety, Future, In-Class, and Assignments. The interpretation of these five factors was verified through the participants' responses during the interviews. The questionnaire developed in this study is a reliable, relatively valid instrument that can be used to explore the multiple dimensions of college students' mathematics self-efficacy and mathematics anxiety.

Morshed (2009) argued that a significant inverse but weak relationship exists between math achievement and overall math anxiety, negative affective reactions and worry. Negative affective reactions correlated most with achievement, but worry related the least. Trujillo (1999) cited in Morshed (2009) suggests that a large number of elementary teachers do possess math anxiety. Some researchers further hold the view that high math anxious teachers might transfer their anxiety on their students by following the rigid and traditional teaching approaches they themselves were taught in their school life (Bulmahn & Young, 1982, Bush, 1989; Martinez, 1987, cited in Morshed, 2009).

Peker (2009) showed that learning styles and mathematics teaching anxiety has a significant difference. He classified learners as divergent, assimilator, convergent, and accommodator. He used Learning Style Inventory (LSI) consist of 12 items and the

Mathematics Teaching Anxiety Scale (MATAS) including 23 items 5 point likert scale with 4 factors as Content knowledge, Self-confidence, Attitude towards mathematics teaching, and Teaching knowledge as instrument. As Content knowledge – 10 items (factor loading ranging from 0.53 to 0.86), Self-confidence – 6 items (factor loading ranging from 0.57 to 0.76), Attitude towards mathematics teaching – 4 items (factor loading ranging from 0.61 to 0.70), and Teaching knowledge – 3 items (factor loading ranging from 0.68 to 0.78).Total number of respondents of the study was 506 pre-service teachers, where 205 elementary school teachers, 173 elementary mathematics teachers, and 128 secondary mathematics teachers in Turkey. About 57% of participants were male (286) and 43% were female (220) in the study. The mean age of participants was 22.41 years. Learning Style Inventory (LSI) developed in 1976 and revised in 1985 by Kolb. A research of LSI was done towards its applicability in Turkish by Askar & Akkoyunlu in 1993. According to Kolb, learning is a four-stage process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation. Mathematics Teaching Anxiety Scale (MATAS) in the study was developed by the Peker (2006) to determine the pre-service teachers' mathematics teaching anxiety levels and scores. The researcher employed the one-way ANOVA with $\alpha = 0.05$ in the analysis of the differences of pre-service teachers' teaching anxieties in mathematics based on their learning styles.

Peker, Halat & Mirasyedioğlu (2010) used a 5 point Likert-type mathematics teaching anxiety scale(MATAS) developed by Peker (2006) consisting of 23 items with four factors, such as Content knowledge – 10 items , Self confidence – 6 items, Attitude towards mathematics teaching – 4 items and Teaching knowledge – 3 items. Reliability estimates of the MATAS were obtained by using Cronbach's alpha for

each subscale. 368 pre-service mathematics teachers where 199 of them were pre-service middle school mathematics teachers and 169 were pre-service high school mathematics teachers. The independent samples t-test with $\alpha = 0.05$ was performed in the study. The highest point a person can make on the MATAS is 115, and the lowest point is 23. The pre-service teachers' teaching anxiety in mathematics is calculated based on the score in the above 23-item scale. It was quantitative study.

Beilock, Gunderson, Ramirez & Levine (2010) assessed math anxiety using the short Mathematics Anxiety Rating Scale (sMARS) of Alexander & Martray (1989) , which is a 25-items version of the widely used 98-items MARS of Suinn (1971) with 5 point Likert scale.17 female (12 first-grade teachers and 5 second-grade teachers) teachers with the average teaching experience was13 years. Math achievement was measured for 117 students (65 girls and 52 boys) (girls: 40 first graders and 25 second graders; boys: 38 first graders and 14 second graders) using the Applied Problems sub-test of the Woodcock–Johnson III Tests of Achievement (Woodcock, McGrew & Mather , 2001) . Regression analysis was performed to identify the affect of female math anxiety on girls' math achievement. The relation between teachers' math anxiety and the students' gender ability and beliefs also checked. Teachers' math anxiety and math knowledge were assessed during the last 2 months of the school year. Students' gender ability and beliefs were assessed after the math achievement task. Children were read two gender-neutral stories, one about a student who is really good at math and another about a student who is really good at reading. After each story, children were asked to draw a picture of the student in the story and were then asked whether the student they drawn was a boy or a girl.

Robertson (1991) cited by McAnallen (2010) described a cycle of mathematics avoidance that leads to a series of phases of mathematics anxiety. In phase one, a

person experiences negative reactions to mathematical situations perhaps resulting from past negative experiences with mathematics, and subsequently leading to phase two in which a person avoids mathematical situations. This avoidance leads to phase three, poor mathematics preparation, later resulting in phase four, poor mathematics performance. This generates more negative experiences with mathematics that subsequently cycles back to phase one. This cycle can be repeated, resulting in a mathematics anxious person becoming increasingly convinced that he or she cannot do mathematics, and research by Robertson (1991) cited by McAnallen (2010) suggested that individuals are rarely able to break the cycle. According to Ashcraft and Kirk (2001) "Mathematics anxiety disrupts the on-going, task-relevant activities of working memory, slowing down performance and degrading its accuracy" (p. 236). According to Levine (1996) cited in McAnallen (2010) large percentage of elementary teachers experienced high levels of mathematics anxiety.

McAnallen (2010) has found one of his studies that 48% reported mild mathematics anxiety, 46% reported moderate mathematics anxiety, and 7% reported severe mathematics anxiety, the relationship between mathematics enjoyment and mathematics anxiety are inversely correlated. He also found a relationship between personal mathematics attitudes and teaching mathematics attitudes are positively correlated. According to the elementary math teachers report, teachers and teaching practice can create math anxiety as feelings of humiliation, embarrassment, the style of the teacher, instructional strategies used or not used, and the lack of conceptual knowledge to teach mathematics.

Pradeep, (2010-2011) used both quantitative and qualitative research instruments to collect the data. Researcher used the combination of two test with 19 items (10+9) both consists of 5 point Likert scale. The questionnaires of the two standardized math

anxiety tests (MAS and AMAS) and also the test anxiety test (TAI) were translated into Dutch and adapted to the Dutch education system. The Mathematics Anxiety Scale (MAS), adapted from Fennema & Sherman's (1976) Mathematics Attitude Scale, consists of 10 items on a 5-point Likert scale where the first five items are worded positively and the next five are worded negatively. Again the Abbreviated Math Anxiety Rating Scale (AMAS), an adapted version of MARS-revised with only 9 items is also a 5-point Likert type scale. Since the test was a combination of the MAS and AMAS the range of the scores for the 19 questions varied from 19 to 95.The higher the score, the higher the level of math anxiety. To examine the relationship between test anxiety and math anxiety the Test Anxiety Inventory (TAI), developed by Spielberger, (1980), was used that consists of 20 items with 4 point likert scale, where worry and emotionality was major components of test anxiety. The Test Anxiety Inventory (TAI) has a minimum score of 20 and a maximum score of 80. Two-week test-retest reliability for the AMAS and MAS were tested. Structured interview and workshop were performed for qualitative section. The purpose of using TAI is examining the relationship between test anxiety and math anxiety.

Shapiro-Wilk test, *t*-test analysis, Wilcoxon signed-rank test, Psychometric test, One-tailed Pearson correlation test were used to analyze the quantitative data. Of the108 participants (87 females and 21 males) and they were of the age group 17-24 years. Some decided questions were asked in the semi structured interview for qualitative part.

According to Arfe and Brewer (2011) adopted math anxiety rating scale in this study from MARS-R of Plake & Parker (1982) with 24 questions, 5 point and 2 factors (learning math anxiety and math evaluation anxiety). The purpose of the study was to adapt MARS-R for online students and to investigate whether academic success in

math decreases the math anxiety. Original MARS developed by Richardson & Suinn (1972), 98 items with 1 factor (about test) but actually it was 2 factor according to Rounds & Hendal (1980) as test anxiety and numerical anxiety . Then Hopko (2003) designed a study to measure construct validity eliminated 12 items of 24 items in his study. The study was quantitative with quasi – experimental design due to the lack of random selection of the sample. The sample consisted of 800 students. A factor analysis employed to determine 2 subscales. Paired t test was performed to analyze the data. After rotation math evaluation anxiety explained 38% and math learning anxiety explained 35% with totaling 73%. The 7 items with factor loads smaller than .70 were deleted from the analysis. After deleting math evaluation anxiety explained 40% and math learning anxiety explained 36% with totaling 76%. Finally adapted 17 items with math evaluation anxiety 8 items and math learning anxiety 9 items was a valid instrument to measure math anxiety of adult online students.

Hadley & Dorward (2011) used modified Mathematics Anxiety Rating Scale-Revised (MARS-R) by Hopko, (2003) with 12 items and 5 point Likert-scaled to measure the elementary teachers math anxiety, where summed for a minimum possible score of 12, indicating no anxiety and to a maximum possible score of 60, indicating high anxiety. Hopko administered the MARS-R to 815 participants and conducted a factor analysis, then dropped 12 out of the 24 items from MARS-R. MARS-R was developed by Plake and Parker's in 1982 from the Mathematics Anxiety Rating Scale (MARS) of Richardson & Suinn, 1972. Modified MARS-R and the original MARS-R were strongly related. The test-retest reliability of the modified MARS-R was .80 and Cronbach's alpha for internal consistency was .95. To investigate elementary teachers mathematics teaching anxiety this study used modified MARS-R (Hopko, 2003) but with an emphasis on teaching mathematics. A panel of mathematics education

researchers and educators was used to evaluate the content validity of the items. It was also 12 items with 5 point Likert-scale. The test-retest reliability of this modified MARS-R was .83 and Cronbach's alpha for internal consistency was .90. Responses were summed for a minimum possible score of 12 indicating no anxiety, to a maximum possible score of 60 indicating high anxiety. A Pearson correlation was calculated to investigate the relationship between mathematics anxiety and mathematics teaching anxiety. Six hundred ninety two (692) teachers from grade one to six from 49 elementary schools in the Western United States were used as participants.

Brown, Westenskow & Moyer-Packenham (2011) investigated whether MA as prior experiences leads to MTA or not. They have found that MA and MTA are not always linked for all pre service teachers, where one-third of the elementary pre-service teachers reported high prior mathematics anxiety but did not experience MTA. They claimed this result from the written reflections of 53 elementary pre-service teachers where most participants were female. They did not use any scale to measure MA and MTA. They have found that yes mathematics teaching anxiety, YES-MTA for yes mathematics anxiety, YES-MA for 20.8% pre-service teachers. Richardson & Suinn (1972) cited as Brown, Westenskow and Moyer-Packenham (2011) created an instrument to measure mathematics anxiety, called the Mathematics Anxiety Rating Scale (MARS), and more recently researchers have created an abbreviated instrument called the MARS-Revised (Alexander & Martray, 1989) cited in Brown, Westenskow and Moyer-Packenham (2011). This instrument has been used widely with elementary pre-service teachers, often revealing higher levels of mathematics anxiety in pre-service teachers when compared with the general undergraduate population (Bursal &

Paznokas, 2006; Harper & Daane, 1998: Hembree, 1990) cited in Brown, Westenskow and Moyer-Packenham (2011).

Plaisance (n.d.) developed a semi-structured interview in order to examine the teachers perceptions about the problem solving and number sense course and their feelings about their own mathematics anxiety. Six demographic and other ten questions related to the students' feelings about mathematics in general and their perceptions of mathematics anxiety. Questions in relation to mathematics anxiety were adapted from a set of interview questions developed by Zbornik (2001). 100 teachers who completed the problem solving and number sense course were invited to participate in an interview related to mathematics anxiety by email, where 20 pre service teachers were responded. Six students scheduled interviews and five students were actually interviewed. Each pre service teacher participated in an individual interview. The interviews lasted approximately thirty minutes. Each interview was audio taped and then transcribed for coding purposes. Interview questions were developed to address the teachers' attitudes about the problem solving and number sense course and their perceptions about mathematics and mathematics anxiety.

Mathematics methods course can reduce pre-service teachers' math anxiety. Harper & Daane (2012) showed that at the end of the methods course the reduction level of math anxiety of pre-service teachers was significant. Ramirez, Gunderson, Levine & Beilock (2012) explored in this study whether math anxiety relates to young children's math achievement. 69 boys, 85 girls total 154 first and second grade children were consider as sample and children's math anxiety was assessed using a newly developed scale.

Haciomeroglu (2013) found that pre-service teachers with lower levels of anxiety had higher mathematical beliefs, where pre-service teachers with higher mathematical

beliefs have confidence in their own skills and abilities to be an effective elementary teacher. Haciomeroglu (2013) used the Mathematics Anxiety Rating Scale-Short Version (MARS-SV) developed by Suinn and Winston (2003) to measure the pre-service teachers' mathematics anxiety. The instrument was adapted to Turkish by Baloglu (2010). The MARS-SV consists of 30 items on a five-point Likert type scale and includes 5 broad dimensions: test, course, application, computation and social anxiety. The reliability coefficient for the overall instrument was calculated as .93. Again the Mathematical Beliefs Instrument (MBI) developed by Peterson, Fennema, Carpenter & Loef (1989) was used in this study. The instrument was adapted to Turkish culture to examine pre-service teachers' mathematical beliefs about learning and teaching by Haciomeroglu (2012), which includes 34 items in a five point likert type scale as "strongly agree" to "strongly disagree" with 4 broad dimensions: (1) Beliefs about how students construct mathematical knowledge, (2) beliefs about teaching mathematical concepts, (3) beliefs about organization of teaching, and (4) beliefs about students' development of mathematical knowledge. The participants were 301 pre-service teachers consist of 200 females and 101 males. An independent samples t-test was conducted to determine the differences between the third year and the fourth year elementary pre-service teachers' mathematical beliefs and mathematics anxiety but an independent t-test was not used to examine the difference between mathematics anxiety and mathematics teaching anxiety scores of pre-service teachers regarding gender Since male pre-service teachers were close to half of the female pre-service teachers. Between 25% and 50% were considered the moderate group but Low and high mathematics anxiety group identified, whose scores were in the lower 25% and in the upper 25% of the distribution. The Pearson product correlation coefficients calculated to explain the possible relationships between math

anxiety and math beliefs. One-way ANOVA and Tukey HSD (Honestly Significant Differences) tests were used to compare the mean MBI scores of the different mathematics teaching anxiety groups. Since male pre-service teachers were close to half of the female pre-service teachers, an independent t-test was not used to examine the difference between mathematics anxiety and mathematics teaching anxiety scores regarding gender.

Haciomeroglu (2014) used the Turkish adapted MARS-SV instrument ([T-MARS-SV], Baloglu, 2010), which was the Mathematics Anxiety Rating Scale-Short Version ([MARS-SV] of Suinn & Winston (2003) to measure the elementary pre-service teachers' mathematics anxiety. The scale includes 30 items on a four-point Likert scale, where higher scores reflect lower level of mathematics anxiety. Another scale the Mathematics Teaching Anxiety Scale (MATAS) developed by Peker (2006) was used to measure pre-service teachers' mathematics teaching anxiety level. It was consist of 23 items with 5 point Likert scale (strongly disagree, disagree, undecided, agree, and strongly agree. Higher scores indicate lower level of mathematics teaching anxiety). The internal reliability of the T-MARS-SV and MATAS was 0.93 and 0.91 respectively. The five subscales of T-MARS-SV were test anxiety, course anxiety, application anxiety, computation anxiety and social anxiety and the four subscales of MATAS were content knowledge, self-confidence, attitude towards mathematics teaching and teaching knowledge. A two-way between-groups multivariate analysis of variance was performed to investigate gender and year spent in the program differences in both mathematics anxiety and mathematics teaching anxiety scores of the pre service teachers. Pearson correlations were calculated to explore the bivariate relations between pre-service teachers' mathematics anxiety and mathematics teaching anxiety. Then, multiple regression analysis was conducted to determine

whether pre service teachers' mathematics anxiety was a predictor of their anxiety about mathematics teaching. Data were collected from 260 **(**165 females and 95 males) pre-service teachers located in northwest part of Turkey.

Reed (2014) investigated to determine professional development would reduce teacher's personal or professional math anxiety. It was a quantitative study using the McAnallen Anxiety in mathematics teaching survey, where the researcher measured the personal and professional math anxiety of pre-service elementary teachers. The McAnallen Anxiety in Mathematics Teaching Survey (MAMTS) was developed by McAnallen in 2009 to facilitate data collection on personal and professional math anxiety in elementary teachers. The MAMTS was consists of 29 items, 15 of which were related to professional math anxiety, and 14 were related to personal math anxiety. The study was based on the results of 177 surveys of teachers of grades one and two. Of the 249 teachers who received the survey, 177 completed the survey. The response rate was 71%. Of the teachers who took the survey, 73% had between zero and seventeen years of classroom teaching experience. The data was analyzed using the KMO and Bartlett's Test of Sphericity to determine reliability and analyze the factors in the results. Then SPSS was used to perform a exploratory factor analysis of the MAMTS and the MAMTS-TCPS. A pearson's correlation coefficient was used as the next step in analyzing the data collected using the MAMTS-TCPS. The dependent variables were professional math anxiety and personal math anxiety. McAnallen used exploratory factor analysis for her data analysis. EFA is used to examine underlying factors within variables or items. McAnallen's data resulted in two factors. She categorized factor one as professional mathematics anxiety and factor two as personal mathematics anxiety. McAnallen's initial MAMTS was 51 items to determine four factors: personal mathematics self-efficacy, personal mathematics anxiety,

mathematics teaching self-efficacy, and mathematics teaching anxiety (McAnallen, 2010, p. 25).

A content validation scale for the pilot survey was developed and given to 12 professionals in the field then 51 items were reduced to 40 items. A revised pilot survey using the 40 items in a 5-point Likert format was distributed to teachers attending two different conferences. Of the 900 questionnires of pilot surveys distributed, 335 were returned. The final instrument had 29 items: 15 related to professional mathematics anxiety, and 14 related to personal math anxiety. The reliability analyses determined that the 15 items comprising professional mathematics anxiety had a Cronbach‘s Alpha of .923 (McAnallen, 2010, p. 27). The 14 items comprising personal mathematics anxiety had a Cronbach‘s Alpha of .952 (McAnallen, 2010, p. 27). The KMO for the scale was .965, which is considered to be outstanding. Bartlett‘s Test of Sphericity was used to compare the correlation matrix to the identity matrix. It was significant at the .000 level, indicating there was not an identify element. In the initial Eignen values, the first four items accounted for 61% of the common variance among the items and the first factor accounted for 49% of the common variance. The Scree Plot indicated one primary factor. The Pattern Matrix indicated two factors, math teaching anxiety and personal math anxiety. Ten factors were discarded because of double loadings.

Reed (2014) determined that the teachers who participated in a year long mathematics course have less professional or personal math anxiety than those who did not participate. The purpose of this study was to determine professional development would reduce teacher personal or professional math anxiety. It was a quantitative study where the McAnallen Anxiety in Mathematics Teaching Survey (MAMTS) was used. Math anxiety affected teachers and students and it is an obstacle for math achievement (The final

report of the National Mathematics Advisory Panel. U.S. Department of Education (NMAP, 2008) , cited in Reed, 2014). The NMAP (2008) cited in Reed (2014) impasses to improve mathematics education are needed for the safety of a nation and quality of life and even the prosperity of a nation. High math anxiety affected the math performance and beliefs about their personal math ability of their students (Sparks, 2011, cited as Kara L. Reed, 2014).

Wilder, Brindley & Dent (2014) used a multi-part questionnaire, where the first part asked five contextual questions about the apprentice, such as their highest previous mathematics qualification and the level of apprenticeship they were taking, the second part asked questions about feelings and beliefs about mathematics, incorporating the Betz (1978) Mathematics Anxiety Scale (MAS) to measure the incidence of mathematics anxiety amongst the sample and the Mathematical Resilience Scale (Kooken et al., 2013). They used the shorter 10-item Mathematics Anxiety Scale (MAS) developed by Betz, 1978, which was deemed more suitable to UK apprentices. MAS have been found to have acceptable internal consistency and test-retest reliability (Pajares & Urdan, 1996**).** MAS were a 10-item scale with five items positively worded and five items negatively worded. Responses are given on a 5-point Likert type scale. The Mathematical Resilience Scale (MRS) is a 23-item scale developed from the construct 'mathematical resilience' by Kooken, a US PhD student, working with her supervisors in US and with Wilder and Lee in UK (Kooken et al., 2013). The MRS has three subscales: value, struggle and growth. Responses are given on a 5 point Likert type scale. The online data was collected using Snap Surveys. The data was largely analyzed within SPSS utilising the frequency, graphs and charts function to explore data descriptively and the ANOVA functions to test the differences between different sub groups. R was used for the regression modeling.

Scoring of negatively worded items was reversed so that a higher score would indicate higher mathematics anxiety.

Kelly (2015) stated that the study was an exploration of math anxiety and attitudes in pre-service elementary school teachers. The use of mixed methods for the study was explained. The survey used as quantitative techniques and interviews, classroom observations as qualitative techniques. Here 50% used qualitative methods only, 29% quantitative methods only and 21% used a mixed methods approach. To get a complete picture of students' math anxiety and attitudes, both quantitative and qualitative evidence were used. The used Math Anxiety and Attitudes Scale (MAAS) was the combined items from Hopko's Math Anxiety Rating Scale-Revised (2003), from Fennema-Sherman's Math Attitudes Scale (1976) and demographic questions that determined gender and college major with 40 items, where twenty-four dealt with math anxiety, twelve with attitudes, and four were demographic. The 36 anxiety and attitude items were on a five point Likert Scale. Sixty two pre-service teachers (14 males and 48 females) were the respondent for the MAAS. Descriptive statistics including means and standard deviations were determined. The attitudes scale was also analyzed using split-half reliability since the first six questions were asked in a positive way and the last six in a negative way. Criterion validity was established by looking at predictive validity. The results of the MAAS were used to determine which students exhibited the highest level of anxiety. The ten students with the highest level of anxiety and worst attitudes about mathematics, as determined by the results of the MAAS, were invited to participate in a focus group. The interviews were recorded and field notes were taken as well. Interviews were transcribed word for word and conducted a thematic analysis by developing a codebook to code the data and to search for trends in the responses (Bowling, 2002).

Atinuke (2015) investigated how the mathematics anxiety differs in terms of various demographic factors for in-service Elementary School Teachers Grades 1 to 8 classes in Canada and found that there was a (1) positive correlation between mathematics anxiety and mathematics teaching anxiety (2) female participants had higher mathematics teaching anxiety and (3) beginning teachers had higher mathematics teaching anxiety than experienced teachers. In quantitative phase, a total number of 163 elementary in-service teachers responded to the online survey (111 in-service elementary school teachers were analysed) and in qualitative phase of the study, the response rate was also low as only four in-service elementary teachers volunteered to take part in the semi-structured interviews. The Spearman's rank-order correlation (r_s) of the participants' RMARS and MATAS-E scores was calculated to examine the relationship between mathematics anxiety and mathematics teaching anxiety. The Mann- Whitney U and Kruskal-Wallis tests were performed on the mathematics anxiety scores obtained from RMARS. In qualitative phase of the study researcher transcribed the data, which was collected from interview then transcripts were analyzed using thematic analysis.

The researcher developed a questionnaire contained various demographic and socio-cultural factors (i.e gender, race, parent's educational background, socio-economic status, number of years of teaching, and highest level of mathematics studied in school) . In addition the Revised Mathematics Anxiety Rating Scale (RMARS*)* was used as the quantitative instrument to examine the level of mathematics anxiety in elementary teachers (i.e., low, moderate, high), whilst the Mathematics Teaching Anxiety Survey (MATAS) was used to determine the types of mathematics teaching anxiety they experienced (e.g. anxiety due to subject knowledge, self-confidence, attitude towards mathematics, and teaching knowledge. (Peker, 2006) . Permissions to

use RMARS and MATAS for this study were obtained from the authors of the instruments. The RMARS was developed from *Mathematics Anxiety Rating Scale* (*MARS*), devised by Richardson & Suinn (1972) to measure mathematics anxiety. MARS is a multidimensional instrument. Due to its length (98 items) Alexander and Martray (1989) examined the psychometric properties of MARS and developed its abbreviated version (namely RMARS) as a quick and effective measure of mathematics anxiety. The RMARS is a 25-item survey comprising of three subscales, such as the mathematics test anxiety subscale (15 items), the mathematics course anxiety subscale (5 items), and the numerical anxiety subscale (5 items). The total score for an individual can vary from 25 to 125 with higher score corresponding to higher mathematics anxiety level. Since, the RMARS has not been used with teachers as participants, in this present study, two of its items (# 3 and # 4) were modified to better fit teachers (rather than students). The internal consistency reliability, initial construct validity and initial concurrent validity were tested.

On the other hand, MATAS is a Turkish instrument that was developed by Peker (2006). It consists of 23 items with 5 responses. Positive responses (13 items) were coded from 1 to 5, while the negative ones (10 items) were reverse-coded from 5 to 1. MATAS is a four factor scale that measures teaching anxiety due to subject knowledge (10 items), anxiety due to self-confidence (6 items), anxiety due to attitude towards teaching mathematics (4 items) and anxiety due to subject teaching knowledge (3 items). To establish the validity, Peker (2006) carried out exploratory factor analysis and reported the analysis of variance for the four factors to be 35.37%, 8.55%, 6.57%, and 5.97% respectively. The reliability coefficients (Cronbach Alpha) of the four factors are reported to be .90, .83, .71, and .61. MATAS was originally created in Turkish language by Peker (2006). The instrument was translated into

English language for the purpose of this study. The translated MATAS instrument is referred to as MATAS-E in this study. The negative items (10) on MATAS-E were reverse coded before the total scores for participants were calculated. These data were analysed using the methods of descriptive and inferential statistics, such as means, standard deviations, Mann -Whitney U test, and Kruskal-Wallis test.

In this study, non parametric techniques were used for data analysis since the data collected with RMARS and MATAS-E were skewed and the variances for the groups (e.g., females and males) that were compared could not be assumed equal. The Mann-Whitney U and Kruskal-Wallis tests were performed on the mathematics anxiety scores obtained from RMARS to determine whether there were statistically significant differences between the groups of participants with respect to gender, socioeconomic status, parental educational levels, years of teaching, and highest mathematics course taken. The Spearman's rank-order correlation (r_s) of the participants' RMARS and MATAS-E scores was calculated to examine the relationship between mathematics anxiety and mathematics teaching anxiety. In the qualitative phase of the study, the researcher transcribed the recorded interviews and the transcripts were analyzed using thematic analysis.

Maloney, Ramirez, Gunderson, Levine & Beilock (2015) tried to better understand why some students perform worse in math than others. The study explored how parents' anxiety about math relates to their children's math achievement. The study tested whether parents' math anxiety predicts their children's math achievement across the school year and found that when parents are more math anxious, their children learn significantly less math over the school year and have more math anxiety by the school year's end. They also found parents' math anxiety did not predict children's reading achievement, which suggests that the effects of parents'

math anxiety are specific to children's math achievement. 868 children (469 girls, 399 boys) were participated. This was a convenience sample. Finally, 438 children whose data were analyzed came from 90 separate classrooms in 29 different schools, including public (both charter and non charter) and private schools in three states. For simplicity, the word "parents" to refer to primary caregivers. Of those who identified their relation to the child, 97% stated that they were "parents." The others indicated that they were foster parents (0.8%), grandparents (1.5%), or legal guardians (0.8%). Of those who answered the optional question about their gender, 89.0% were female and 11.0% were male. Children completed measures of math achievement, reading achievement, and math anxiety as part of a larger study. Math achievement was measured using the applied problems subtest of the Woodcock-Johnson III Tests of Achievement (Woodcock, McGrew & Mather, 2001). Reading achievement was measured using the Letter-Word Identification subtest of the Woodcock-Johnson III. Children are asked to identify the letters and read the words aloud. Math anxiety was assessed using a revised version of the Child Math Anxiety Questionnaire (C-MAQ) (Ramirez et al., 2013; Suinn, Taylor, & Edwards, 1988). The revised CMAQ (CMAQ-R) was designed for first and second grade children and involves 16 items that ask children how nervous they would feel during various math-related situations. Children responded by pointing to one of five faces that corresponded to different states on an emotional gradient. (1 = not nervous at all, 2 = a little nervous, 3 = somewhat nervous, 4 = very nervous, 5 = very, very nervous). Scores were averaged across the 16 questions. This scale had good reliability, where Cronbach's alpha was .84 in the Fall and .82 in the Spring. Parents were sent questionnaire packets, which they completed and returned by mail. Math anxiety was evaluated using the short Mathematics Anxiety Rating Scale (sMARS) (Alexander & Martray, 1989), which is

a 25-item version of the widely used 98-item Mathematics Anxiety Rating Scale (Richardson & Suinn, 1972) of a 5-point scale. All analyses were performed on the average of the 25 items. Parents also completed an assessment of their homework helping behavior using the question, "How often do you help your child with their math homework?" Answers were made on a 7-point scale (1 = never, 2 = once a month, 3 = less than once a week, 4 = once a week, 5 = 2–3 times a week, 6 = every day, 7 = more than once a day). To obtain a proxy for math achievement, we also asked parents to indicate their highest level of education obtained and to indicate the number of high school and college level math courses they had taken. Teachers' math anxiety was assessed using the sMARS. Teachers' math knowledge was assessed using the Elementary Number Concepts and Operations subtest of the Content Knowledge for Teaching Mathematics (CKT-M) measure (Hill, Schilling, & Ball, 2004). The task consists of 26 multiple-choice questions.

Georges, Hoffmann & Schiltz (2016) used a total of 86 students, where some participants were removed from the sample due to different cause. The 63 remaining participants were assigned to either a low math anxiety (LMA) or a high math anxiety (HMA) group based on a median-split procedure (Young et al., 2012; Rubinsten et al., 2015). Two participants with math anxiety scores equal to the median value were excluded from analyses. The final sample, thus, consisted of 61 participants, including 31 LMA and 30 HMA individuals. The study performed correlation and regression to analyze the data. Math anxiety was assessed using the abbreviated math anxiety rating scale (aMARS) (Alexander & Martray, 1989; Baloˇglu & Zelhart, 2007) comprising 25items. Participants were instructed to report their level of anxiety for each item on a five-point Likert scale, with 1 for "not at all anxious" and 5 for "very much anxious." The math anxiety score for each participant was calculated as the sum of all 25 item-

scores. Individual levels of math anxiety could, thus, range from 25 to125, with increasing scores reflecting an increased level of anxiety. The repeated measures ANOVA and linear trends method was used to determine the SNARC effect and NDE at the group level. The individual regression equations method provides a single numerical value for both the SNARC effect and the NDE for every participant. Mental rotation ability was assessed using the 24-item MRT-Aby Petersetal (1995).

Uysal, &Yüksel (*2016*) investigated the relationship between pre-service elementary teachers' mathematics teaching beliefs and mathematics anxiety, where 96 (72 female and 24 male) pre-service elementary teachers were respondent. The present study was limited with data quantitative in nature. Convenience sampling data were collected through two survey questionnaires: "Mathematics Anxiety Rating Scale: Short Version [MARS-SV]" of Suinn and Winston (2003), which was adapted by Baloğlu (2010) into Turkish 30 items and five factors as the Mathematics Test Anxiety, Course Anxiety, Computation Anxiety, Application Anxiety and Social Anxiety with 5 point scale and "Beliefs about the Teaching of Mathematics" , which was developed by Baydar (2000) with six-point rating scale single factor as general belief about math . One of the most commonly used approaches to assess teachers' beliefs is case-study methodology. With case study includes some combinations of classroom observations, interviews, surveys, concept mapping, mathematics education researchers rich data set which is important for theory building (Philippe, 2007). Data analysis involved descriptive and inferential statistics at the level of significance is 0.05. Descriptive statistics were calculated to provide means and standard deviations and bivariate correlation analysis was also performed to analyze the data.

Ganley & McGraw (2016) found that little work has focused on this relation between math anxiety and math performance in young children. Participants in the

main sample were 296 students (281 students were used for analyses) in the first through third grades (first grade 114, second grade 98, third grade 84) from two elementary schools in a city in the South east. The sample was 55% percent male. The average age of students at the time of testing was 7 years 3 months for first-grade students, 8 years 3 months for second-grade students, and 9 years 4months for third-grade students. The original MASYC and five newly-developed items were administered to students on a four-point Likert Scale with choices of yes, kind of, not really, and no. The MASYC contains 12 items, five of which are worded in the opposite direction. The five new math anxiety items were developed by the researchers based on other math anxiety scales designed to use with children (Suinn et al., 1988; Chiu and Henry, 1990; Wu et al., 2012; Jameson, 2013; Ramirez et al., 2013 cited in Ganley & McGraw , 2016)) and based on the results of the cognitive interviews . Finally, the study developed of a revised version (MASYC-R) from the Math Anxiety Scale for Young Children (MASYC), Harari etal.,2013) and the findings suggest that the MASYC-R is appropriate for use with young children and can help researchers to answer important questions about the nature and development of math anxiety at this age.

Researchers used many scale as instrument to measure mathematics anxiety at different level, where they developed or revised or modified the scales to minimize its limitations (Pradeep, 2010-2011, Eden, Heine & Jacobs, 2013). It can be concluded as the following chart to see at a glance.

Table 2.1: Name of the different math anxiety scale

Full name	**Abbreviation**	**items**	**Reference**
Mathematics Anxiety Rating Scale	MARS	98	Richardson & Suinn (1972)

Revised Mathematics Anxiety Rating Scale	RMARS	25	Alexander & Martay (1989)
Mathematics anxiety scale for children	*MASC*	-	Chiu & Henry, (1990)
Mathematics anxiety survey	*MAXS*	-	Gierl & Bisanz, (1995)
Math anxiety questionnaire	*MAQ*	-	Thomas & Dowker, 2000) (cited in Krinzinger, Kaufmann & Willmes, 2009)
Scale for early mathematics anxiety	*SEMA*, based on MARS;	-	Wu, Barth, Amin, Malcarne, & Menon, (2012)
Pictorial test for early signs of math anxiety	-	-	Aarnos & Perkkilä, (2012)
Child math anxiety questionnaire	*CMAQ*, based on MARS-E;	-	Ramirez, Gunderson, Levine, & Beilock (in press)
12-item mathematics anxiety scale	-	12	Vukovic, Kieffer, Bailey & Harari, (2013)
Mathematics Anxiety Rating Scale Revised	MARS-R	24	Plake & Parker (1982)
Revised MARS-R	Revised MARS-R	24	Hopko (2003)
Mathematics Anxiety Rating Scale Short Version	MARS-SV	30	Suinn & Winston (2003)
Mathematics Anxiety Rating Scale for Adolescents	MARS-A	98	Suinn & Edwards (1982)
Mathematics Anxiety Rating Scale for Elementary School	MARS-E	26	Suinn, Taylor & Edwards (1988)
Mathematics Attitude Scale	MAS	12	Fennema & Sherman (1976)
Mathematics Anxiety Questionnaire	MAQ	11	Wigfield & Meece (1988)

Mathematics Anxiety Questionnaire	MAQ	22	Wigfield & Meece (1981)
Mathematics Anxiety Scale	MAS	10	Betz (1978)
Math Anxiety Scale-Revised	MAS-R	14	Bai et al. (2009)
Abbreviated Mathematics Anxiety Scale	AMAS	9	Hopko et al. (2003)
Mathematical Resilience Scale	MRS	23	Kooken et al (2013
Mathematics Self-Efficacy and Anxiety Questionnaire	MSEAQ	29	Diana (2009)
Teacher Beliefs Survey	Teacher Beliefs Survey	26	Beswick (2005)
Math Anxiety Scale for Young Children	MASYC	12	Harari et al.,2013
Revised Math Anxiety Scale for Young Children	MASYC-R	13	Ganley & McGraw (2016)
Mathematics Teaching Anxiety Scale-English Version	MATAS-E	23	Peker (2006)
Math Anxiety and Attitudes Scale	MAAS	40	-
McAnallen Anxiety in Mathematics Teaching Survey	MAMTS		McAnallen (2010)
Minnesota Mathematics Attitude Inventory	MAI	48	
Math anxiety scale	MAS	14	Mahmood and Khatoon(2011)

2.4 Teachers' personal mathematics anxiety

Haciomeroglu (2014) explained mathematics as a gatekeeper for successful college completion and employment and therefore, students' achievement in mathematics is the important factor in their career development. "During the past 30 years, the lower performance and the lower participation of girls and women in mathematics have

been of major concern among policy makers and educational researchers in the USA and in most western European countries" (Pustjens, Damme, & Munter, 2008, p.568). Uusimaki & Nason, (2004) concluded that mathematics anxiety has been a serious problem in learning and teaching from elementary through university levels, over the last three decades. Mathematics anxiety has a huge influence on students' career choice and also on mathematics education (Bai, Wang, Pan & Frey, 2009). Smith (2004) stated that the mathematics teacher at any level faces serious barrier to teach students who experience math anxiety. Pradeep (2010-2011) noted that mathematics anxiety is not just only in students, but it also exists in teachers. When mathematics anxious students take up teaching as a profession in the future and transfer their anxieties to their students, then mathematics anxiety in teachers and students can concluded as cyclical in nature (Brady & Bowd, 2005; Smith, 2004). Reed, (2014) reported in this way that "math anxious teachers tended to be math anxious students". So, it is fact that math anxiety is a genuine problem facing students, teachers, and parents (Smith, 2004). Math anxiety can occurs at different ages in different people for different reasons where the main cause and at a time the best prevention of math anxiety is the teacher himself (Smith, 2004). Therefore, "teachers are the critical component of success in mathematics education" as cited in (Reed, (2014). "Knowing is half the battle" (Johns, Schmader & Martens, 2005, p. 175), therefore, if a teacher understands about math anxiety it will be possible to prevent it and help students overcome it (Smith, 2004).

The measurement of mathematics anxiety is important for understanding the nature and the degree of its presence (Hembree, 1990). The experience of mathematics anxiety always not be the same for all teachers due to differences in their past learning experiences and opportunities, cultural expectations, and social backgrounds,

therefore, it is needed to be examined its' both cognitive and socio-cultural aspects among elementary school teachers in Canada (as cited in Atinuke, 2015). Rachel McAnallen (2010) investigated in her mixed method study, mathematics anxiety and professional anxiety about teaching mathematics in in-service elementary teachers, where she developed a survey instrument titled the McAnallen Anxiety in Mathematics Teaching Survey (MAMTS). It was one of the only studies about in-service elementary math teachers, where she concluded that teachers not only lacked conceptual knowledge of mathematics, but also were not able to interpret mathematical activities and did not teach challenging mathematical ideas (McAnallen, 2010). Trujillo, & Hadfield, (1999) found that mathematics anxiety maximum time begins at the secondary level.

Researchers have found that teachers may create, increase, or reduce mathematics anxiety among students at all levels through their attitude and behavior, teaching methods and formal instructions (e.g. Sloan, 2010). At the position of teaching mathematics their anxieties might be transmitted to their students (Brady & Bowd, 2005; Vinson, 2001). Jackson & Leffingwell (1999) found that seven percent of the participants had only positive experiences in mathematics classes from the kindergarten level through the university level.

2.5 Teachers professional mathematics anxiety

Mathematics teaching anxiety can be defined as "pre- and in-service teachers' feelings of tension and anxiety that occurs during teaching mathematical concepts, theories, and formulas or during problem solving" (as cited in Peker, 2009). Brown, Westenskow & Moyer-Packenham, (2011) explained this type of anxiety is different from the generally used term mathematics anxiety because it is about their capacity to teach mathematics. Gardner & Leak (1994) concluded teaching anxiety as anxiety

experienced involves the preparation of teaching activities and execution of classroom activities. According to Levine (1993), anxiety for teaching mathematics is a repeated fear of pre-service teachers. Liisa Uusimaki & Rod Nason (2004) cited as "Teachers' beliefs about mathematics have a powerful impact on the practice of teaching". Brown, Westenskow & Moyer-Packenham (2011) stated that it is difficult to isolate mathematics teaching anxiety from mathematics anxiety. A Turkish researcher recently developed an instrument titled the "Mathematics Teaching Anxiety Scale" (MATAS) (Peker, 2009). Peker & Halat (2009) showed that teaching techniques and learning styles were the remarkable factors of the pre-service teachers' mathematics teaching anxiety.

Peker (2009) indicated that learning style preference is the affecting variable of pre-service teachers' mathematics teaching anxiety and suggested that various reasons for mathematics teaching anxiety for a pre service or in-service teacher, such as teaching point difficulty, inadequate mathematical knowledge, inadequate level of interest towards the teaching profession, incapability to the level of the learners of the pre- or in-service teacher. Godbey (1997) claimed that negative self-talk is the main cause of mathematics teaching anxiety in some pre-service teachers. Several factors, such as content knowledge, attitude towards mathematics, and self confidence are related to both mathematics anxiety and mathematics teaching anxiety (as cited in Peker, 2009). Gender was not a cause among the pre-service elementary school teachers' mathematics teaching anxiety (Peker & Halat, 2008). But Fish & Fraser (2001) found that among the university professors surveyed about teaching anxiety, females were reporting more teaching anxiety than males. Peker, (2009) explained the symptoms of mathematics teaching anxiety as conclusive nervousness, the inability to concentrate,

negative self talk, being easily upset by noises, being unable to hear the students, and sweaty palms etc.

Bursal & Paznokas (2006) suggested that high levels of mathematics anxiety and low confidence to teach elementary mathematics were negatively related in pre-service teachers. Hembree (1990) worried that teachers who experienced higher levels of mathematics anxiety may unconsciously pass on negative feelings to their students. Hadley & Dorward (2011) showed that teachers, who are anxious about mathematics obviously they anxious about teaching mathematics and also they have lower levels of mathematics teaching self-efficacy (Bursal & Paznokas, 2006). Brown, Westenskow & Moyer-Packenham (2011) stated that someone may experience mathematics teaching anxiety without mathematics anxiety if they are not confident about their capacity to teach the mathematics. On the other hand, (Harper & Daane (1998) and Hembree (1990) indicated that mathematics anxiety is a reason in pre-service teachers' lack of confidence in teaching practices.

Haciomeroglu (2013) found that Pre-service teachers with low mathematics anxiety are more confident to teach elementary mathematics than the pre-service teachers with moderate and high mathematics anxiety. Brown, Wetenskow and Moyer-Packenham (2011) found in their study that "one-third of the pre-service teachers had high level of mathematics anxiety but did not have mathematics teaching anxiety". Peker & Ertekin (2011) showed that the relationship between pre-service teachers' mathematics anxiety and mathematics teaching anxiety were positively significant with a medium effect size. McAnallen (2010) found that mathematics anxiety has an effect on their mathematics teaching in elementary teachers.

The relationship between mathematics anxiety and mathematics teaching anxiety is not always exist (as cited in Atinuke, 2015). Hadley & Dorward (2011) also found the

lower mathematics anxiety in in-service male teachers compared to female but it was not lower in mathematics teaching.

2.6 Causes of mathematics anxiety

"Teacher's personal school experiences, especially at secondary level, influence the development of negative beliefs and anxiety about mathematics" (as cited in Uusimaki & Nason , 2004). Trujillo & Hadfield (1999) categorized the causes of negative beliefs and anxiety about mathematics into three categories as environmental factors, intellectual factors and personality factors. They included negative experiences in the classroom, parental pressure, insensitive teachers, traditional manner of teaching as rigid sets of rules, non-participatory classrooms for environmental factors and included taught with mismatched learning styles, student attitude and lack of persistence, self-doubt, lack of confidence in mathematical ability, lack of perceived usefulness of mathematics for intellectual factors then included unwillingness to ask questions due to shyness, low self-esteem , for females viewing mathematics as a male domain for personality factors. Hadfield and McNeil (1994) also divided into three areas: environmental, intellectual, and personality factors as the causes of mathematics anxiety. Learning styles, instructional methods, mathematics achievement levels, and confidence in doing mathematics etc. are the affecting variables of mathematics anxiety (Sloan, Daane & Giesen; 2002). Sometimes math-anxiety comes from poor teaching or humiliation and sometimes it comes from the math-anxious teachers, parents, siblings or peers (Stuart, 2000). Different factors such as content knowledge, attitude towards mathematics, and self confidence related to mathematics anxiety and at the same time mathematics teaching anxiety (as cited in Muray Peker, 2009). Different researchers found the cause of mathematics anxiety as the ways mathematics were presented, self-perceptions,

family influences, and mathematics test anxiety, learning experiences with math, teacher and parents attitudes toward math etc. (as cited in Reed ,2014).

Jackson & Leffingwell (1999) found the negative experiences in mathematics in secondary education classrooms, such as memories of struggling with particular concepts , embarrassing moments of making mathematics errors in front of peers , uncaring teachers and gender biased issues (Brady & Bowd, 2005), unsympathetic teachers (Cornell , 1999) as the cause of mathematics anxiety. Mathematics anxiety does not have a single cause, the attitudes of teacher, the teaching techniques and bad experiences with math teachers are the causes (as cited in Plaisance n.d.).

Different researcher explained the cause of mathematics anxiety as someone may not be good at mathematics, mathematical mind is needed for mathematics, someone good at the arts means one cannot be good at mathematics moreover the abstract nature of mathematics (as cited in Elizabeth Jackson , 2008). Brady & Bowd (2005) explained that adversity, restlessness and insensitivity in mathematics teachers can be added as the cause of mathematics anxiety. Furner & Duffy (2002) identified gender as a possible cause of mathematics anxiety. Brady & Bowd (2005) suggested that girls get less help and more laughing when experiencing difficulties. Mathematics anxiety and mathematics teaching anxiety have a great impact on pre-service teachers' possible effectiveness in teaching of mathematics to students (Bursal & Paznokas, 2006; Peker & Ertekin, 2011). Uusimaki & Nason, (2004) suggested that negative school experiences as a student, lack of family assistance and outcome of their former mathematics teachers could be the cause for the sources of pre-service teachers' mathematics anxiety. Poor test grades, inability to complete difficult assignments, negative tendency of parents and teachers about mathematics can be the cause of math anxiety (Smith, 2004). Teachers and parents those who are afraid of mathematics

transmit their attitude to their students and children (Furner & Duffy, 2002). Teacher should allow even encourage students to ask question , he should never comment as stupid or slow , he should not separate boys and girls as student (Jackson & Leffingwell, 1999), because its' can minimize the cause of math anxiety. If the teacher is not inspired or does not enjoy teaching mathematics, then one cannot expect his students to be motivated to learn it (Smith, 2004). Pradeep, (2010-2011) explained the teachers related causes of students mathematics anxiety, such as lack of content knowledge , attitudes towards mathematics , teaching methods and mathematics anxiety of teachers etc.. Math anxiety is negatively related with math achievement (Lee, 2009). Other researcher also found that the relationship between students' mathematics anxiety and mathematics achievement is negative (Hembree, 1990; Khatoon & Mahmood, 2010). Though parents' math anxiety did not predict children's reading achievement but it affect children's math achievement (as cited in Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015).

There are many variables, such as mathematics anxiety , learning styles , instruction , lack of self-confidence , teacher beliefs, environment , lack of parental support , and gender , can affect students' mathematics learning abilities, where mathematics anxiety is a major factor that affects student achievement and attitude towards mathematics (as cited in Peker , 2009). Gender is an important factor in the learning of mathematics (Altermatt & Kim, 2004 and Halat, 2006). It has documented by research that many students have learning difficulties in mathematics (e.g. Gutierrez, Jaime, & Fortuny, 1991; Halat, 2007). Ercikan et al. (2005) claimed that parent's highest educational level was the strongest predictor of student achievement in mathematics because they can explain the usefulness of mathematics their daughters and sons.

Pre-service teachers' highest level of formal mathematics education negatively related to their anxiety levels (Brady & Bowd, 2005). The social and motivational factors may be the cause of female teachers' higher mathematics anxiety than their male counterparts (Altermatt & Kim, 2004, Hembree, 1990, Khatoon & Mahmood, 2010). Hembree (1990) found a moderate to large negative correlation between math anxiety and math confidence. Wigfield and Meece (1988) and Hembree (1990) found a moderate negative relation between math anxiety and math interest. Karp (1991) suggested that teachers with negative beliefs about mathematics can developed a helplessness response in students but the teachers with positive beliefs can help students to enjoy mathematics and thus, teacher beliefs play an important role in their students' achievement in mathematics (Emenaker, 1996). Williams (1988) noted that teachers pass on their negative attitudes to students and Wood (1988) claimed that teachers negative attitudes may be affected their own teaching. Swars et al., (2007) revealed that the pre-service teachers, who belief in their abilities strongly they can teach mathematics more effectively. Uusimaki & Nason (2004) suggested that negative school experiences of pre-service teachers' could be the reasons for their negative beliefs and anxiety.

2.7 Effect of mathematics anxiety

Wood (1988) indicated that mathematics anxiety can be passed on to students through their teachers. Mathematics anxiety have various effects, such as avoiding mathematics courses, limiting one's selection of college and career choice, decreasing mathematics achievement, and feeling ashamed about mathematics (Betz, 1978; Richardson & Suinn, 1972; Tobias & Weissbrod, 1980). Mathematics anxiety can control students' mathematical achievement by affecting memory, creating nervousness and an inability to concentrate **(**as cited in Jackson, 2008). Cockcroft

(1982) found that people develop coping strategies for everyday life, and people try to avoid mathematics where possible (Brady & Bowd, 2005). Mathematics anxiety can exists in adults including teachers described both as an irrational phobia and a rational fear related emotional factors, such as anger ,tension fault, panic, dislike, embarrassment, fright, terror, ignorance, frustration (as cited in Jackson , 2008).

The teachers, who have higher levels of anxiety can transmit their negative feelings, avoidance and fear of mathematics to students unconsciously (Sloan, 2010; Vinson, 2001) and teachers mathematics anxiety can develop "negative attitudes toward mathematics and poor mathematical performances for their future students" (as cited in Haciomeroglu, 2014). Hembree (1990) explained that the feelings of anxiety can guide to develop fear, distress, shame, inability to cope, sweaty palms, nervous stomach, difficulty in breathing, and loss of ability to concentrate. Other symptoms also included as tension, nervousness, worrying, edginess, impatience, confusion, fear, and developing a mental block (as cited in Pradeep, 2010-2011).

Although math anxiety may have serious result in both daily life and in work mathematics anxiety has its roots in teaching and teachers and it affects student academic achievement also the effectiveness of elementary teachers (as cited in Malinsky, Ross, Pannells & Mark, 2006). Wigfield & Meece (1988) noted that emotionality is the physiological aspect of anxiety and worry as the cognitive aspect of anxiety. Mathematics avoidance is a main negative effect of mathematics anxiety and it can limit the career choice of students ultimately country will suffer in science and technology (Hembree, 1990). Uusimaki & Nason, (2004) explained that the beliefs of teachers hold about mathematics have an impact on the classroom activities. Teachers with high math anxiety always like to teach using traditional methods and they spend less time to solve problem and exploration (Karp, 1991). Mathematics

anxiety reduces teachers' skills and they spend less time for small-group instruction (Swars, Daane, & Giesen, 2006).

Mathematics teaching anxiety has an important role in how one would discuss abstract ideas in a easy way for students (Haciomeroglu, 2014). Math anxiety has been recognized as an obstacle to math achievement (National Mathematics Advisory Pane, U.S. Department of Education: Washington, DC, 2008). Furner & Duffy, (2002) estimated that two-thirds of adults loathe and fear mathematics. Perina, (2002) claimed math anxiety severely hinders students' working memory. Jackson & Leffingwell (1999) noted that math anxiety can start at different ages for different people even some students may experience it third or fourth grade. Ashcraft and Kirk (2001) explained that "math anxiety disrupts the ongoing, task-relevant activities of working memory, slowing down performance and degrading its accuracy" (p. 236).

Teachers with medium or high levels of mathematics anxiety may unconsciously transfer their avoidance and fear of mathematics to their students (Wood, 1988). Mathematics anxiety not only affects individuals' achievement in mathematics but also their attitudes toward mathematics (Atinuke, 2015). Vinson, (2001) revealed that teachers with mathematics anxiety may generate students with mathematics anxiety. Low achievement in mathematics can grow negative emotions and attitudes toward mathematics in students, create tendency to avoid mathematics in the future (Hembree, 1990).

Mathematics anxiety affects the students' mathematics performance and self-confidence (Jackson & Leffingwell, 1999). Reed (2014) stated that the **r**esearch about mathematics anxiety has been highly inspired by increasing cognitions that it intimidates student achievement. There is no gender difference in terms of teaching anxiety between pre-service teachers (Marso & Pigge, 1998 and Ameen, Guffey &

Jackson, 2002). Malinsky et al. (2006) found that the pre-service elementary female teachers' mathematics anxiety level were higher than that of males. Bowd & Brady (2003) also found that the pre-service female teachers had significantly greater mathematics anxiety than male. Fish & Fraser (2001) found gender difference in the teaching anxiety of university professors. Although **d**ifferent research found that gender was not a factor in mathematics anxiety for university students (Dane, 2005), college students (Haynes, Mullins & Stein , 2004). Khatoon & Mahmood (2010) reported that nearly half of the secondary school students had a moderate level of anxiety and that females showed more anxiety toward mathematics than male. Liu (2008) hypothesized that as mathematics anxiety is a learned behavior, it is possible to reduce over time and different mathematics methods courses can reduce mathematics anxiety effectively (Huinker & Madison, 1997; Tooke & Lindstrom, 1998).

2.8 Previous research about mathematics anxiety

2.8.1 Before 21st century

James & Hendel, (1980) examined the dimensionality of Mathematics Anxiety Rating Scale (MARS). The responses to 94 MARS items were obtained for 350 female participants in a mathematics-anxiety program. The items were inter-correlated and the correlation matrix was factored by a principal-axes technique. Two factors were identified and labeled as Mathematics Text Anxiety and Numerical Anxiety. Kelly and Tomhave (1985) found that a high proportion of the female pre service elementary teachers were math anxious and it could affect their pupils. Mathematics Anxiety Rating Scale (MARS) was used to determine their level of anxiety toward mathematics. Allan & Judith (1988) assessed math anxiety in 6th- grade through 12th-grade students' beliefs, attitudes, and values about mathematics. It was longitudinal investigation .Two components of math anxiety as negative affective reactions

component and cognitive component by using confirmatory factor analyses .Girls reported stronger negative affective reactions to math than boys. Tooke, & Lindstrom (1998) found that no significant reduction of anxiety was measured of pre service elementary teachers where used a very traditional manner but other sections of the methods course showed a significant reduction. To find ways of reducing the mathematical anxiety of pre-service elementary teachers, three cases were investigated. The first was a section of mathematics for elementary teachers taught in a very traditional manner, and the second was the same course taught in a manner consistent with the recent recommendations of the National Council of Teachers of Mathematics. The third case included two sections of a methods course which covered the same mathematical content, as well as addressing how it should be taught to children. The Mathematics Anxiety Rating Scale for Adults was administered before and after the courses. Carol & Leffingwell (1999) identified different activities of instructors to create math anxiety in student classes from kindergarten through college, such as difficulty of material, gender bias, insensitive and uncaring perceptions of instructors, angry behavior, unrealistic expectations, embarrassing students in front of peers, insensitive and uncaring attitude, communication and language barrier, lack of quality of instruction. Bradford (1999) developed and validated the Math Affect Trait Questionnaire (MATQ) for the investigation of affect during mathematical problem solving. Anxiety, math interest, and self-esteem under problem solving conditions are the main constructs measured by the MATQ.

2.8.2 First decade of 21st century

Mark & Elizabeth (2001) revealed that working memory capacity was negatively associated with math anxiety but Geary & Widaman, (1992) reported that working memory and math performance were positively related. Vinson, (2001) claimed that

Mathematics anxiety is more than a dislike toward mathematics. Smith (2004) claimed that teachers' attitudes towards mathematics affect their students' attitudes towards mathematics. The study shows that these bad attitudes towards mathematics come out in a teacher's teaching style, willingness to help students, creativity, and general attitudes in the classroom. This study has demonstrated that teachers need to be aware of the impact that they have on their students' attitudes in mathematics. Smith also described that frustrated teachers are less likely to find creative ways of helping their students understand concepts and since they do not enjoy teaching mathematics, they are more likely to become stagnant in their teaching style.

Uusimaki & Nason (2004) investigated the causes of Australian pre-service primary teachers' negative beliefs and anxiety about mathematics. They found that 66% of the participants perceived that their negative beliefs and anxiety towards mathematics emerged in primary school, 22% identified it as secondary school where secondary school teachers as the major contributing factor, 11% of the participants identified it as tertiary education, 48% explained their cause of math anxiety as mathematical knowledge and 33% said that due to insecure feelings of making mistakes. They suggested that the beliefs hold teachers about mathematics have an impact in the mathematics classroom. Bursal & Paznokas (2006) measured sixty five pre service elementary teachers' math anxiety levels and confidence levels to teach elementary mathematics and science, where the research found that the low math anxious pre service teachers were more confident to teach elementary mathematics.

Malinsky, Ross, Pannells & Mark (2006) claimed mathematics anxiety has been the topic of more research than any other in the affective domain. Feelings of math anxiety can lead to panic, tension, helplessness, fear, distress, shame, inability to cope, sweaty palms, nervous stomach, difficulty breathing, and loss of ability to

concentrate (as cited in Malinsky, Ross, Pannells & Mark. 2006). Although math anxiety may have an effect in both daily life and in work its roots is in teaching and teachers (as cited in Malinsky, Ross, Pannells & Mark. (2006). Gerardo & Delgado (2007) showed that achievement and with attitudes toward mathematics were negatively correlated and also found that girls mathematics anxiety was higher than boys. Jackson (2008) found that the majority of these students teacher experience negative physical or emotional feelings about mathematics. Only 19% of respondents did not experience negative emotional or physical factors when engaged in mathematics. 61% experienced both emotional and physical factors together and 81% experienced either emotional, or physical, or both factors. The aim of the study was to explore the existence of mathematics anxiety in student teachers and how such anxiety may affect their learning for primary teaching.

Zakaria & Nordin (2008) investigated the effects of mathematics anxiety on matriculation students as related to motivation and achievement. Findings revealed a low but significant negative correlation between mathematics anxiety and achievement and also a strong significant negative correlation between mathematics anxiety and motivation. The study also revealed a significant low positive correlation between motivation and achievement. Matriculation students' math anxiety scores were used to assign them into three groups as low math anxiety group, moderate anxiety group and high math anxiety group. Students whose scores fell between 33% and 67% were considered the moderate group. Low and high anxiety groups consisted of the students, whose scores were in the lower 33% and in the upper 33% of the distribution respectively.

Bai, Wang, Pan & Mary (2009) revised 14-item bi-dimensional Mathematics Anxiety Scale (MAS-R) and found to have high internal consistency reliability, parallel-item

consistency, and construct validity. Two-factor solution was significantly better than the one-factor solution indicates that the bi-dimensional scale optimally captured the two dimensions of mathematics anxiety. Eigen value, screeplot and variance explained the exploratory factor analysis identified two factors. The two factors explained 66.7% of the total variance of the 14 items. The strong amount of variance explained and the significantly large loadings suggest that the 14-item bi-dimensional scale MAS-R is a valid instrument to measure mathematics anxiety with both positive and negative effects. Peker (2009) classified teachers as learners as divergent, assimilator, convergent, and accommodator. There was no difference between pre-service elementary and secondary mathematics teachers' teaching anxiety. All groups of pre-service teachers had teaching anxieties in mathematics, where convergent learners had the lowest mean score and divergent learners had the highest mean score. However, the pre-service elementary school teachers had the highest level and the pre-service secondary mathematics teachers had the lowest level of teaching anxiety in mathematics which was not statistically significant.

Peker, Halat, & Mirasyedioğlu (2010) found that the differences are not statistically significant with the level of mathematics teaching anxiety between pre-service male and female, middle and high school mathematics teachers respectively. The study revealed that there was no statistically significant gender-related difference in mathematics teaching anxiety between pre-service male and female mathematics teachers. Beilock, Gunderson, Ramirez & Levine (2010) found that at the beginning of the school year, there was no significant relation between teachers' math anxiety and students' math achievement and the end of the school year, the higher a teacher's math anxiety, the lower was the girls' but not the boys' math achievement.

One possibility is that female teachers' math anxiety helps to confirm which gender is good at math and it has an impact on girls' math achievement.

Pradeep, (2010-2011) conducted an exploratory factor analysis on the 10-item MAS component and on the 9-item AMAS component of the math anxiety test. The factor analysis of the 9-item remainder of the MAS test resulted in only one component. An exploratory factor analysis was conducted on the 9-item AMAS component of the math anxiety test using a principal components extraction and varimax rotation with Kaizer normalization within a two-factor forced solution. The two factor exploratory analysis accounted for 69.6% of the variance. The math anxiety measured via MAS was positively significantly correlated to the math anxiety measured via AMAS. The correlation between the scores on the math anxiety scale and the test anxiety scale was significant, where 38% of the variance is accounted for by the relationship. Pradeep (2010-2011) also claimed that the main cause of the pre service primary teachers' math anxiety has been their negative classroom experiences in mathematics in the primary level. Alexander (2010) claimed that math anxiety and low self-efficacy create stumbling blocks in math education. Researchers emphasized to create a classroom environment where students gain confidence in their math abilities, lower their math anxiety, increase their math self-efficacy and participate in a healthy learning community (as cited in Alexander, 2010).

2.8.3 Recent studies

Arfe & Susan (2011) has found that the adapted MARS-R consisting of 17 items was a valid and reliable instrument to measure math anxiety of online students. The 7 items with factor loads smaller than .70 were deleted from analysis. As a result the explained variance was increased to 76%. Brown, Westenskow & Moyer-Packenham (2011) stated that the relationship between mathematics anxiety and mathematics

teaching anxiety is not always the same for all pre-service teachers. 39.6% pre-service teachers, who reported no prior mathematics anxiety as well as no anxieties about teaching mathematics**.** 20.8% pre-service teachers described prior mathematics anxieties as well as anxiety while teaching mathematics. 18.9% pre-service teachers wrote about personal mathematics anxieties in their backgrounds but did not describe mathematics teaching anxiety. 17% pre-service teachers revealed no mathematics anxieties in their personal backgrounds but the high levels of MTA when teaching mathematics.

Hadley & Dorward (2011**)** found that if elementary teachers' math anxiety turned into teaching anxiety it might have a negative impact on students' ability to learn mathematics properly. They also noted that mathematics anxiety have an impact in major life decisions of individuals**.** Less experience was more anxious in elementary mathematics teaching. If mathematics teaching anxiety is higher than student mathematics achievement is lower. Mathematics anxiety and mathematics teaching anxiety are positively related. Teachers with positive attitudes toward math were found to encourage student initiative and independence. The National Council of Teachers of Mathematics (NCTM) notes that "those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures" (NCTM, 2000, p. 5). Learning style, personality type, and math beliefs of individuals can create math anxiety (Hadfield & McNeil, 1994).

Harper & Daane (2012) found a significant reduction of math anxiety in pre service elementary teachers after completing the methods course. The researcher recommended that pre-service teachers should be realize their individual levels of math anxiety and to prevent their own negative dispositions toward mathematics from being transmitted to their future elementary students. Young, Wu, & Menon (2012)

claimed that math anxiety is a negative emotional reaction to situations involving mathematical problem solving but its neuro developmental origins are unknown. A total of 54 children (7- to 9-year-old) from the San Francisco area were originally recruited for this study. All measures have been shown to have accurate validity and reliability and have been normed for use in children. Devine et al. (2012) found that no gender differences for mathematics achievement but levels of math anxiety and test anxiety were higher for girls than for boys. Girls and boys showed a positive correlation between math anxiety and test anxiety and a negative correlation between math anxiety and mathematics performance.

Ramirez, Gunderson, Levine & Beilock (2012) found a negative relation between math anxiety and math achievement for children. One hundred and fifty four first- and second-grade children were the respondent. They suggested that early identification and treatment of math anxieties is important because these early anxieties may snowball and eventually lead students to avoid math courses and math-related career choices. Ashcraft & Krause (2007) found that math anxiety is correlated with poor mathematical knowledge and low course grade. Kiamanesh, Hejazi and Esfahani, (n.d.) found that math self-concept and math anxiety were highly correlated. The results showed that math self-efficacy is a strong predictor of math achievement compared to math self-concept, perceived usefulness of mathematics and gender. The mediating role of math self-efficacy between gender, math self-concept, perceived usefulness of mathematic and math achievement was confirmed. The regression analysis showed that math self-concept and gender explained significantly 8.6 and 3.8 percent of the variance in the math achievement score respectively. The difference between males and females in math self-efficacy, math self-concept and math achievement were significant.

Haciomeroglu (2013), found that mathematics anxiety and mathematical beliefs of pre-service teachers were significant small negative relationship. It was suggested that the stronger beliefs and felt less anxious were more confident to teach mathematics effectively. Haciomeroglu (2014) revealed that pre-service teachers generally had a low level of mathematics anxiety and mathematics teaching anxiety. A two-way multivariate analysis of variance was performed to compare the mean scores of the dependent variables (mathematics anxiety and mathematics teaching anxiety) and two independent variables (gender and year spent in the program). Nine dependent variables were used under two dependent variables as test anxiety, course anxiety, application anxiety, computation anxiety, social anxiety, content knowledge, self-confidence, attitude towards mathematics teaching, and teaching knowledge. The independent variables were gender and year spent in the program. 35% of the variability in pre-service teachers' content knowledge anxiety related to mathematics teaching was predicted by their test, course and computation anxiety. 14% of the variability in pre-service teachers' self-confidence related to mathematics teaching anxiety was predicted by test anxiety. 15% of the variability in pre-service teachers' attitude towards mathematics teaching was predicted by course and application anxiety. 3% of a small variability in pre-service teachers' teaching knowledge was explained by application anxiety.

Reed (2014) found that the personal and professional anxiety were negatively correlated and the yearlong math course can reduce teacher math anxiety. The Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were used to determine whether or not the data were suitable for factor analysis. The Bartlett's Test of Sphericity was significant. Finally, a two-factor solution was suggested where the factor one accounted for 33.34% of the total variability, and factor two for 9.39% of the total

variability. The two factors account for 42.73% of the variance within the 25 variables in examining the correlations the high scores on the personal math anxiety factor represent less personal math anxiety whereas low scores on the professional math anxiety factor represent more professional math anxiety.

Chowdhury (2014) found that female students reported significantly more anxious than males and students with higher achievements in mathematics reported lower degrees of mathematics anxiety. Shamoon (2014) showed that 50.9% student teachers expressed an overall negative experience where 18.9% have had rather positive experiences, 30.1% expressed a more neutral view towards the subject of mathematics and it was suggested that teachers math anxiety may influence their performance in the classroom and it turn into their pupils' perception about mathematics.

Atinuke (2015) wanted to explore the nature and causes of mathematics anxiety and its relationship with mathematics teaching anxiety and demographics factors such as, gender, ethnicity, socio-economic status, highest level of mathematics studied and parental educational level. It was the online survey where some questions were about demographic factors and some questions about real life and academic situations for math anxiety. The results indicated that 19 (17.1%) of the 111 participants experienced low level of mathematics anxiety, 71 (64%) experienced moderate level, and 21 (18.9%) experienced high level of mathematics anxiety. Here mathematics anxiety was classified as low, moderate, severe. The mathematics anxiety mean scores of male were lower than the females. There was no statistically significant difference in the mathematics anxiety scores with respect to mothers' highest educational level but there was a statistically significant difference for fathers' highest educational level. The result of the analysis revealed a statistically significant, strong positive correlation between mathematics anxiety and mathematics teaching anxiety. The

moderate and high mathematics anxiety groups differed significantly in mathematics teaching anxiety scores. Major themes from the face-to-face Interviews as the cause math anxieties such as positive early experiences, participants' lack of understanding of mathematics concepts, lack of parental support in mathematics, teachers' teaching strategies, insensitive comments, and "mean" behavior , teachers' and parental influences and interaction, transfer of mathematics anxiety from teachers to students.

Maloney, Ramirez, Gunderson, Levine & Beilock (2015) explored how parents' anxiety about math relates to their children's math achievement. The goal of the study was to better understand why some students perform worse in math than others. The study found that when parents are more math anxious, their children learn significantly less math over the school year and have more math anxiety if parents report providing frequent help with math homework. They also found parents' math anxiety and did not predict childrens reading achievement. Beginning-of-year math anxiety of children and end-of-year math anxiety were positively correlated. Awasthi, & Imam (2015) found that the difference between the anxiety levels of males and females was significant, where females were found to be more anxious than male towards mathematics. They also revealed that low achievement in mathematics inclined students to be more anxious towards the subject.

Martínez, Martínez, & Mizala (2015) found that the negative influence of mathematics anxiety on pre-service elementary school teachers' expectations about students. They also found that mathematics anxiety and mathematics self-efficacy were negatively correlated in pre-service elementary school teachers. Srivastava, Imam & Singh (2016) found the significant difference between male and female students anxiety in math, where females' anxiety levels was high than males in mathematics. It was also found that the children, whose parents that are not educated

or less educated were more anxious than those whose both parents or one having higher level of education. The purpose of the study was the effect of gender and parental education on mathematics anxiety. The researcher used 1000 secondary school students as sample size where the tool used in the Mathematics anxiety scale (MAS) developed by Mahmood & Khatun (2011) and also a personal background assessment questionnaire prepared by the investigator.

Uysal & Dede (2016) revealed that pre-service elementary teachers' scores on beliefs about teaching mathematics were high, whereas mathematics anxiety levels were low in general. Haciomeroglu (2013) reported in her study that there was a small negative relationship between math anxiety and mathematical beliefs among pre-service teachers. Wigfield & Meece (1988) assessed math anxiety in elementary and secondary school students' beliefs, attitudes, and values concerning mathematics and found that affective component of math anxiety related more strongly and negatively related than did the worry component to children's ability perceptions, performance perceptions, and math performance.

Ganley & McGraw (2016) examined the reliability and validity of the MASYC as well as to examine the reliability and validity of a revised version of this measure (MASYC-R). It was also examined the internal consistency using Cronbach's alpha for the entire12-item (MASYC) and 17-item (MASYC + 5 new items) scales and item-total correlations. The internal consistencies were 0.80 for the 12-item scale and 0.87for the17-item scale. Researchers conducted a regression analysis in which they predicted math anxiety from general anxiety, math performance, and math attitudes. We conducted three hierarchical regression analyses, one for each MASYC-R factor, in which they first entered general anxiety and math performance and then entered the three math attitude variables math confidence, interest, and importance. For negative

reactions, the first model, with general anxiety and math performance, accounted for 39% of the variance. When math attitudes included in the model math confidence and math interest were identified as significant predictors but math importance was not.

2.9 Research gap of the mentioned studies

Many literatures have reviewed about mathematics anxiety in this research. The study of mathematics anxiety was started in the early 1950s (Alexander, 2010) and instruments have been developing to investigate mathematics anxiety (Fennema & Sherman, 1976). Over the last decade researchers are trying to understand when and how math anxiety develops (Ganley & McGraw, 2016). Smith (2004) noted that math anxiety is a kind of problem facing by students and teachers, where the main cause of math anxiety is the teacher himself. The majority of the researches were on the levels of student math anxiety, the relationship between math anxiety and math achievement, gender difference in student math anxiety, impact of parents' math anxiety on student math anxiety and different techniques for reducing students' math anxiety. Though some researches have been worked on pre-service and elementary math teachers but very little researches have been conducted on in-service math teachers and secondary math teachers. So it is an appropriate area to conduct a research.

2.10 Conceptual framework

Any research framework helps the researcher to retain a sharp focus on the work. The conceptual framework is the researcher's idea on how the research problem will be solved. Statistically the conceptual framework describes the major dependent and independent variables in the research and the relation between them in the study. It also outlines the input, process and output of the whole investigation. The conceptual framework identifies the research tools and methods that may be used to carry out the

research effectively. Sometimes the conceptual framework is also called the research paradigm. In this research the conceptual framework firstly indicates independent variables, then interaction among them and finally the output of the study as given by the chart below (Figure 2.1).

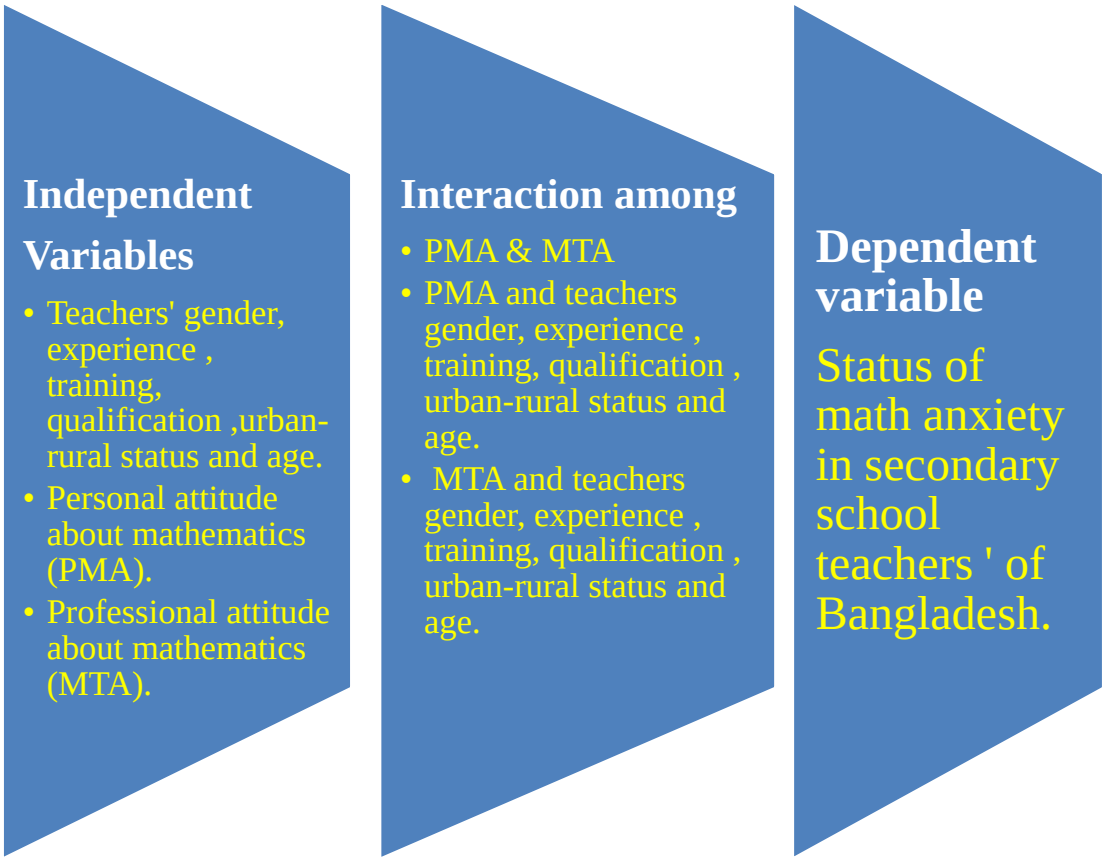

Figure 2.1: Conceptual framework of the study

CHAPTER 3
METHODOLOGY

CHAPTER 3
METHODOLOGY

3.1 Introduction

This chapter has eight sections, such as introduction, research design, population & sample, tools for data collection, piloting, procedures used for data collection, analysis and interpretation of data and finally ethical issues.

3.2 Research design

The design of a study is the researcher‘s plan of action for answering the research questions. Quality research design is to minimize possible errors by maximizing the reliability and validity of the data. Design is more than statistics and it requires insights. This study was exploratory in nature and used quantitative method to collect and analyze the data. At first, instrument (MAMTS) was revised slightly and then it was translated into Bangla named MAMTS-B. The instrument was administered to check the validity and reliability after translation into Bangla out of the original sample area. Then data were collected using questionnaire from the participants by using MAMTS-B with demographic questions. Convenient and purposive way was used for sampling. Exploratory factor analysis, pearson correlation coefficient, regression analysis, ANOVA and t-test were performed to analyze and interpret the data.

3.3 Population and Sampling

There are different types of secondary schools, such as government high school, non-government high schools, boys’ school, girls’ school, pilot high school etc. All in-service secondary schools teachers (those who taught mathematics) of Bangladesh were the targeted population of this study. Variation in math teachers of secondary schools exists according to gender, teaching experience, age, training, academic qualification, professional education etc..

In Bangladesh there are 8 administrative divisions. The 4 divisions-Dhaka, Chattagram Rajshahi and Barishal were selected considering regional variations. Rajshahi division was selected from north region, Dhaka division from middle region, Chittagong division from south-east region and Barishal division from south-west region. From these 4 divisions 8 districts were chosen conveniently, where 2 from each division. From each district 2 upazillas were selected conveniently. Three schools were selected from each upazila. Thus, 48 schools were selected from 16 upzillas. All of the teachers who taught mathematics of 48 schools were considered as sample. A total of 242 mathematics teachers (male 193 and female 49) were included as participants for the study. The sample size is shown in the Table 3.1, where name of the divisions, districts, upzillas are included but name of the schools are included in appendix.

Table 3.1 Selection of sampling area and samples

Division	**District**	**Upzilla**	**No. of Schools**	**No. of Teachers**
Dhaka	Dhaka	Savar	03	14
		Dohar	03	15
	Narayangonj	Narayangonj	03	30
		Bondar	03	21
Rajshahi	Rajshahi	Rajshahi Sadar	03	16
		Bagha	03	08
	Shirajgonj	Ullapara	03	13
		Shirajgonj Sadar	03	15
Chattagong	Bramonbaria	Nobinagar	03	21
		Coshba	03	12
	Comilla	Homna	03	15
		Candina	03	16

Barishal	Barishal	Barishal Sadar	03	14
		Uzirpur	03	12
	Pirojpur	Nesarabad	03	12
		Kawkhali	03	08
Total=04	08	16	48	242

3.4 Tools for Data Collection

For identification of math anxiety in secondary school teachers (who teach mathematics) researcher used McAnallen Anxiety in Mathematics Teaching Survey (MAMTS). MAMTS also used before to investigate mathematics anxiety in elementary teachers' of the United States in rural, urban communities. MAMTS was used to measure mathematics anxiety and attitudes or confidence about teaching mathematics in elementary teachers. The MAMTS measures teachers' perceptions of whether they experience personal mathematics anxiety and whether they have anxiety when they teach mathematics by asking them on a 5-point Likert scale (strongly disagree, disagree, 'neither'agree nor disagree, agree, strongly agree). McAnallen spent three years to develop the MAMTS. The development of the MAMTS began with 51 items to determine four factors as personal math self-efficacy, personal math anxiety, math teaching self-efficacy, and math teaching anxiety. The pilot survey was performed to check content validation and given to 12 professionals in the field to determine the validity of the 51 items. Then, 51 items were reduced 40 items. Again revised pilot survey using the 40 items was distributed to teachers attending two different conferences. Then, she used an exploratory factor analysis (EFA) and evaluated the factors in the scale. It was determined two underlying factors of math anxiety from the analysis of data where KMO for the scale was .965 and Bartlett's Test was significant at the .000 level which was considered as outstanding. Factor one

was professional mathematics anxiety and factor two was personal mathematics anxiety. Finally the instrument MAMTS was contained 25 items. 13 items were related to the Professional Mathematics Anxiety (the renamed teaching self-efficacy and anxiety factor) and 12 items were related to Personal Mathematics Anxiety (the renamed personal math self-efficacy and anxiety factor). Factor one named as math teaching anxiety and the factor two named as math anxiety in this study. Factor one (13 items) had a Cronbach‘s Alpha of .923 and factor two had a Cronbach‘s Alpha (12 items) of .952. Out of 25 items of MAMTS, 12 items were positively worded and 13 items were negatively worded. The positive and negative items were not arranged in the original scale serially.

The tools have been revised to adapt at secondary level in Bangladesh. Our primary and secondary teachers' qualifications are almost same. Item 12 of the original tools was "I avoided taking non-required math courses in college". The word course changed into chapter because, no alternative course in mathematics at college level in our curriculum. Item 3 was "I feel confident in my ability to teach mathematics to grade one level". In exchange of grade one, secondary level already used because it was used for secondary level. Our all teachers are not expert in English. So the original scale was translated into Bangla. Permission was obtained from the author of MAMTS to use this instrument. The following changes did not hamper originality of the scale.

The second section of the revised tools contained items requesting information on demographic and employment characteristics. Demographic information were included items, such as gender, educational qualification, professional qualification, experience, age and subject based training, urban-rural status. Two questions have been set to measure the level of self rated math anxiety. Before preparing the second

section of the tools, researcher reviewed many questionnaires framed by other researchers. He also discussed with his supervisor and some other experienced mathematics teachers to choose the specific items in the questionnaire. To avoid identification teachers had given opportunity to write or not his/her name or used nick name. In this way a draft questionnaire was prepared. A detailed questionnaire was given in the appendix. No controversial question was used. The languages of the demographic questions were checked properly. Time needed to fill up the questionnaire maximum 30 minutes. Twenty demographic questions were included in the second sections out of 45 questions.

3.5 Piloting

The purpose of piloting was to ensure the validity and reliability of the tools for data collection. The original scale was in English and its validity and reliability was declared. In this study the original tool (MAMTS) was translated into Bangla named MAMTS-B. Therefore, it was needed to check the validity of Bangla version of MAMTS named MAMTS-B. The tool was pre-tested in 2 high schools located in Dhaka city which were not included in the actual study. The respondents were 30 secondary teachers (who taught math at secondary level), where 28 teachers were male and 2 were female. At first English format was filled-up by the respondents' then Bangla format. Total scores were calculated from 5- point likert scale both in English and Bangla format. Negatively worded statements were calculated as strongly disagree 1, disagree 2, not agree nor disagree 3, agree 4, strongly agree 5 and positively worded statements were calculated reversely so that a high score indicates high anxiety. Then, correlation was performed and found r =0.918, which was highly satisfactory. The value of r indicates that the translated Bangla version (MAMTS-B) questionnaire from the original English version (MAMTS) questionnaire was valid.

Then, to check reliability of Bangla version of MAMTS (MAMTS-B), it was administered another 30 respondents (secondary teachers those who were the students of a teachers training college), where the number of male were 14 and female were 16. Again after 7 days the same questionnaire was administered to the same respondents. To minimize the impact of memory factor 2nd time all the statements were reversely arranged. The correlation between two mean score for test and retest was .926 which was highly satisfactory. Then compared the two mean scores and performed t-test for pair sample. Though the two mean score was slightly different but it was not significant at 95 % confidence level. After piloting it was found that some items (demographic section) were not needed. So the tools were revised on the basis of the experience of the pilot testing.

3.6 Procedure of Data Collection

Duration of data collection was 3 months. Data were collected from January to March in 2018. Researchers gathered different information about sample schools such as location of the school, duration of school time, schools examination period or running class period etc.. After reaching a school, the purpose of the researcher was described to the head teachers and the verbal consents were taken. After piloting the revised tools in Bangla named MAMTS-B (translated from original MAMTS in English) was used to collect data. The participants have got full freedom of offering or not giving their opinions or withdrawing their given opinions. The respondents have got the opportunity of using nick names. Researcher himself collected data from the teachers in most of the cases. So, it was possible to minimize any confusion. During data collection period, the experiences of piloting were always kept in mind. It was needed more or less 30 minutes to fill-up the questionnaire. Totally, data were collected from

242 secondary math teachers from 48 secondary schools to explore math anxiety and math teaching anxiety.

3.7 Presentation, Analysis and Interpretation of Data

All the collected questionnaires were coded before analysis. Then the work of entry was done. After processing and recoding (some cases) data was ready for analysis. According to research question data were categorized and analyzed. Descriptive statistics were carried out for various categorical variables to get frequencies and percentages. Data were analyzed using computer program namely Statistical Package for Social Sciences (SPSS). The results of data analysis were presented in table form, graphs and pie-charts. All graphs and pie-charts were made by using Excels.

Scores for each participant were computed by adding the item values on the MAMTS-B .The negative items (13) on MAMTS-B were reversely coded before the total scores for participants were calculated. Participants' scores on MAMTS-B and the overall means and standard deviations of their scores were used to assign them into anxiety groups (i.e., low, moderate, high). That is, participants whose scores on MAMTS-B were at least one standard deviation below the overall mean were categorized as possessing low mathematics anxiety level, while those with scores that were at least one standard deviation above the overall mean were considered as having high mathematics anxiety level. Moderate mathematics anxiety level was assigned to participants, whose scores were not up to one standard deviation below or above the overall mean. Analysis of variance (ANOVA) was performed to compare the different level of math anxiety score and math teaching anxiety score. T-test was performed to compare anxiety scores for different category of teachers, such as gender, age, urban-rural status, teaching experience, training, educational qualification, professional education etc.. Researcher performed reliability analysis to

determine the Kaiser Meyer Olkin (KMO) value for measuring sampling adequacy and also performed Bartlett‘s Test of Sphericity to analyze the results where two factors identified by the MAMTS. The exploratory factor analysis was used to determine if the constructs for math teaching anxiety and personal math anxiety were valid. Pearson’s correlation coefficient was used to determine the relation between personal math anxiety and professional math anxiety. Regression analysis was done to know the model that means the dependency of math teaching anxiety on personal math anxiety.

3.8 Ethical issues

- After informing the purpose of the research, the opinions were taken with the consultations of the respondents.
- The participants had the full freedom of offering or not giving their opinions or withdrawing their given opinions.
- The respondents had the opportunity of using nick names.
- The permission was taken from the head heachers at the time of data collection from the teachers.
- No manipulation was done in preparing results by analyzing information.
- For using all kinds of information, accurate references have been given.
- Teachers name or institutes name were not mention anywhere in the report.
- Teachers’ opinion will not be used any other purposes except this research.

CHAPTER 4
DATA ANALYSIS AND FINDINGS

CHAPTER 4
DATA ANALYSIS AND FINDINGS

4.1 Introduction

This chapter deals with the presentation and analysis of data collected through the tools, McAnallen Anxiety in Mathematics Teaching Survey-Bangla version (MAMTS-B). This instrument was administered to the secondary school teachers, who teach mathematics at secondary level. According to the sampling design of the study it was planned to collect data from 242 respondents of different categories. Of them 193 were male and 49 were female. Responses were analyzed by using the software SPSS under the following major areas, such as data presentation, data analysis, key findings etc. This chapter presents the quantitative data analysis and findings in four sections, such as introduction, data presentation, data analysis and key findings.

4.2 Data presentation

4.2.1 Teachers' gender status and urban-rural status: The participants in the study were 242 in-service secondary school teachers, who taught mathematics at secondary level (class six to ten) where 193 (79.8%) of them were males and 49 (20.2%) were females. According to the definition of Urban Area Report 2014 (p. 8) of Population and Housing Census 2011 of Bangladesh Bureau of statistics (BBS), urban and rural statuses of respondents' were decided.

Table 4.1: Respondents' gender status and urban-rural status

Category	N (%)
Gender	
Male	193(79.8)
Female	49(20.2)
Total	242(100)
Urban-rural status	
Urban	142(58.7)
Rural	100(41.3)
Total	242(100)

4.2.2 Teachers' age and experience: The age range of the respondent teachers from 23.17years to 60 years, where the age was also categorized as up to 30, more than 30 to 40, more than 40 to 50 and more than 50 to 60. The average age of the teachers was 40 years. Majority (58.7%) of the teachers' ages were up to 40. Many (43.8%) of the teachers' experience were within 10 years where majority (70.7%) of the teachers' experience within 20 years. It may be caused many secondary schools established day by day, therefore, many teachers were appointed newly. The range of the teaching experience was from .08 to 39 years and the average of the teaching experience was14.14 years.

Table 4.2: Respondents' age and experience

Category	N(242)
Age range	
Up to 30 years	32(13.2)
More than 30 years to 40 years	110(45.5)
More than 40 years to 50 years	60(24.8)
More than 50 years to 60 years	40(16.5)
Total	242(100)
Experience as secondary teacher	
Upto 10 years	106(43.8)
More than 10 years to 20 years	65(26.9)
More than 20 years to 30 years	50(20.7)
More than 30years to 40 years	21(8.7)
Total	242(100)

4.2.3 Teachers' subject's status at graduation level: It was mentionable that more than fifty percent (50.4%) teachers were not taken mathematics at graduation level in their educational life. All of them were not appointed as a mathematics teacher but they were taking math classes at the secondary level (class 6

to 10). On the other hand, only 17.8% teachers had degree of M.Sc in mathematics, where 13.6% were with honors in mathematics. Again 47.9% teachers did not have any master degree and 34.3% had master degree in other subjects but they did have mathematics at graduation level because 49.6% teachers were taken mathematics at degree level.

Table 4.3: Respondents' subject's at graduation and post graduation level

Category	N(242)
Subject at graduation level	
Graduation with mathematics	120(49.6)
Graduation without mathematics	122(50.4)
Total	242(100)
Subject at post graduation level	
M.Sc. in math with Hon's	33(13.6)
M.Sc. in math without Hon's	10(4.1)
Post graduation without math	83(34.3)
No post graduation	116(47.9)
Total	242(100)

4.2.4 Teachers professional education and subject (mathematics) based training

There were 73.6% teachers had B.Ed. or M.Ed. degree, where 63.6% teachers had only B.Ed. degree and 26.4% teacher did not have any professional degree. But majority (54.1%) of the teachers did not have any training on mathematics. Because 50.4% teachers were not actually appointed as math teacher and they did not have mathematics as a subject at graduation level. So, they were not considered for subject training.

Table 4.4: Respondents professional education and subject based training

Category	N(242)
Professional degree	
B.Ed.	154(63.6)
M.Ed.	24(9.9)
None	64(26.4)
Total	242(100)
Training in mathematics	
Yes	111(45.9)
No	131(54.1)
Total	242(100)

4.2.5 Self rated math anxiety and its level

Teachers were asked to rate about their existing math anxiety and the level of their math anxiety. A majority of the teachers 208 (86%) said that they did not have math anxiety and only 34 (14%) were agreed where 50% had low level anxiety and 50% had moderate level. On the other hand 86.54% teacher mentioned that they had math anxiety at low level, 12.98% was at moderate level and 0.48% was at high level those who disagreed about math anxiety. So, the self rated anxiety level was not reliable and it was finally measured by rating scale.

Table 4.5: Respondents' self- rated math anxiety and its level

Category	N(242)
Existence of math anxiety	
Yes	34(14)
No	208(86)
Total	242(100)
Math anxiety level	
Low	17(50)
Moderate	17(50)
High	0(0)
Total	242(100)

4.3 Findings of the study

4.3.1 Exploratory factor analysis

The founder author of (MAMTS) have explored two factor as personal math anxiety and professional math anxiety by using exploratory factor analysis in her study. Therefore, the current researcher also used exploratory factor analysis to confirm the factors. At first Kaiser-Meyer-Olkin (KMO) and Bartlett‘s Test of Sphericity were used to determine whether or not the data were suitable for factor analysis. The score of KMO indicates sampling adequacy for the existing sample size. If KMO values between 0.5 and 1.0 then it indicate that the factor analysis is appropriate. If a value close to 1 mean the patterns of correlations are relatively close. According to Field (2013), 0.6 is a minimum KMO value that indicates a sample is adequate for factor analysis. The KMO value for this study is .934, indicated that factor analysis was appropriate with principal component analysis. Fabrigar & Wegener (2012) suggested that Bartlett‘s Test of Sphericity is a test statistic which is used to examine the hypothesis. The Bartlett‘s Test of Sphericity was significant in this study ($p < 0.000$) indicating that the variables were correlated. Here the chi square value for Bartlett‘s test of Sphericity was 2799 (larger than 1,100), so the researcher was decided that the factors were uncorrelated.

More than one criterion are needed to determine factorization of a data set Costello and Osborne (2005) where principal component analysis was used as the extraction method. Initially principal component factor analysis reflected four factors with an eigenvalue greater than 1. Scree test, total variance of the variables, and the difference between the observed and reproduced correlations (residuals) were used to determine the factorization. Again, according to opinion of Cattell (1966), the number of factors can be determined by evaluating the drop in the scree plot. Here the scree plot (Figure

4.1) was examined to determine the point at which variance contributed by the factors leveled off and the result was suggested a two-factor solution. Then a second principal component factor analysis was run and requested a two-factor analysis.

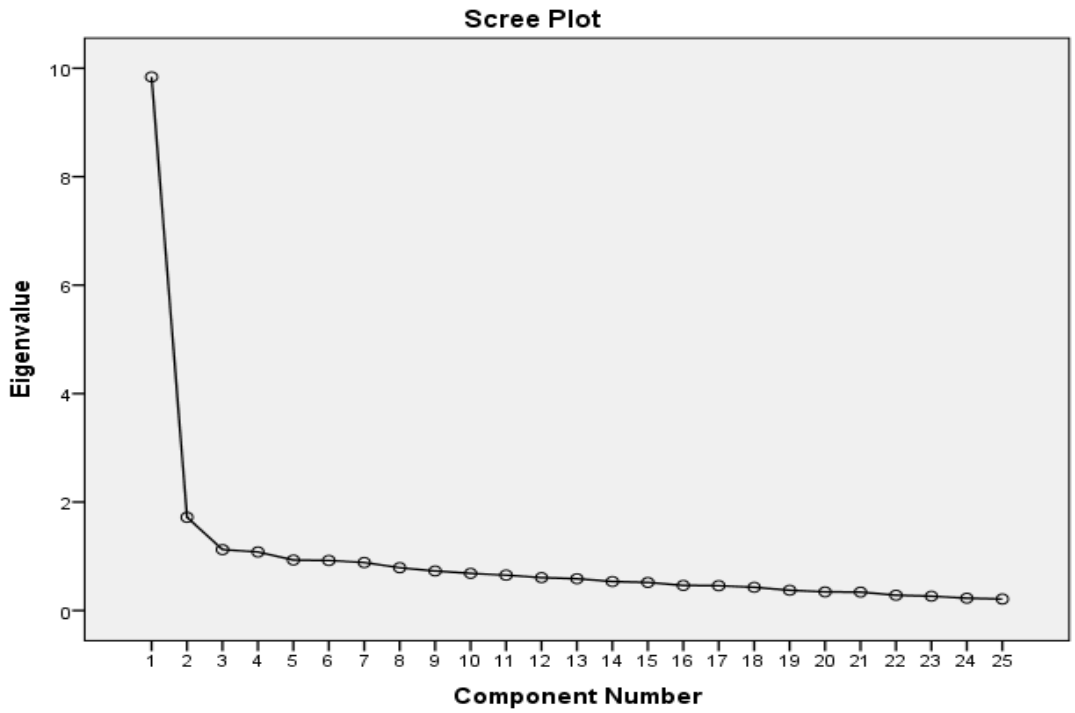

Figure 4.1: Scree Plot of Eigenvalues

The communalities were reflected and indicated the amount of common variance in each item where variables have values above 0.2. According to UCLA: (Statistical Consulting Group, 2013), values smaller than 0 .2 indicate that they do not align with the factor solution.

Table 4.6: Communalities

Item	Extraction
1. I was one of the best math students when I was in school.	.396
2. Having to work with fractions causes me discomfort.	.381
3. I feel confident in my ability to teach mathematics to students in the grade I currently teach.	.517

4. I am confident that I can learn advanced math concepts.	.454
5. When teaching mathematics, I welcome student questions.	.653
6. I have trouble finding alternative methods for teaching a mathematical concept when a student is confused.	.536
7. I can easily do math calculations in my head.	.467
8. I find it difficult to teach mathematical concepts to students.	.468
9. I feel confident using multiple resources when I teach.	.442
10. I don‘t have the math background to differentiate instruction for the most talented students in my class.	.489
11. I dislike having to teach math every day.	.393
12. I avoided taking non-required math courses in college.	.203
13. I am confident in my math abilities.	.620
14. I am confident that I can solve math problems on my own.	.317
15. I become anxious when I have to compute percentages.	.484
16. I have math anxiety.	.570
17. It makes me nervous to think about having to do any math problem.	.470
18. On average, other teachers are probably much more capable of teaching mathematics than I am.	.305
19. I cringe when a student asks me a math question I can‘t answer.	.243
20. I am comfortable working on a problem that involves algebra.	.605
21. I have strong aptitude when it comes to math.	.712
22. I doubt that I will be able to improve my math teaching ability.	.382
23. If I don‘t know the answer to a student‘s math question, I have the ability to find the answer.	.470
24. I become anxious when a student finds a way to solve a problem with which I‘m not familiar	.260
25. I would welcome a chance to have the math supervisor evaluate my math teaching.	.721

Factor one accounted for 39.357% of the total variability, and factors two for 6.877% of the total variability. The two factors account for 46.234% of the variance within the

25 variables. The pattern matrix of the two variables in this study was evaluated and shown in Table 4.7. Because the findings of the studies are aligned with McAnallen‘s study, the researcher named one variable personal math anxiety and another is math teaching anxiety.

Table 4.7: Items loading for factors math teaching anxiety and personal math anxiety respectively

Items	Math teaching anxiety	personal math anxiety
25. I would welcome a chance to have the math supervisor evaluate my math teaching.	.802	
20. I am comfortable working on a problem that involves algebra	.776	
21. I have strong aptitude when it comes to math.	.776	.332
5. When teaching mathematics, I welcome student’ questions.	.750	.301
13. I am confident in my math abilities.	.695	.371
23. If I don‘t know the answer to a student‘s math questions, I have the ability to find the answer.	.678	
4. I am confident that I can learn advanced math concepts.	.652	
9. I feel confident using multiple resources when I teach.	.638	
1. I was one of the best math students when I was in school.	.595	
7. I can easily do math calculations in my head.	.583	.357
3. I feel confident in my ability to teach mathematics to students in the grade I currently teach.	.545	.468
11. I dislike having to teach math every day.	.535	.327
10. I don‘t have the math background to differentiate instruction for the most talented	.509	.479

students in my class.		
22. I doubt that I will be able to improve my math teaching ability.	.453	.421
6. I have trouble finding alternative methods for teaching a mathematical concept when a student is confused.		.727
16. I have math anxiety.		.722
17. It makes me nervous to think about having to do any math problem.		.681
15. I become anxious when I have to compute percentages.	.441	.539
8. I find it difficult to teach mathematical concepts to students.	.442	.521
19. I cringe when a student asks me a math question I can‘t answer.		.491
2. Having to work with fractions causes me discomfort.	.375	.491
14. I am confident that I can solve math problems on my own.		.490
18. On average, other teachers are probably much more capable of teaching math than I am.	.314	.455
24. I become anxious when a student finds a way to solve a problem with which I‘m not familiar.		.417
12. I avoided taking non-required math courses in college		.400

4.3.2 Reliability analysis

Reliable measurement can give consistent result of a study but the measurement has to be done in the same way. Stability reliability was confirmed in this study by using test-retest by administering same questionnaire at two different times. The results of cronbach‘s Alpha indicate reliability status of a scale. Here reliability analysis was performed to determine the Cronbach's Alpha factors. The Chronbach‘s Alpha for the

12 items identified for personal math anxiety in this study was .866 and for the 13 items identified for math teaching anxiety was .868 indicating that the items are appropriately clustered together in both cases. McAnallen‘s study reflected a Chronbach‘s Alpha of .95 for personal math anxiety and .92 for professional math anxiety (math teaching anxiety).

4.3.3 Validity analysis

Reliability is necessary but not enough.Validity means accuracy of the result of the study which is mainly dependent on the validity of the tools. It matches between the conceptual definition and operational definition. Internal validity and external validity are mainly needed to ensure for good research. Beside these content validity, predective validity, concurrent validity, criterion validity and construct validity also needed for somewhere. In this study MAMTS (2010) was used as tools to determine the level of personal math anxiety and math teaching anxiety. McAnallen spent three years to develop the MAMTS to measure teachers’ math anxiety by using their attitudes, confidence and perceptions when they teach mathematics and about mathematics as a subject. It was started with 51 items. At first it was checked by 12 professionals of respective field to confirm the validity of the tools and in this way content validity was confirmed. To avoid repetition 51 items were reduced to 40 items. Again another pilot survey was used with 40 items in 5 point likert scale and it was distributed to 900 teachers where 335 were returned. Then, used exploratory factor analysis and confirmed two factors. Factor one was professional math anxiety (math anxiety about teaching) and factors two was personal math anxiety (math anxiety about subject). Finally it was reduced to 25 items where 13 items for math teaching anxiety and 12 items for personal math anxiety. Some demographic questions were introduced with the original scale as teachers age, experience,

educational qualification, training, urban- rural status, gender etc.. In this way different types of validity were confirmed. The researcher adjusted the tools with Bangladeshi education system. Therefore, the internal validity of the tools was established. To confirm external validity all hypothesis were tested with 95% confidence level or the 5% level of significance.

4.3.4 Personal math anxiety level

In order to find the levels of personal mathematics anxiety that participants experienced, MAMTS-B composite scores of mathematics anxiety related 12 items were calculated by adding their responses to each item on the survey for 242 in-service secondary teachers. The negative items on MAMTS-B were reversely coded before the total scores for participants were calculated because highest score treated as maximum anxiety level. The lowest mean score obtained was 1.25 and the highest was 4.00 out of the possible 5.00.

Table 4.8: Information about personal math anxiety score

Personal math anxiety	
Mean	2.1946
Std. Error of Mean	.04151
Median	2.1250
Mode	2.17
Std. Deviation	.64572
Variance	.417
Skewness	1.595
Std. Error of Skewness	.156
Kurtosis	2.142
Std. Error of Kurtosis	.312
Range	2.75
Minimum	1.25
Maximum	4.00

A positively skewed distribution was noted with a skewness value of 1.59 and kurtosis value 2.14 indicated that the distribution was relatively leptokurtic but it was very close to normal. Figure 4.2 presents the distribution of participants' personal mathematics anxiety scores.

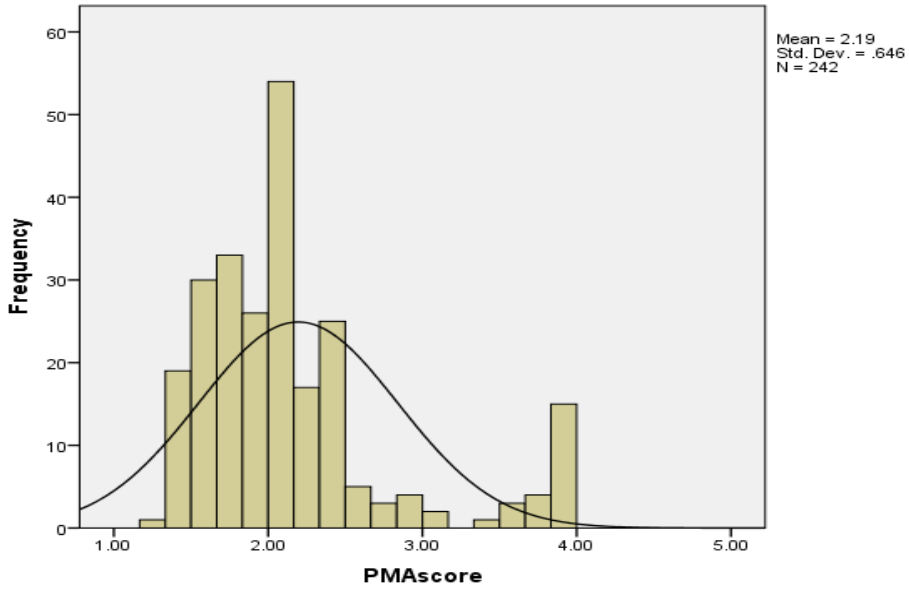

Figure 4.2: Distribution of personal math anxiety score

Therefore, the overall means and standard deviations of their scores were used to assign them into anxiety groups as low, moderate and high. Participants whose scores on MAMTS-B were at least one standard deviation below the overall mean were categorized as possessing low mathematics anxiety level, while those with scores that were at least one standard deviation above the overall mean were considered as having high mathematics anxiety level. Moderate mathematics anxiety level was assigned to participants whose scores were not up to one standard deviation below or

above the overall mean. The results indicated that 31 (12.8%) of the 242 participants experienced low level of mathematics anxiety, 184 (76%) experienced moderate level, and 27(11.2%) experienced high level of mathematics anxiety. On the other hand, teachers were asked about existing math anxiety and the level of their math anxiety. 86% of the teachers said that they did not have math anxiety and only 14% were agreed. Again 81.4% teacher mentioned that they had math anxiety at low level and 18.2% were at moderate level. There is a big difference between the two results. Calculated result from the scale is shown in the Figure 4.3 below.

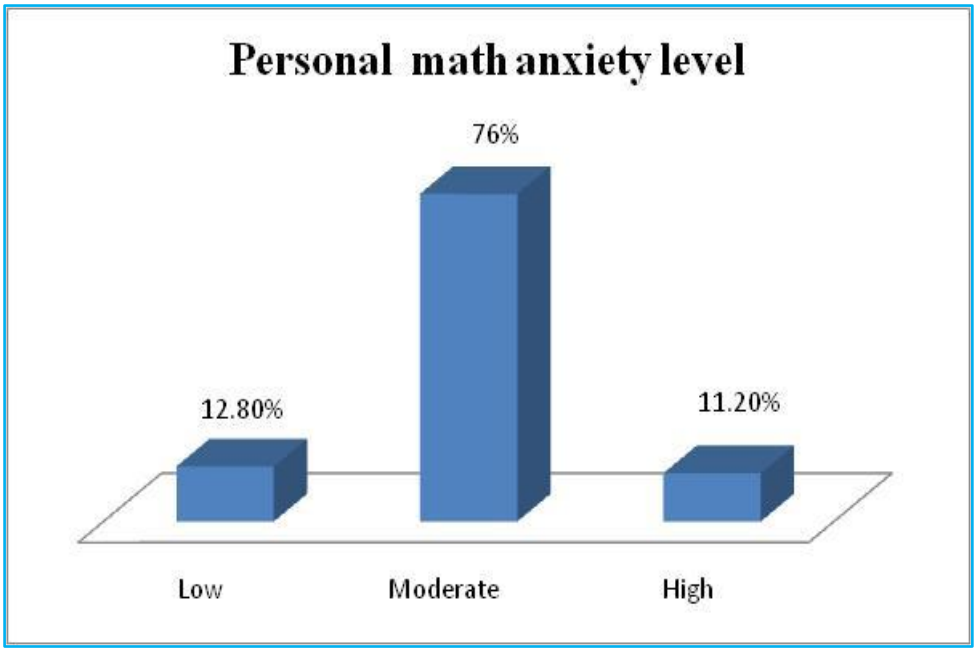

Figure 4.3: Personal math anxiety level of the respondents

One way ANOVA was performed to compare (mean) the difference between group of math anxiety level (Low, Moderate and High). Here $P < .01$, so, the math anxiety levels were differed and statistically significant at 99% confidence level. Table 4.9(a) and 4.9(b) shows the means and ANOVA (Analysis of variance) respectively.

Table 4.9(a): Means for PMA level (Low, Moderate, High)

Personal math anxiety level	N (%)	Mean (Math anxiety score)	Std. Deviation
Low	31 (12.8%)	1.5054	0.07739
Moderate	184 (76%)	2.0811	0.27583
High	27 (11.2%)	3.7593	0.35001
Total	242 (100%)		

Table 4.9(b) : One way ANOVA for PMA score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	83.198	2	41.599	575.105	.000
Within Groups	17.288	239	.072		
Total	100.485	241			

4.3.5 Math teaching anxiety level: In MAMTS-B there were 13 items for professional math anxiety, where some items were negative. The negative items on MAMTS-B were reversely coded before the total scores for participants were calculated. The lowest mean score obtained was 1.23 and the highest was 4.08 out of the possible 5.00..

Table 4.10: Information about MTA score

Math Teaching Anxiety	
Mean	2.3032
Std. Error of Mean	.04079
Median	2.1538
Mode	2.46

Std. Deviation	.63458
Variance	.403
Skewness	1.487
Std. Error of Skewness	.156
Kurtosis	2.089
Std. Error of Kurtosis	.312
Range	2.85
Minimum	1.23
Maximum	4.08

A positively skewed distribution was noted with a skewness value of 1.49 and kurtosis value 2.01 indicated that the distribution was relatively leptokurtic but it was also very close to normal. Figure 4.4 presents the distribution of participants' mathematics anxiety scores.

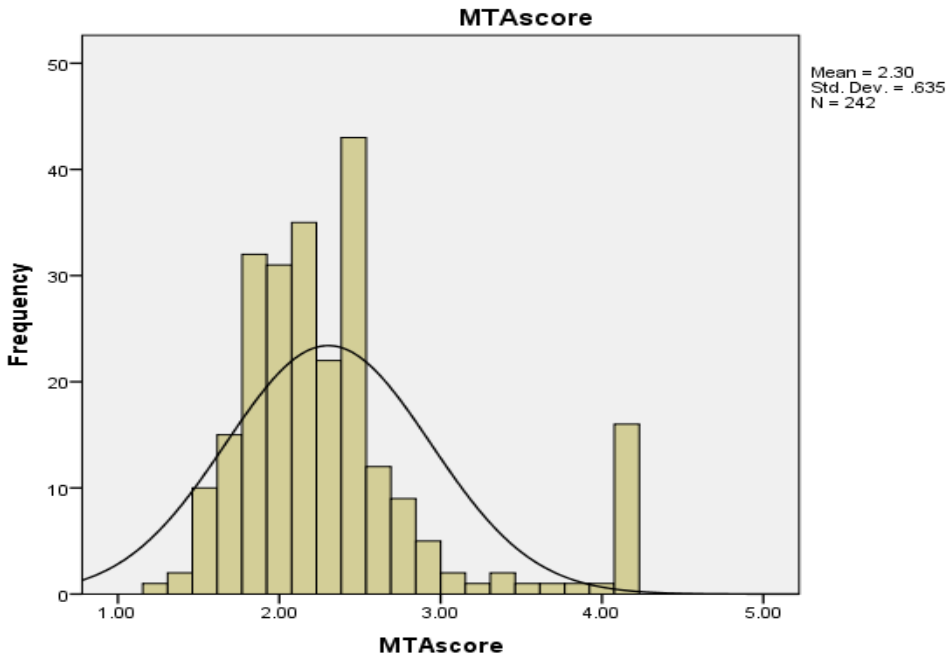

Figure 4.4: Distribution of math teaching anxiety score

Therefore, the overall means and standard deviations of their scores were used to assign the math teaching anxiety groups as low, moderate and high according to the same way of math anxiety group. The results indicated that 28 (11.6%) of the 242 participants experienced low level of mathematics teaching anxiety, 189 (78.1%) experienced moderate level and 25(10.3%) experienced high level of mathematics teaching anxiety.

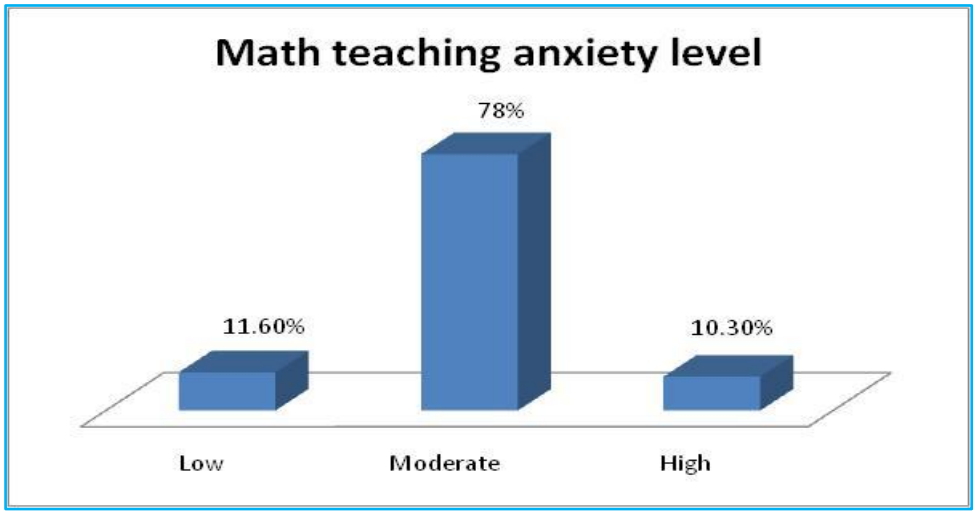

Figure 4.5: Math teaching anxiety level of the respondents

One way ANOVA was also performed to compare (mean) the difference between group of math teaching anxiety level (Low, Moderate and High).Here P < .01, so, the math teaching anxiety levels were differed and statistically significant at 99% confidence level. Table 4.11(a) and 4.11(b) shows the means and ANOVA (Analysis of variance) respectively.

Table 4.11(a): Means for MTA level (Low, Moderate, High)

Math teaching anxiety level	N (%)	Mean (Math teaching anxiety score)	Std. Deviation
Low	28 (11.6%)	1.5659	0.11883
Moderate	189 (78.1%)	2.2076	0.29643
High	25 (10.3%)	3.8523	0.36550
Total	242(100%)		

Table 4.11(b): One way ANOVA for MTA score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	76.941	2	38.471	457.280	.000
Within Groups	20.107	239	.084		
Total	97.048	241			

4.3.6 Highest five scores of personal math anxiety and math teaching anxiety according to items mean score

Out of 25 items some were leading position according to mean score for math anxiety such as item no. 12 “I avoided taking non-required math courses in college” was the highest position, item 14 “I am confident that I can solve math problems on my own” was the second position. Again item 18 “On average, other teachers are probably much more capable of teaching than I am” was the first and item 19 “I cringe when a student asks me a math question I can‘t answer” was the second respectively according to mean score for math teaching anxiety.

Table 4.12: Highest five scorer items for PMA and MTA

Factors	Items	Mean score
Personal math anxiety	12. I avoided taking non-required math courses in college.	2.64
	14. I am confident that I can solve math problems on my own.	2.37
	4. I am confident that I can learn advanced math concepts.	2.34
	16. I have math anxiety.	2.30
	1. I was one of the best math students when I was in school.	2.26
	18. On average, other teachers are probably much more capable of teaching than I am	3.04

Math teaching anxiety	19. I cringe when a student asks me a math question can‘t answer.	2.96
	24. I become anxious when a student finds a way to solve a problem with which I‘m not familiar	2.57
	6. I have trouble finding alternative methods for teaching a mathematical concept when a student is confused.	2.50
	22. I doubt that I will be able to improve my math teaching ability.	2.47

4.3.7 Highest five scores of personal math anxiety and math teaching anxiety according to respondents mean score

Out of 242 respondent first five personal scores were identified and mentioned for personal math anxiety and math teaching anxiety as shown in the Table 4.13 where same score can be achieved more than one person. Here person were not identified. Highest score was 4.00 for personal math anxiety and 4.08 was for math teaching anxiety.

Table 4.13: Highest five scores for PMA and MTA.

Factors	Mean score
Personal math anxiety	4.00
	3.75
	3.67
	3.58
	3.50
Math teaching anxiety	4.08
	4.00
	3.85
	3.69
	3.54

4.3.8 Correlation analysis

In this study personal math anxiety, math teaching anxiety, teachers' age and teaching experience all are the quantitative variables. The researcher ran a pair wise correlation analysis between the two factors (personal math anxiety and math teaching anxiety) and the demographic variables (Teachers age and Teaching experience) and all the coefficients were analyzed with significance level. The analysis reflected two significant correlations. Both the factors personal math anxiety and math teaching anxiety were highly and positively correlated ($r = .890$, $p < .001$) and significant at the level .o1 . Again Teaching experience and teachers age were also highly correlated ($r = .925$, $p < .001$) and significant at the level .o1 . But all other correlation such as personal math anxiety and math teaching anxiety with teachers' age and teaching experience are respectively was very poor and not significant. The correlations and the significance level are shown in the Table 4.14.

Table 4.14: Pair wise correlation of four quantitative variables

Variable	**personal math anxiety**	**math teaching anxiety**	**Teaching experience**	**Teachers age**
personal math anxiety	1	.890	.049	.049
sig. level		.000	.448	.448
math teaching anxiety	.890	1	.082	.089
sig. level	.000		.203	.169
Teaching experience	.049	.082	1	.925
sig. level	.448	.203		.000
Teachers age	.049	.089	.925	1
sig. level	.448	.169	.000	

The relation between personal math anxiety score and math teaching anxiety score also represented by the scatter plot which is shown in the Figure 4. 6 below.

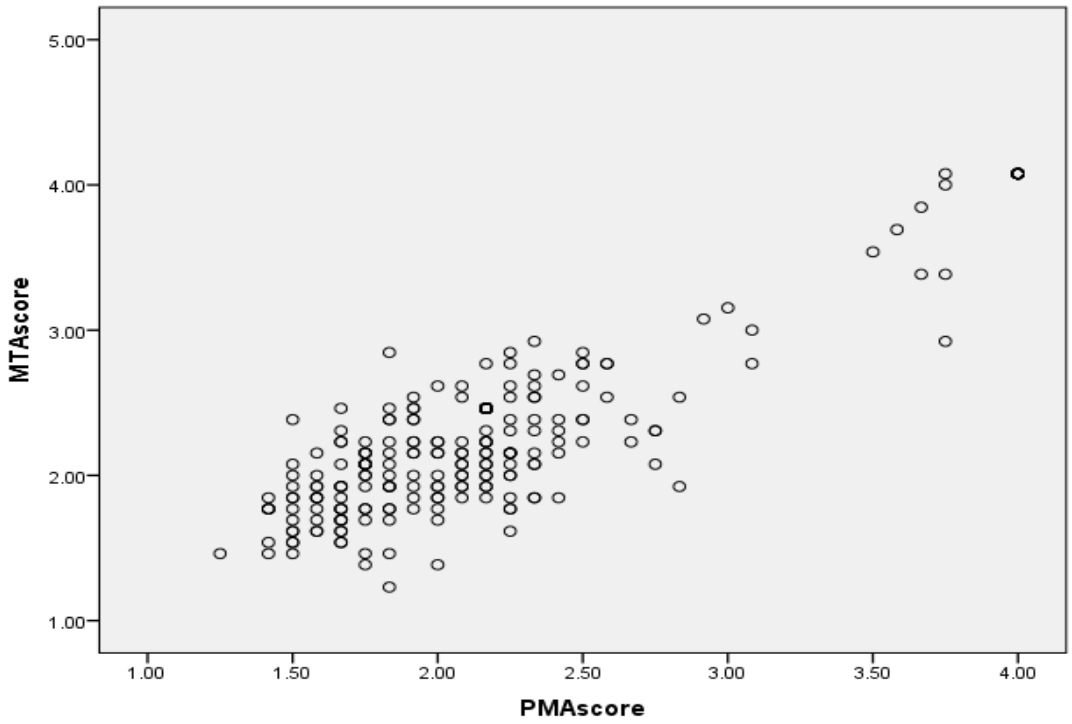

Figure 4.6: Scatter plot for personal math anxiety score and math teaching anxiety score

4.3.9 Regression analysis

In regression analysis math teaching anxiety was consider as dependent variable and personal math anxiety as independent variable. No other variable were considered as independent variable because the correlation of other variable with personal math anxiety or math teaching anxiety was not significant as found from correlation analysis. The value of r (.89) between personal math anxiety score and math teaching anxiety score was highly and positively correlated. Here adjusted R square (Coefficient of determination) was .79 that is math teaching anxiety is 79% depend on personal math anxiety and $p < .01$ which was statistically significant at 99% confidence level. Here r is positive, therefore, if the personal math anxiety score of any teacher is high then his/her math teaching anxiety score will be high. The result is shown in the Table 4.15 and 4.16 below.

Table 4.15: The value of R, R square and adjusted R square

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.890	.792	.791	.28987

Table 4.16: Sum of squares for Regression and Residual

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	76.883	1	76.883	915.021	.000
Residual	20.166	240	.084		
Total	97.048	241			

The estimated value of alpha is .384, which implies that on average increase in math teaching anxiety (%) is .384 when increase in personal math anxiety (%) is 0. Again the estimated value of beta is .875, which implies that for 1% increase in personal math anxiety the average amount of increase in math teaching anxiety is .875%. Here beta is positive, so, if personal math anxiety will increase then math teaching anxiety will increase.

Table 4.17: The value of the coefficient of alpha and beta

Coefficients of alpha and beta					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Beta	Beta		
(Constant)	.384	.066		5.081	.000
MAscore	.875	.029	.890	30.249	.000

The P-value for alpha is .000. So, we may conclude that the intercept coefficient not equal to 0. Again the P-value for beta is .000. So, it was concluded that beta was not equal to 0 which was significant at1% level. That means, math teaching anxiety changes as the changes of personal math anxiety. Therefore, the regression model can write as Y = .384 + .875 X that is MTA = .384 + .875 PMA. Here MTA means mathematics teaching anxiety and PMA means personal mathematics anxiety.

4.3.10 Impact of demographic characteristics on personal math anxiety and math teaching anxiety

4.3.10.1 Impact of gender on personal math anxiety and math teaching anxiety

The mean score of personal math anxiety of males is 2.14 with standard deviation of .61 and that of females 2.39 with SD of .74, where p is equal .03 with degrees of freedom 240. The results clearly indicate that there is significant difference between personal math anxiety scores of both males and females at 97% confidence level. Therefore, females did have more anxiety levels than males for mathematics. Again the mean score of math teaching anxiety of males is 2.26 with standard deviation of .58 and that of females 2.46 with SD of .79, where p is equal .10 with degrees of freedom 240 which was not significant at 95% confidence level (Table 4.18). So, there is no enough evidence in favor of difference between male and female teachers in math teaching anxiety. In both the cases PMA and MTA levens test was significant so variances were assumed not equal (Table: 34 & Table: 36 in Annex-L).

Table 4.18: Gender and math anxiety

	Gender	N	Mean	Std. Deviation	df	Sig.
Personal math anxiety	Male	193	2.14	.61	240	.03
	Female	49	2.39	.74		
Math teaching anxiety	Male	193	2.26	.58	240	.10
	Female	49	2.46	.79		

4.3.10.2 Impact of urban-rural status on personal math anxiety and math teaching anxiety

The mean score of personal math anxiety of urban teachers is 2.15 with standard deviation of .58 and that of rural teachers is 2.39 with SD of .74, where p is equal .26 with degrees of freedom 240. Again the mean score of math teaching anxiety of urban teachers is 2.28 with standard deviation of .59 and that of rural teachers is 2.33 with SD of .68, where p is equal .58 with degrees of freedom 240. Both cases the result was not significant at 95% confidence level (Table 4.19). So, there is no enough evidence in favor of difference between the urban and rural teachers in both personal math anxiety and math teaching anxiety. For PMA levens test was sig. (.02) and for MTA levens test was not sig. (.33), (Table: 38 & Table: 40 in Annex-L).

Table 4.19: Urban-rural status and math anxiety

		N	Mean	Std. Deviation	df	Sig.
Personal math anxiety	Urban	142	2.15	.58	240	.28
	Rural	100	2.25	.72		
Math teaching anxiety	Urban	142	2.28	.59	240	.59
	Rural	100	2.33	.68		

4.3.10.3 Impact of professional education on personal math anxiety and math teaching anxiety

The mean score of personal math anxiety of those who had professional education (B.Ed., M.Ed.) is 2.20 with standard deviation of .61 and those who did not have professional education is 2.17 with SD of .74, where p is equal .77 with degrees of freedom 240. Again the mean score of math teaching anxiety of those who had professional education (B.Ed., M.Ed.) is 2.31 with standard deviation of .61 and that of those who did not have professional education is 2.30 with SD of .70, where p is

equal .90 with degrees of freedom 240. Both cases the result was not significant at 95% confidence level (Table 4.20). So, there is no enough evidence in favor of difference between the professionally trained and non- trained teachers in personal math anxiety and math teaching anxiety. In both the cases PMA and MTA, levens test was not significant so varriances were assumed equal (Table: 42 & Table: 44 in Annex-L).

Table 4.20: Professional education and math anxiety

		N	Mean	Std. Deviation	df	Sig.
Personal math anxiety	Bed or Med	178	2.20	.61	240	.77
	None	64	2.17	.74		
Math teaching anxiety	Bed or Med	178	2.31	.61	240	.94
	None	64	2.30	.70		

4.3.10.4 Impact of subject at graduation level on personal math anxiety and math teaching anxiety

The mean score of personal math anxiety of those teachers who did have mathematics at degree level is 2.01 with standard deviation of .37 and that of those teachers who did not have mathematics at degree level is 2.38 with SD of .79, where p is equal .000 with degrees of freedom 240. Again the mean score of math teaching anxiety of those teachers who did have mathematics at degree level is 2.14 with standard deviation of .41 and that of those teachers who did not have mathematics at degree level is 2.47 with SD of .76, where p is equal .000 with degrees of freedom 240. Both cases the result was significant at 99% confidence level (Table 4.21). So, there is a difference in personal math anxiety and math teaching anxiety between the teachers those did have or not mathematics at degree level. In both the cases PMA and MTA, levens test was significant so varriances were assumed not equal (Table: 50 & Table: 52 in Annex-L).

Table 4.21: Impact of having mathematics at graduation level

	Subject at deg. level	N	Mean	Std. dev.	df	Sig.
Personal math anxiety	degree with math	120	2.01	.37	240	.000
	degree without math	122	2.38	.79		
Math teaching anxiety	degree with math	120	2.14	.41	240	.000
	degree without math	122	2.47	.76		

4.3.10.5 Impact of subject based training on personal math anxiety and math teaching anxiety

The mean score of personal math anxiety of trained teachers in mathematics is 2.03 with standard deviation of .41 and that of non- trained teachers in mathematics is 2.34 with SD of .77, where p is equal .000 with degrees of freedom 240. Again the mean score of math teaching anxiety of trained teachers in mathematics is 2.18 with standard deviation of .43 and that of non trained teachers in mathematics is 2.41 with SD of .75, where p is equal .004 with degrees of freedom 240. Both cases the result was significant at 99% confidence level (Table: 4.22). So, there is a difference in personal math anxiety and math teaching anxiety between the teachers those did have or not training in mathematics at degree level. In both the cases PMA and MTA, levens test was significant so varriances were assumed not equal (Table: 46 & Table: 48 in Annex-L).

Table 4.22: Impact of subject based training on PMA and MTA

	Training in mathematics	N	Mean	Std. Deviation	df	Sig.
Personal math anxiety	yes	111	2.03	.41	240	.000
	no	131	2.34	.77		
Math teaching anxiety	yes	111	2.18	.43	240	.003
	no	131	2.41	.75		

4.4 key findings

- The average age of the teachers was 40 years and majority (58.7%) of the teacher's age was up to 40. Again the experiences of majority (70.7%) teachers were within 20 years.
- 50.4% secondary math teachers did not have mathematics as a subject at degree level.
- 54.1% secondary math teachers did not have any training in mathematics.
- 82.2% secondary math teachers did not have master degree or have master degree in other subjects without mathematics and only13.6% were master degree with honors in mathematics.
- It was found that 12.8% secondary math teachers experienced low level of personal mathematics anxiety, 76% experienced moderate level, and 11.2% experienced high level.
- It was also found that 11.6% secondary math teachers experienced low level of mathematics teaching anxiety 78.1% experienced moderate level, and 10.3% experienced high level.
- Females had more personal math anxiety than that of males but not in mathematics teaching anxiety.
- The difference between urban and rural teachers in personal math anxiety and math teaching anxiety were not significant.
- The personal math anxiety mean score and math teaching anxiety mean score were slightly differed on professional education but the difference was not significant.

- There was a significant difference between the teachers those who had taken or not mathematics at graduation level on personal math anxiety and similarly in math teaching anxiety.
- Teachers, who were non-trained in mathematics their personal math anxiety score and math teaching anxiety score were higher than those who were trained. In, both cases there were significant at 99% confidence level.
- Personal mathematics anxiety and mathematics teaching anxiety were highly associated ($r = 0.89$), where mathematics teaching anxiety was 79% dependent on personal mathematics anxiety.

CHAPTER 5
DISCUSSION AND CONCLUSION

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5.1 Introduction

There are six sections in this chapter such as introduction, discussion, limitations, conclusion, recommendations and suggestions for the future research. At first introduction deals the arrangement of the chapter. In the discussion portion findings were compared with other studies and meaning of the findings was mentioned also even explained about other sections. In recommendation section the researcher was recomended for all stakeholders based on the findings. Then in conclusion area final words of the study were stated. Finally it was stated about further scope for other researchers.

5.2 Discussion of Results

Data were collected from 48 schools where girls' schools, boys' schools, govt. schools, non govt. schools, pilot schools were existed. At first 4 divisions were selected according to regional variation. Then 8 districts and 16 upazillas were selected conveniently considering time, money and communication system. Three schools were selected from each school purposively considering different type of secondary schools and every math teachers were selected from each school. Finally 242 teachers were selected as sample which was also sufficient for factor analysis.

Bangla version of MAMTS named as MAMTS-B were used as tools. To adapt at secondary level in Bangladesh it has been revised.Our all teachers are not familiar with English. So the original scale was translated into Bangla. Out of 25 items of MAMTS, 12 items were positively worded and 13 items were negatively worded. The positive and negative items were not arranged in the original scale serially. Therefore it was needed to check the validity of Bangla version of MAMTS named MAMTS-B. Then correlation was performed and found r =0.918 which was

highly satisfactory. The value of r indicates that Bangla version (MAMTS-B) of original English version (MAMTS) questionnaire translation was valid. The author (MacAnallen, 2010) of the tools with 25 items explored 2 factors as personal math anxiety and professional math anxiety. In this study the researcher confirmed 2 factors for MAMTS-B named as personal math anxiety and math teaching anxiety. The Kaiser - Meyer - Olkin (KMO) value for this study was 0.934 which is near equal to the original tools 0.965 and the Bartlett's Test was significant. Two factors jointly accounted for 46.234% of the total variance which was same to the original study (MacAnallen, 2010). The cornbach alpha value was 0.86 for 12 items (math anxiety) and 0.868 for 13 items (math teaching anxiety) where MacAnallen alpha score were 0,95 and 0.92 for the same factor respectively.

Out of 242 secondary teachers 193 (80%) were male and 49 (20%) were female. A huge number of female teachers have at secondary level but this number is poor in math teaching. It can be mentioned here that all of these 49 female teachers were not appointed in mathematics where it was a total number of those who taught mathematics. Actually only 21(8.68%) female teachers were appointed as math teacher. Because girls avoid science group at SSC, HSC and then avoid mathematics at degree level. They consider mathematics is a difficult subject or math is not for girls. Even teachers also comment about girls in such way. The number of urban schools and rural schools were near about equal but number of urban teachers (142) was more than rural teachers (`100). According to the number of students in urban schools, the number of teachers was more than rural schools. The percentage of new teachers was high where majority of the teachers (58.7%) were up to 40 years , it may be caused that increase new schools were increased day by day and new teachers has appointed accordingly. In the same way many teachers (43.8%) teaching experience

was within 10 years. Only 49.6% teachers were taken mathematics at their degree level and only 17.8% teachers did have master degree in mathematics. There is a big difference between appointed math teachers and those who taught math. 50.4% teachers were taught mathematics those who were not appointed as math teacher. There are so many causes involved here. Shortage of mathematics teachers and the interest of private coaching are the mentionable causes. Another research can be conducted to explore the reason. Though sufficient number of teacher did have professional education (B.Ed, M.Ed) but the picture of subject training is very poor where only 45.9% teachers did have trained in mathematics because subject training only allotted only for subject teacher. Teachers those who appointed in other subjects (Business studies, Biology, General Science, Religion, Agriculture etc.) they have got training in their relevant subjects. It might be hampered mathematics education at secondary level. 86% teachers said that they did not have math anxiety. On the other hand 81.4% teachers rated their math anxiety as low. It may be caused that they did not clear about themselves about on math anxiety. So they thought normally they did not have any math anxiety but it should be clearly identified at least to reduce math anxiety and to build up their confidence about mathematics.

The distribution of math anxiety score and math teaching anxiety score was very closed to normal. It was positively skewed. Therefore math anxiety level was classified by using mean and standard deviation. The system was parallel for the study (Atinuke, 2015). The score were calculated in this way that the highest score means high level of anxiety and the lowest score means the low level anxiety. Before calculation negative statements were scoring reversely. It was found that 31 (12.8%) teachers experienced low level, 184 (76%) moderate level and 27(11.2%) experienced high level math anxiety which was comparable with other study (Atinuke, 2015 ;

MacAnallen, 2010). Again the math teaching anxiety level was also classified by using mean and standard deviation. The system was parallel for the study (Atinuke, 2015). The score were also calculated in this way that the highest score means high level of anxiety and the lowest score means the low level anxiety. Before calculation negative statements were scoring reversely. It was found that 28 (11.6%) teachers experienced low level, 189 (78.1%) moderate level and 25(10.3%) experienced high level math teaching anxiety which was comparable with other study (Atinuke, 2015; MacAnallen, 2010). Number of the teachers experienced mild or moderate mathematics anxiety and mathematics teaching anxiety may be higher since some teachers may be embarrassed to admit that they experienced both these anxiety.

Pair wise correlation was run for math anxiety, math teaching anxiety, teaching experience and age of the teachers. The correlation between math anxiety and math teaching anxiety is 0.89 which is indicated high association between the two factors (Kristin & Dorward, 2011 ; Reed , 2014 ; Atinuke, 2015). Actually it is very difficult to separate personal math anxiety and math teaching anxiety. If one exists then other one also exists. It may be caused that normally teaching anxiety and mathematics teaching anxiety are not same. Therefore this study was found math teaching anxiety is dependent on personal math anxiety by using regression analysis. And it was also found that math teaching anxiety is 79% dependent on personal math anxiety which was significant at 99% confidence level. Regression equation also found that MTA = .384 + .875 PMA. Here it is mentionable that teaching experience and teachers age was not significantly correlated with personal math anxiety and math teaching anxiety. So for these two variables, the regression was not run. Therefore teaching experience and age was not considered as predictor with personal math anxiety for the dependent variable math teaching anxiety.

Gender effect is significant on both math anxiety and math teaching anxiety. Here in both cases mean score of math anxiety and math teaching anxiety for female is high. So, both math anxiety and math teaching anxiety were higher for female than male. Many studies have found the same difference (Malinsky et al. , 2006; Khatoon & Mahmood, 2010 ; Bowd & Brady , 2003 ; William & William, 1985) . On the other hand, some studies did not find any significant difference ((Marso & Pigge, 1998 and Ameen, Guffey & Jackson, 2002). Math anxiety score and math teaching anxiety score for urban and rural teacher were slightly different but not significant. In Bangladesh all the graduation level education (College) under the same university with same curriculum and same examination system. So in general quality is almost same everywhere. Therefore professional education (B.Ed., M.Ed.) and subject training situation is the same for urban and rural everywhere. It may be caused here. Those who did have professional education (B.Ed., M.Ed.) or not, there is no significant difference between them on math anxiety and math teaching anxiety. It might be different. So it is a big question about the quality of our professional education. In our secondary education more than fifty percent (50%) teacher teaches mathematics but they were not appointed as in mathematics teacher and they did not have mathematics at their graduation level and rest of the teachers did have mathematics at their graduation level. There is a significant difference both of the category of their mean score of personal math anxiety and math teaching anxiety. Besides the professional education, subject based training is another way to build up the quality of the teachers. Most of the teachers did not get any training on mathematics under subject based training because the teachers those who teach mathematics at secondary level all of them were not appointed as math teachers but subject based training is offered only for relevant subject teachers. There is a

significant difference between trained and non-trained teachers regarding their personal math anxiety score and math teaching anxiety score.

5.3 Limitations of the study

Though it was mentioned about the secondary school teachers in the title, the study was conducted only on secondary math teachers, who taught mathematics at grad six to ten. There are 18000 secondary schools in Bangladesh due to the restriction of time and money the researcher have surveyed all mathematics teachers of only 48 secondary schools (242 mathematics teachers) as it was generalized result for whole Bangladesh. Convenient and purposive method was used to select school, which was one of the limitations of the study to generalize the result. Sometimes teachers did not want to disclose his/her weakness by giving their real opinion, but the researcher tried best to convince them to inform his ethical commitment. This study was limited only on quantitative data where qualitative data might be used to triangulate the data for wider understanding at the same time.

5.4 Recommendations

i) Only subject teacher should teach mathematics at secondary level as their anxiety level was below than other and it was statistically significant.

ii) Educational qualification for secondary math teachers may at least master degree in mathematics.

iii) All teachers are needed training in mathematics under subject based training because subject based training can reduce ones anxiety level and improve confidence.

iv) All teachers should have quality professional education, which can improve their professionalism.

v) Only 9.9% teachers did have M.Ed. degree. It should be increased.

vi) For getting female math teacher, girls should be encouraged to take mathematics at SSC , HSC levels and then finally at graduation level.

vii) Special training may deliver to the secondary teachers about the proper use of appropriate teaching aid.

5.5 Conclusion

Based on the findings of the study, it can be concluded that secondary math teachers are experienced the different level of math anxiety and math teaching anxiety such as low, moderate and high but it is cleared that most of the teacher were experienced both personal math anxiety and math teaching anxiety at moderate level. Again mathematics teaching anxiety is highly correlated with personal mathematics anxiety. The study also concludes that there is an effect of gender, subject based training, subject studied at graduation level on personal math anxiety and math teaching anxiety. This study has also found imbalanced among the self - rated math anxiety level and measured from the math anxiety scale.

5.6 Suggestions for Future Research

Other researcher can try to find the different causes of math anxiety of secondary math teachers. Reducing technique can be developed by another research. Teachers' mental condition at the time of feeling math anxiety can be analyzed by another research. Research can be conducted about duties of parents, the education of parents, socio- economic condition of parents. Genetic factor may be another cause of math anxiety. It can be investigated that whether quality supervision, quality text book, appropriate curriculum, quality training can reduce math anxiety or not. About the impact of math anxiety on student achievement can be investigated by another

research. Different sides of students math anxiety can be investigated. Mathematics anxiety scale can be developed more technically because teachers may be embarrassed to agree with any anxiety. Qualitative or mixed method may be used to investigate this mathematics anxiety.

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ANNEXURES

ANNEXURES

ANNEX – A

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Application for tools

Billal Hossain Tue, Dec 6, 2016 at 10:28 PM

Rachel McAnallen
<rmathmania@gmail.com>

Dear Dr. Rachel R. McAnallen

My name is Md. Billal Hossain. I am a PhD student at Institute of Education and Research (IER) of Dhaka University of Bangladesh. My supervisor is professor M. Nazmul Haq (professor of educational psychology, IER, DU). Actually I am a teacher of mathematics since 1996 at Ideal school & College, Dhaka, Bangladesh (a national level prominent school of Bangladesh) which is beside India in Asia. I have completed M.Phil (math education), M.sc and B.sc (hon's) in mathematics, MEd and BEd.

My research title is "**Mathematics Anxiety in Secondary School Teachers of Bangladesh**: **An Exploratory Study**". I am interested to analyze teachers math anxiety and their math teaching anxiety with respect to different criteria. So I need to measure their MA and MTA level. I want to use your Math Anxiety Scale (MAMTS). I have read your PhD thesis from internet .I know about yourself. You spent your life for better teaching to reduce math anxiety from students and teachers. You have completed PhD at 75 years of age which is really unbelievable. You are known as Ms. math. I know you are interested teach teachers to teach math

.Qualification of secondary and elementary math teachers are almost same so I can use MAMTS for PhD research if you allowed. My supervisor also agrees with me. If any adaption is needed in our situation it will be decided after consultation with my supervisor and of course you will be informed.

Please sent me MAMTS and some essential tips which will helpful for me. I will be very lucky if I can use MAMTS in my PhD thesis and I will be very grateful to you. I am waiting to receive your mail.

Sincerely

Md. Billal Hossain
Senior teacher (mathematics)
Ideal School &College, Banasree Branch, Rampura, Dhaka-1219, Bangladesh.
PhD student, IER,DU,Dhaka, Bangladesh.
Cell: 8801819231578
Email: billalhossainisc@gmail.com

ANNEX – B

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Permission from Tools owner:

Rachel McAnallen Wed, Dec 14, 2016 at 11:15 PM

<rmathmania@gmail.com>

To: Billal Hossain <billalhossainisc@gmail.com>

Dear Billal,

I am thrilled and honored that you would like to use the math anxiety instrument (MAMTS) that I developed to further your research. Of course, you may use it and I give you permission to adjust or change anything with it to suit your research needs.

Please stay in touch and let me know if there is anything else I can help you with.

Most Sincerely,

Rachel aka Ms Math

ANNEX – C

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Original Tools in English (MAMTS):

McAnallen Anxiety in Mathematics Teaching Survey Survey (MAMTS)

Please circle the number that best describes your level of agreement with the statement.

	Strongly agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1. I was one of the best math students when I was in school.					
2. Having to work with fractions causes me discomfort.					
3. I feel confident in my ability to teach mathematics to students in the grade I currently teach.					
4. I am confident that I can learn advanced math concepts.					
5. When teaching mathematics, I welcome student questions.					
6. I have trouble finding alternative methods for teaching a mathematical concept when a student is confused.					
7. I can easily do arithmetic calculations in my head.					
8. I find it difficult to teach mathematical concepts to students.					
9. I feel confident using sources other than the mathematics textbook when I teach.					

10. I don't have the math skills to differentiate instruction for the most talented students in my math classes.					
11. I dislike having to teach math every day.					
12. I avoided taking non-required math courses in college.					
13. I have a lot of self-confidence when it comes to mathematics.					
14. I am confident that I can solve math problems on my own.					
15. I become anxious when I have to compute percentages.					
16. I have math anxiety.					
17. It makes me nervous to think about having to do any math problem.					
18. On the average, other teachers are probably much more capable of teaching math than I am.					
19. I cringe when a student asks me a math question that I can't answer.					
20. I am comfortable working on a problem that involves algebra.					
21. I have strong aptitude when it comes to math.					
22. I doubt that I will be able to improve my math teaching ability.					
23. If I don't know the answer to a student's mathematical question, I have the ability to find the answer.					
24. I become anxious when a student finds a way to solve a problem with which I am not familiar.					
25. I would welcome the chance to have my supervisor evaluate my math teaching.					

26. I am a: ❑ Male ❑ Female

27. Number of Years Mathematics Teaching Experience_____

Current Grade Level Teaching _____ . Highest Grade Level Taught_____

28. Place a check mark in front the following math classes you successfully completed in high school: _____Algebra 1 _____Geometry _____Algebra 2 _____Trigonometry/Pre calculus _____Calculus 1 _____Calculus 2

29. What is the highest level math class that you passed in college? ----------

30. Compare yourself to other elementary math teachers in terms of your mathematical abilities:

❑ 1 One of the worst ❑ 2 Way below average ❑ 3 Belowaverage

❑ 4 Average ❑ 5 Aboveaverage ❑ 6 Way above average ❑ 7 One of the best

31. Do you enjoy doing math? ❑ Yes ❑ No – *Skip to Question 34*

32. When did you first realize that you enjoyed mathematics?

❑ Primary school (K-2) ❑ Elementary (3-5) ❑ Middle school (6-8)

❑ High school (9-12) ❑ College/Adulthood ❑ Don‘t remember

33. Describe what you enjoy about mathematics:

_____
_____
_____
_____
_____
_____

34. Do you experience “math anxiety?” ❑ Yes ❑No – *Please continue to end.*

35. Rate the degree of your math anxiety.❑1 – Mild ❑2 - Moderate ❑3 – Severe

36. When did you first experience math anxiety?

❑ Primary school (K-2) ❑ Elementary (3-5) ❑ Middle school (6-8)

❑ High school (9-12) ❑ College/Adulthood ❑ Don‘t remember

37. Please describe the circumstances that led to your first experience with math anxiety (use the back of the paper if you need more space).

_____
_____
_____
_____
_____
_____

ANNEX – D

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Revised tools for piloting (English):

Part - A

Attitudes Towards Mathematics and Mathematics Teaching Survey

Please mark the tick sign that best describes your level of agreement with the statement.
Here five alternate answers are strongly agree, agree, neither agree nor disagree, disagree, strongly disagree

	Strongly agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1. I was one of the best math students when I was in school.					
2. Having to work with fractions causes me discomfort.					
3. I feel confident in my ability to teach mathematics to students in the grade I currently teach.					
4. I am confident that I can learn advanced math concepts.					
5. When teaching mathematics, I welcome student questions.					
6. I have trouble finding alternative methods for teaching a mathematical concept when a student is confused.					
7. I can easily do arithmetic calculations in my head.					

8. I find it difficult to teach mathematica concepts t students.					
9. I feel confident using sources other than the mathematics textbook when I teach.					
10. I don't have the math skills to differentiate instruction for the most talented students in my math classes.					
11. I dislike having to teach math every day.					
12. I avoided taking non-required math courses in college.					
13. I have a lot of self-confidence when it comes to mathematics.					
14. I am confident that I can solve math problems on my own.					
15. I become anxious when I have to compute percentages.					
16. I have math anxiety.					
17. It makes me nervous to think about having to do any math problem.					
18. On the average, other teachers are probably much more capable of teaching math than I am.					
19. I cringe when a student asks me a math question that I can't answer.					
20. I am comfortable working on a problem that involves algebra.					
21. I have strong aptitude when it comes to math.					

22. I doubt that I will be able to improve my math teaching ability.					
23. If I don't know the answer to a student's mathematical question, I have the ability to find the answer.					
24. I become anxious when a student finds a way to solve a problem with which I am not familiar.					
25. I would welcome the chance to have my supervisor evaluate my math teaching.					

Part - B

26. Name of teacher:

27. Sex: ❑ Male ❑ Female

28. Name of school: ……..

29. Location of school:

Municipality/Union:.....Upzila: ---------- District:----------

30. Age (as of December 31, 2017): Year ---------- Month ----------

31. Educational qualification (last degree/ certificate obtained) : ……

32. Training received: (One teacher may have different trainings; requested to mention all) ❑ C-in-Ed ❑ DPEd ❑ B. Ed ❑ M. Ed ❑ others

33. Teaching experience (as of December 31, 2017) :

Year---------- Month----------

34. Group at Secondary Level: ❑ Humanities ❑ Business Studies ❑ Others

❑ Science (With Higher Math) ❑ Science (Without Higher Math)

35. Group at Higher Secondary Level: ❑ Humanities ❑ Business Studies

❑ Others ❑ Science (With Higher Math) ❑ Science (Without Higher Math)

36. Please mention your subject at degree level:

1. ---------- 2. ---------- n3.----------

37. If you have Hon's degree, please mention your subject. ----------

38. Name of your subject at master degree level: ----------

39. Name of your university at Hon's / master degree level: ----------

40. Did you participate any subject based training in mathematics?

❑ Yes. ------❑ No.------

41. If answer of the question no. 38 is yes mention the type of training:

❑ Name ---------- ❑ Duration (day):----------

42. Which classes do you teach mathematics? --------- --------- ---------- ---------- ------

43. Do you experience "math anxiety?

❑ Yes ❑ No

44. Rate the degree of your math anxiety.

❑ Mild ❑ Moderate ❑ Severe

45. Name of your university for B. Ed / M. Ed degree: ..... / .....

ANNEX – E

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Revised tools for piloting (Bangla):

প্রথম অংশ

(গণিত সম্পর্কে এবং গণিতে পাঠদানের মনোভাব জরিপ অভীক্ষা)

সম্মানিত উত্তর দাতাকে প্রতিটি উক্তির বিপরীতে দেওয়া পাঁচমাত্রার যে কোন একটিতে (যা তাঁর বিবেচনায় প্রযোজ্য বলে মনে হয়) টিক চিহ্ন দেয়ার অনুরোধ করছি । পাঁচটি বিকল্প উত্তর হলো : সম্পূর্নরূপেএকমত, একমত, নিরপেক্ষ, একমত নই, একেবারেই একমত নই।

	সম্পূর্নরূপে একমত	একমত	নিরপেক্ষ	একমত নই	একেবারেই একমত নই
১। আমি স্কুল জীবনে গণিত বিষয়ে শিক্ষার্থীদের মধ্যে অন্যতম ছিলাম।					
২। ভগ্নাংশের অংক করতে আমি অস্বস্তি বোধ করি।					
৩। আমি গ্রেড-১ শিক্ষার্থীদের গণিত পাঠদানে নিজেকে সামর্থ্যবান বলে আত্মবিশ্বাসী / মনেকরি।					
৪। আমি অগ্রবর্তী গণিতের ধারনা শিখতে পারি বলে আত্মবিশ্বাসী।					
৫। পাঠদান কালে আমি শিক্ষার্থীদের প্রশ্নকে স্বাগত জানাই।					
৬। যখন ছাত্ররা সমস্যা বোধ করে তখন গাণিতিক ধারনা শিখানোর ক্ষেত্রে বিকল্প পাঠদান পদ্ধতি খুঁজে পেতে আমি সমস্যায় পড়ি।					
৭। আমি পাটিগণিতের হিসাব সমূহ সহজেই মাথা খাটিয়ে করতে পারি।					
৮। ছাত্রদেরকে গাণিতিক ধারনা শিখাতে আমার কাছে কঠিন মনে হয়।					
৯। পাঠদানের সময় গণিত পাঠ্যবই বহির্ভূত অন্য উৎসের ব্যবহারে আমি বিশ্বাসী /ভাল মনে করি।					

১০। শ্রেণি কক্ষে অত্যন্ত মেধাবী শিক্ষার্থীদের জন্য পৃথক নির্দেশনা দেওয়ার মত গাণিতিক দক্ষতা আমার নেই।					
১১। আমি প্রতিদিন গণিত শিখানোটাকে অপছন্দ করি।					
১২। আমি কলেজে অধ্যয়নকালে অপ্রয়োজনীয় গণিত কোর্স নেয়াটাকে এড়িয়ে চলতাম।					
১৩। গণিত বিষয়ে আমার যথেষ্ট আত্মবিশ্বাস আছে।					
১৪। আমি নিশ্চিত যে আমি নিজেই গাণিতিক সমস্যা সমাধান করতে পারি।					
১৫। আমি চিন্তিত/উদ্বিগ্ন হই যখন আমাকে শতকরার হিসাব করতে হয়।					
১৬। আমার গণিত ভীতি/আশঙ্কা /দুশ্চিন্তা আছে।					
১৭। গণিতের কোন সমস্যার কথা চিন্তা করলে আমি বিচলিত হই।					
১৮। সার্বিকভাবে গণিত পাঠদানে অন্য শিক্ষকরা আমার চেয়ে অধিক দক্ষ।					
১৯। শিক্ষার্থীদের গণিতের প্রশ্নের উত্তর দিতে না পারলে আমি লজ্জিত হই।					
২০। বীজগণিত বিষয়ক সমস্যা নিয়ে কাজ করতে আমি স্বাচ্ছন্দ্য বোধ করি।					
২১। গণিতের প্রতি আমার প্রবল ঝোঁক আছে?					
২২। আমার গণিত পাঠদানের ক্ষমতা বৃদ্ধির/উন্নয়নের ব্যাপারে আমি সন্দিহান।					
২৩। যদি আমি শিক্ষার্থীদের কোন গাণিতিক প্রশ্নের উত্তর না জানি তবে আমি তা খুঁজে বের করার সামর্থ্য রাখি।					
২৪। আমি অস্বস্তি বোধ করি যখন কোন শিক্ষার্থী আমার পরিচিত নয় এমন সমস্যা সমাধানের পদ্ধতি খুঁজে পায় ।					
২৫। আমার গণিত বিষয়ের পাঠদান মূল্যায়নের জন্য আমি তত্ত্বাবধায়ককে স্বাগত জানাই।					

দ্বিতীয় অংশ

২৬। শিক্ষকের নাম ঃ ২৭। লিঙ্গ ঃ ❑ পুরুষ ❑ মহিলা

২৮। বিদ্যালয়ের নাম ঃ ……..……..

২৯। বিদ্যালয়ের অবস্থান ঃ পৌরসভা/ইউনিয়ন..... উপজেলা:.....জেলা:.....

৩০। বয়স (৩১ শে ডিসেম্বর ২০১৭ পর্যন্ত) ঃ বছর ---------- মাস----------

৩১। সর্ব্বোচ্চ শিক্ষাগত যোগ্যতা ঃ ……

৩২। পেশাগত যোগ্যতা ঃ ❑সি-ইন-এড-----❑ ডিপিএড----❑ বিএড------❑ এমএড ❑ অন্যান্য --

৩৩। মাধ্যমিক শিক্ষক হিসাবে চাকুরির মোট অভিজ্ঞতা । বছর---------- মাস ----------

৩৪। মাধ্যমিক পর্যায়ে পঠিত বিভাগ : ❑ ব্যবসায় শিক্ষা ❑ মানবিক ❑ অন্য যেকোন

❑ বিজ্ঞান (উচ্চতর গণিত সহ) ❑ বিজ্ঞান (উচ্চতর গণিত ছাড়া)

৩৫। উচ্চ মাধ্যমিক পর্যায়ে পঠিত বিভাগ : ❑ ব্যবসায় শিক্ষা ❑ মানবিক ❑ অন্য যেকোন

❑ বিজ্ঞান (উচ্চতর গণিত সহ) ❑ বিজ্ঞান (উচ্চতর গণিত ছাড়া)

৩৬। স্ড়বাতক পর্যায়ে পঠিত বিষয় সমূহ ঃ ১। ---------- ২। ---------- ৩।----------

৩৭। আপনি স্ড়বাতক (সম্মান) ডিগ্রী ধারী হলে বিষয়ের নাম: .....

৩৮। স্ড়বাতকোত্তর ডিগ্রী ধারী হলে পঠিত বিষয় ঃ ----------

৩৯। আপনি স্ড়বাতক / স্ড়বাতকোত্তর পর্যায়ে যে বিশ্ববিদ্যালয়ে অধ্যয়ন করেছেন তার নাম: ..... / .....

৪০। গনিতের উপর বিষয় ভিত্তিক কোন প্রশিক্ষনে অংশগ্রহণ করেছেন কি? ১। হ্যাঁ.------- ২। না.--------

৪১। ৩৮নং প্রশেড়বর উত্তর হ্যাঁ হলে প্রশিক্ষনের ধরন ঃ ১। নাম---------- ২। সময় (দিন):----------

৪২। কোন কোন শ্রেণিতে গণিত পাঠদান করেন? --------- --------- ---------- ----------

৪৩। আপনার কি গণিত ভীতি আছে? ❑ হ্যাঁ ❑ না

৪৪। আপনার গণিত ভীতির মাত্রা চিহ্নিত করুন? ❑ হালকা ❑ মধ্যম ❑ তীব্র

৪৫। আপনি বিএড / এমএড ডিগ্রী যে বিশ্ববিদ্যালয়ে থেকে পেয়েছেন তার নাম: ..... / .....

ANNEX – F

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Finally revised tools in Bangla (MAMTS-B):

প্রথম অংশ

(গণিত এবং গণিত পাঠদানের মনোভাব জরিপ অভীক্ষা)

সম্মানিত উত্তর দাতাকে প্রতিটি উক্তির বিপরীতে দেওয়া পাঁচমাত্রার মতামতের যে কোন একটিতে টিক চিহ্ন দেয়ার অনুরোধ করছি ।

	সম্পূর্ন রূপে একমত	একমত	নিরপেক্ষ	একমত নই	একেবারেই একমত নই
১। আমি স্কুল জীবনে গণিত বিষয়ে শিক্ষার্থীদের মধ্যে অন্যতম ছিলাম।					
২। ভগ্নাংশের অংক করতে আমি অস্বস্তি বোধ করি।					
৩। আমি মাধ্যমিক শিক্ষার্থীদের গণিত পাঠদানে নিজেকে সামর্থ্যবান বলে আত্মবিশ্বাসী।					
৪। আমি অগ্রবর্তী গণিতের ধারনা শিখতে পারি বলে আত্মবিশ্বাসী।					
৫। পাঠদান কালে আমি শিক্ষার্থীদের প্রশ্নকে স্বাগত জানাই।					
৬। যখন ছাত্ররা সমস্যা বোধ করে তখন গাণিতিক ধারনা শিখানোর ক্ষেত্রে বিকল্প পাঠদান পদ্ধতি খুঁজে পেতে আমি সমস্যায় পড়ি।					
৭। আমি পাটিগণিতের হিসাব সমূহ সহজেই মাথা খাটিয়ে করতে পারি।					
৮। ছাত্রদেরকে গাণিতিক ধারনা শিখাতে আমার কাছে কঠিন মনে হয়।					
৯। পাঠদানের সময় গণিত পাঠ্যবই বহির্ভূত অন্য উৎসের ব্যবহারে আমি আত্মবিশ্বাসী।					

১০। শ্রেণি কক্ষে অত্যন্ত মেধাবী শিক্ষার্থীদের জন্য পৃথক নির্দেশনা দেওয়ার মত গাণিতিক দক্ষতা আমার নেই।					
১১। আমি প্রতিদিন গণিত শিখানোটাকে অপছন্দ করি।					
১২। আমি কলেজে অধ্যয়নকালে অপ্রয়োজনীয় গণিত অধ্যায় সমুহ এড়িয়ে চলতাম।					
১৩। গণিত বিষয়ে আমার যথেষ্ট আত্মবিশ্বাস আছে।					
১৪। আমি নিশ্চিত যে আমি নিজেই গাণিতিক সমস্যা সমাধান করতে পারি।					
১৫। আমি উদ্বিগ্ন হই যখন আমাকে শতকরার হিসাব করতে হয়।					
১৬। আমার গণিতে দুশ্চিন্তা আছে।					
১৭। গণিতের কোন সমস্যার কথা চিন্তা করলে আমি বিচলিত হই।					
১৮। সার্বিকভাবে গণিত পাঠদানে অন্য শিক্ষকরা আমার চেয়ে অধিক দক্ষ।					
১৯। শিক্ষার্থীদের গণিতের প্রশ্নের উত্তর দিতে না পারলে আমি লজ্জিত হই।					
২০। বীজগণিত বিষয়ক সমস্যা নিয়ে কাজ করতে আমি স্বাচ্ছন্দ্য বোধ করি।					
২১। গণিতের প্রতি আমার প্রবল ঝোঁক আছে?					
২২। আমার গণিত পাঠদানের ক্ষমতা উন্নয়নের ব্যাপারে আমি সন্দিহান।					
২৩। যদি আমি শিক্ষার্থীদের কোন গাণিতিক প্রশ্নের উত্তর না জানি তবে আমি তা খুঁজে বের করার সামর্থ্য রাখি।					
২৪। আমি অস্বস্তি বোধ করি যখন কোন শিক্ষার্থী আমার পরিচিত নয় এমন সমস্যা সমাধানের পদ্ধতি খুঁজে পায় ।					
২৫। আমার গণিত বিষয়ের পাঠদান মূল্যায়নের জন্য আমি আমার তত্ত্বাবধায়ককে স্বাগত জানাই।					

দ্বিতীয় অংশ

২৬। শিক্ষকের নাম ঃ .....

২৭। লিঙ্গ ঃ ❑ পুরুষ ❑ মহিলা

২৮। আপনি যে বিদ্যালয়ে কর্মরত তার নাম ঃ .....

২৯। বিদ্যালয়ের অবস্থান ঃ পৌরসভা/ইউনিয়ন..... উপজেলা:.....জেলা:.....

৩০। বয়স (৩১ শে ডিসেম্বর ২০১৭ পর্যন্ত) ঃ বছর ---------- মাস----------

৩১। সর্ব্বোচ্চ শিক্ষাগত যোগ্যতা ঃ .....

৩২।পেশাগত যোগ্যতা ঃ ❑ সি-ইন-এড ❑ডিপিএড ❑বিএড ❑এমএড ❑কোনটিই নেই ।

৩৩। মাধ্যমিক শিক্ষক হিসাবে চাকুরির মোট অভিজ্ঞতা ঃ বছর---------- মাস --------

৩৪। স্নাতক পর্যায়ে পঠিত মূল বিষয় সমূহ ঃ

১। --------- ২। ---------- ৩।----------

৩৫। আপনি স্নাতক (সম্মান) ডিগ্রী ধারী হলে বিষয়ের নাম: .....

৩৬। স্নাতকোত্তর ডিগ্রী ধারী হলে বিষয়ের নাম ঃ ----------

৩৭। আপনার কি গণিত ভীতি আছে?

❑ হ্যাঁ ❑ না

৩৮। গনিতের উপর বিষয় ভিত্তিক কোন প্রশিক্ষনে অংশগ্রহণ করেছেন কি?

১। হ্যাঁ.------- ২। না.---

৩৯। গনিতের উপর বিষয় ভিত্তিক কোন প্রশিক্ষন থাকলে তা কত দিন?

১।-----দিন ২।------- দিন ৩।------- দিন

৪০। কোন কোন শ্রেণিতে গণিত পাঠদান করেন? ------- ------- --------- --------

৪১। আপনার গণিত ভীতির মাত্রা চিহ্নিত করুন?

❑ হালকা ❑ মধ্যম ❑ তীব্র

ANNEX – G

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

List of selected 48 high schools

Division	District	Upzilla	Name of schools	No. of teacher
Dhaka	Dhaka	Savar	1.Savar Girls High School	14
			2. Savar Labratory High School	
			3. Savar Adarchandra High School	
		Dohar	1. Joypara Pilot Model High School	15
			2. Begum Ayesa Pilot Girls High School	
			3. Lotakhola Azhar Ali Memorial High School	
	Narayon gonj	Narayon gonj	1. Morgan Girls High School	30
			2. Gonobidah Niketon High School	
			3. JoyGobinda High School	
		Bondar	1. B.M. Union High School	21
			2. Bandor Girls High School	
			3. Shikdar Abdul Malek High School	
Rajshahi	Rajshahi	Rajshahi sador	1.Govt. Laboratory High School	16
			2. Rajshahi Govt. Girls High School	
			3. Laksimpur Girls High School	
		Bagha	1. Arani Monmohini High School	08
			2. Arani F.N. Girls High School	
			3. Khodda Bausa High School	
	Shirajgonj	Ullapara	1. Pholia High School	13
			2. Mohanpur K.M.Institution (High School)	
			3. Bara Pangasi High School	

		Shirajgonj sador	1. Saleha Ishaq Govt. Girls High School	15
			2. B.L. Govt. High School	
			3. Jahanara High School	
Chittagong	Bramon baria	Nobinagar	1.Bitghar Radanath High School	21
			2.Shibpur Union High School	
			3.Dhanashi High School	
		coshba	1. Gopinathpur Shaheed BabulHigh School	12
			2. Barai Alhaj Shalam High School	
			3. Kuti Girls High School	
	Comilla	Homna	1. Ramkrishnapur K.K R.K High School	15
			2. Kamal Sritee Girls High School	
			3. Kashipur Hashemia High School	
		Candina	1. Mohicail High School	16
			2. Zobeda Momtaj Girls High School	
			3. Madaya Bazar Sadim High School	
Barisal	Barisal	Barisal sadar	1. Udaon High School	14
			2. Mathuranath Public High School	
			3. Sahudpur High School	
		Uzirpur	1. Otra High School	12
			2. Vabnipur Haji Ibrahim High School	
			3. Habibpur High School	
	Pirojpur	Nesarabad	1. Sarupkathi Pilot Model High School	12
			2. Sarupkathi Girls High School	
			3. Akolom Muslim High School	
		Kawkhali	1. Iron Joykul S.M. High School	08
			2. Uttar Nilti Samatot High School	
			3. Joykul Adarsha Girls High School	
Total=04	08	16	48	242

ANNEX – H

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Piloting data

Table - 01

Average anxiety score for English version Tools

Anxiety score	Frequency	Percent	Cumulative Percent
1.12	1	3.3	3.3
1.40	2	6.7	10.0
1.56	1	3.3	13.3
1.64	1	3.3	16.7
1.76	1	3.3	20.0
1.84	1	3.3	23.3
1.88	1	3.3	26.7
1.92	1	3.3	30.0
1.96	1	3.3	33.3
2.00	2	6.7	40.0
2.04	1	3.3	43.3
2.08	1	3.3	46.7
2.20	2	6.7	53.3
2.28	1	3.3	56.7
2.32	1	3.3	60.0
2.40	1	3.3	63.3
2.44	1	3.3	66.7
2.48	2	6.7	73.3
2.52	1	3.3	76.7
2.56	1	3.3	80.0
2.60	1	3.3	83.3
2.76	1	3.3	86.7
3.16	1	3.3	90.0
3.28	1	3.3	93.3
3.44	2	6.7	100.0
Total	30	100.0	

ANNEX – H

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Piloting data

Table - 02

Average anxiety score for Bangla version Tools

Anxiety score	Frequency	Percent	Cumulative Percent
1.16	1	3.3	3.3
1.48	2	6.7	10.0
1.52	1	3.3	13.3
1.56	1	3.3	16.7
1.60	1	3.3	20.0
1.76	1	3.3	23.3
1.84	3	10.0	33.3
1.88	1	3.3	36.7
2.00	1	3.3	40.0
2.04	3	10.0	50.0
2.12	1	3.3	53.3
2.16	1	3.3	56.7
2.20	2	6.7	63.3
2.28	2	6.7	70.0
2.36	1	3.3	73.3
2.44	1	3.3	76.7
2.52	2	6.7	83.3
2.60	1	3.3	86.7
2.88	1	3.3	90.0
3.04	1	3.3	93.3
3.60	2	6.7	100.0
Total	30	100.0	

ANNEX – H

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Piloting data

Table - 03

Comparison between the scores of English version and Bangla version tools

Items	Average anxiety score for english version	Average anxiety score for bangla version
Valid	30	30
Mean	2.2387	2.1627
Std. Error of Mean	.10694	.10541
Median	2.2000	2.0800
Mode	1.40[a]	1.84[a]
Std. Deviation	.58576	.57736
Variance	.343	.333
Skewness	.413	.899
Std. Error of Skewness	.427	.427
Kurtosis	-.024	1.009
Std. Error of Kurtosis	.833	.833
Range	2.32	2.44
Minimum	1.12	1.16
Maximum	3.44	3.60
Sum	67.16	64.88

ANNEX – H

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Piloting data

Table - 04

Correlation the scores between English version and Bangla version tools

		Average anxiety score for English version	Average anxiety score for Bangla version
Average anxiety score for English version	Pearson Correlation	1	.918**
	Sig. (2-tailed)		.000
	N	30	30
Average anxiety score for Bangla version	Pearson Correlation	.918**	1
	Sig. (2-tailed)	.000	
	N	30	30

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

ANNEX – H

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Piloting data

Table - 05

Average anxiety score of Test for Bangla version Tools

Anxiety score	Frequency	Percent	Cumulative Percent
1.28	1	3.3	3.3
1.68	2	6.7	10.0
1.72	2	6.7	16.7
1.76	1	3.3	20.0
1.80	2	6.7	26.7
1.88	1	3.3	30.0
2.00	1	3.3	33.3
2.04	1	3.3	36.7
2.08	1	3.3	40.0
2.12	1	3.3	43.3
2.16	1	3.3	46.7
2.24	3	10.0	56.7
2.28	1	3.3	60.0
2.40	1	3.3	63.3
2.44	2	6.7	70.0
2.48	2	6.7	76.7
2.52	1	3.3	80.0
2.68	1	3.3	83.3
2.92	1	3.3	86.7
2.96	1	3.3	90.0
3.00	1	3.3	93.3
3.24	1	3.3	96.7
3.36	1	3.3	100.0
Total	30	100.0	

ANNEX – H

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Piloting data

Table - 06

Average anxiety score of Re-test for Bangla version Tools

Anxiety score	Frequency	Percent	Cumulative Percent
1.44	1	3.3	3.3
1.80	1	3.3	6.7
1.84	1	3.3	10.0
1.88	2	6.7	16.7
1.92	1	3.3	20.0
1.96	1	3.3	23.3
2.00	2	6.7	30.0
2.04	1	3.3	33.3
2.20	1	3.3	36.7
2.24	1	3.3	40.0
2.28	2	6.7	46.7
2.32	1	3.3	50.0
2.36	3	10.0	60.0
2.40	1	3.3	63.3
2.44	2	6.7	70.0
2.52	4	13.3	83.3
2.60	1	3.3	86.7
2.68	1	3.3	90.0
3.04	1	3.3	93.3
3.28	1	3.3	96.7
3.44	1	3.3	100.0
Total	30	100.0	

ANNEX – H

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Piloting data

Table - 07

Comparison between of the scores Test and Re-test for Bangla version tools

Items	Scores for test	Scores for Re- test
Valid	30	30
Mean	2.2547	2.3187
Std. Error of Mean	.09149	.07850
Median	2.2400	2.3400
Mode	2.24	2.52
Std. Deviation	.50109	.42998
Variance	.251	.185
Skewness	.438	.690
Std. Error of Skewness	.427	.427
Kurtosis	-.182	1.130
Std. Error of Kurtosis	.833	.833
Range	2.08	2.00
Minimum	1.28	1.44
Maximum	3.36	3.44
Sum	67.64	69.56

ANNEX – H

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Piloting data

Table - 08

Correlation the scores between Test and Re-test Bangla version tools

		Test	Re-test
Test	Pearson Correlation	1	.926**
	Sig. (2-tailed)		.000
	N	30	30
Re-test	Pearson Correlation	.926**	1
	Sig. (2-tailed)	.000	
	N	30	30

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

ANNEX – I

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Table for data presentation

Table - 09

Gender of the Teacher

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	193	79.8	79.8	79.8
Female	49	20.2	20.2	100.0
Total	242	100.0	100.0	

Table - 10

School Location of the Teachers

	Frequency	Percent	Valid Percent	Cumulative Percent
Urban	142	58.7	58.7	58.7
Rural	100	41.3	41.3	100.0
Total	242	100.0	100.0	

Table - 11

Age of the Teachers

	Frequency	Percent	Valid Percent	Cumulative Percent
Age upto 30	32	13.2	13.2	13.2
Age from 31 to 40	110	45.5	45.5	58.7
Age from 41 to 50	60	24.8	24.8	83.5
Age from 51 to 60	40	16.5	16.5	100.0
Total	242	100.0	100.0	

Table - 12

Professional Education

	Frequency	Percent	Valid Percent	Cumulative Percent
BEd	154	63.6	63.6	63.6
MEd	24	9.9	9.9	73.6
None	64	26.4	26.4	100.0
Total	242	100.0	100.0	

Table - 13

Teaching Experience

	Frequency	Percent	Valid Percent	Cumulative Percent
Upto 10 years	106	43.8	43.8	43.8
More than 10 years and upto 20 years	65	26.9	26.9	70.7
More than 20 and upto 30 years	50	20.7	20.7	91.3
More than 30 and upto 40 years	21	8.7	8.7	100.0
Total	242	100.0	100.0	

Table - 14

Subject at graduation level

	Frequency	Percent	Valid Percent	Cumulative Percent
degree with math	120	49.6	49.6	49.6
degree without math	122	50.4	50.4	100.0
Total	242	100.0	100.0	

Table - 15

Subject at masters degree level

	Frequency	Percent	Valid Percent	Cumulative Percent
Msc in math with Hon's	33	13.6	13.6	13.6
Msc in math without Hon's	10	4.1	4.1	17.8
mastr degree without math	83	34.3	34.3	52.1
no master degree	116	47.9	47.9	100.0
Total	242	100.0	100.0	

Table - 16

Training in mathematics

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	111	45.9	45.9	45.9
No	131	54.1	54.1	100.0
Total	242	100.0	100.0	

Table - 17

Self rating math anxiety

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	34	14.0	14.0	14.0
No	208	86.0	86.0	100.0
Total	242	100.0	100.0	

Table - 18

Self rating math anxiety level

	Frequency	Percent	Valid Percent	Cumulative Percent
Light	197	81.4	81.4	81.4
Moderate	44	18.2	18.2	99.6
Severe	1	.4	.4	100.0
Total	242	100.0	100.0	

Table - 19

Different Information about math anxiety

		Personal math anxiety	Math teaching anxiety
N		242	242
Mean		2.1946	2.3032
Std. Error of Mean		.04151	.04079
Median		2.1250	2.1538
Mode		2.17	2.46
Std. Deviation		.64572	.63458
Variance		.417	.403
Skewness		1.595	1.487
Std. Error of Skewness		.156	.156
Kurtosis		2.142	2.089
Std. Error of Kurtosis		.312	.312
Range		2.75	2.85
Minimum		1.25	1.23
Maximum		4.00	4.08
Percentiles	25	1.7500	1.9038
	50	2.1250	2.1538
	75	2.3333	2.4615

Table - 20

Personal math anxiety score

	Frequency	Percent	Valid Percent	Cumulative Percent
1.25	1	.4	.4	.4
1.42	6	2.5	2.5	2.9
1.50	13	5.4	5.4	8.3
1.58	11	4.5	4.5	12.8
1.67	19	7.9	7.9	20.7
1.75	17	7.0	7.0	27.7
1.83	16	6.6	6.6	34.3
1.92	13	5.4	5.4	39.7
2.00	13	5.4	5.4	45.0
2.08	12	5.0	5.0	50.0
2.17	42	17.4	17.4	67.4
2.25	17	7.0	7.0	74.4
2.33	12	5.0	5.0	79.3
2.42	6	2.5	2.5	81.8
2.50	7	2.9	2.9	84.7
2.58	3	1.2	1.2	86.0
2.67	2	.8	.8	86.8
2.75	3	1.2	1.2	88.0
2.83	2	.8	.8	88.8
2.92	1	.4	.4	89.3
3.00	1	.4	.4	89.7
3.08	2	.8	.8	90.5
3.50	1	.4	.4	90.9
3.58	1	.4	.4	91.3
3.67	2	.8	.8	92.1
3.75	4	1.7	1.7	93.8
4.00	15	6.2	6.2	100.0
Total	242	100.0	100.0	

Table - 21

Math teaching anxiety score

	Frequency	Percent	Valid Percent	Cumulative Percent
1.23	1	.4	.4	.4
1.38	2	.8	.8	1.2
1.46	5	2.1	2.1	3.3
1.54	5	2.1	2.1	5.4
1.62	7	2.9	2.9	8.3
1.69	8	3.3	3.3	11.6
1.77	16	6.6	6.6	18.2
1.85	16	6.6	6.6	24.8
1.92	18	7.4	7.4	32.2
2.00	13	5.4	5.4	37.6
2.08	16	6.6	6.6	44.2
2.15	19	7.9	7.9	52.1
2.23	15	6.2	6.2	58.3
2.31	7	2.9	2.9	61.2
2.38	11	4.5	4.5	65.7
2.46	32	13.2	13.2	78.9
2.54	7	2.9	2.9	81.8
2.62	5	2.1	2.1	83.9
2.69	2	.8	.8	84.7
2.77	7	2.9	2.9	87.6
2.85	3	1.2	1.2	88.8
2.92	2	.8	.8	89.7
3.00	1	.4	.4	90.1
3.08	1	.4	.4	90.5
3.15	1	.4	.4	90.9
3.38	2	.8	.8	91.7
3.54	1	.4	.4	92.1
3.69	1	.4	.4	92.6
3.85	1	.4	.4	93.0
4.00	1	.4	.4	93.4
4.08	16	6.6	6.6	100.0
Total	242	100.0	100.0	

ANNEX – J

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Factor analysis

Table - 22

Factors Identified in the MAMTS

Personal math anxiety	Professional math anxiety
I was one of the best math students when I was in school.	I feel confident in my ability to teach. mathematics to students in the grade I currently teach.
Having to work with fractions causes me discomfort.	When teaching mathematics, I welcome student questions.
I am confident that I can learn advanced math concepts.	I have trouble finding alternative methods for teaching a mathematical concept when a student is confused.
I can easily do arithmetic calculations in my head.	I find it difficult to teach mathematical concepts to students.
I have a lot of self-confidence when it comes to mathematics.	I feel confident using a variety of resources to teach math.
I avoided taking non-required math courses in college.	I dislike having to teach math every day

I have math anxiety. I am confident that I can solve math problems on my own. I become anxious when I have to compute percentages. I am comfortable working on a problem that involves algebra. I have a strong aptitude when it comes to math. It makes me nervous to think about having to do any math problem.	I don‘t have the math skills to differentiate instruction for the most talented students in my math classes. On average, other teachers are probably much more capable of teaching math than I am. I cringe when a student asks me a math question that I can‘t answer. I become anxious when a student finds a way to solve a problem with which I am not familiar. I doubt that I will be able to improve my math teaching ability. I would welcome the changes to have the math supervisor evaluate my teaching.

Table - 23

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.934
Bartlett's Test of Sphericity	Approx. Chi-Square	2799.217
	df	300
	Sig.	.000

Table - 24

Communalities

	Initial	Extraction
MA1	1.000	.396
MA2	1.000	.381
MTA1	1.000	.517
MA3	1.000	.454
MTA2	1.000	.653
MTA3	1.000	.536
MA4	1.000	.467
MTA4	1.000	.468
MTA5	1.000	.442
MTA6	1.000	.489
MTA7	1.000	.393
MA5	1.000	.203
MA6	1.000	.620
MA7	1.000	.317
MA8	1.000	.484
MA9	1.000	.570
MA10	1.000	.470
MTA8	1.000	.305
MTA9	1.000	.243
MA11	1.000	.605
MA12	1.000	.712
MTA10	1.000	.382
MTA11	1.000	.470
MTA12	1.000	.260
MTA13	1.000	.721

Extraction Method: Principal Component Analysis.

Table - 25

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.839	39.357	39.357	9.839	39.357	39.357	6.824	27.298	27.298
2	1.719	6.877	46.234	1.719	6.877	46.234	4.734	18.936	46.234
3	1.124	4.496	50.729						
4	1.080	4.321	55.051						
5	.931	3.726	58.777						
6	.923	3.691	62.467						
7	.886	3.543	66.010						
8	.789	3.158	69.168						
9	.729	2.916	72.084						
10	.685	2.740	74.824						
11	.652	2.609	77.433						
12	.607	2.426	79.860						
13	.587	2.346	82.206						
14	.535	2.139	84.345						
15	.519	2.075	86.421						
16	.463	1.852	88.273						
17	.458	1.833	90.106						
18	.428	1.713	91.819						
19	.374	1.495	93.315						
20	.344	1.377	94.691						
21	.340	1.362	96.053						
22	.282	1.129	97.182						
23	.264	1.057	98.239						
24	.228	.913	99.152						
25	.212	.848	100.000						

Extraction Method: Principal Component Analysis.

Table - 26

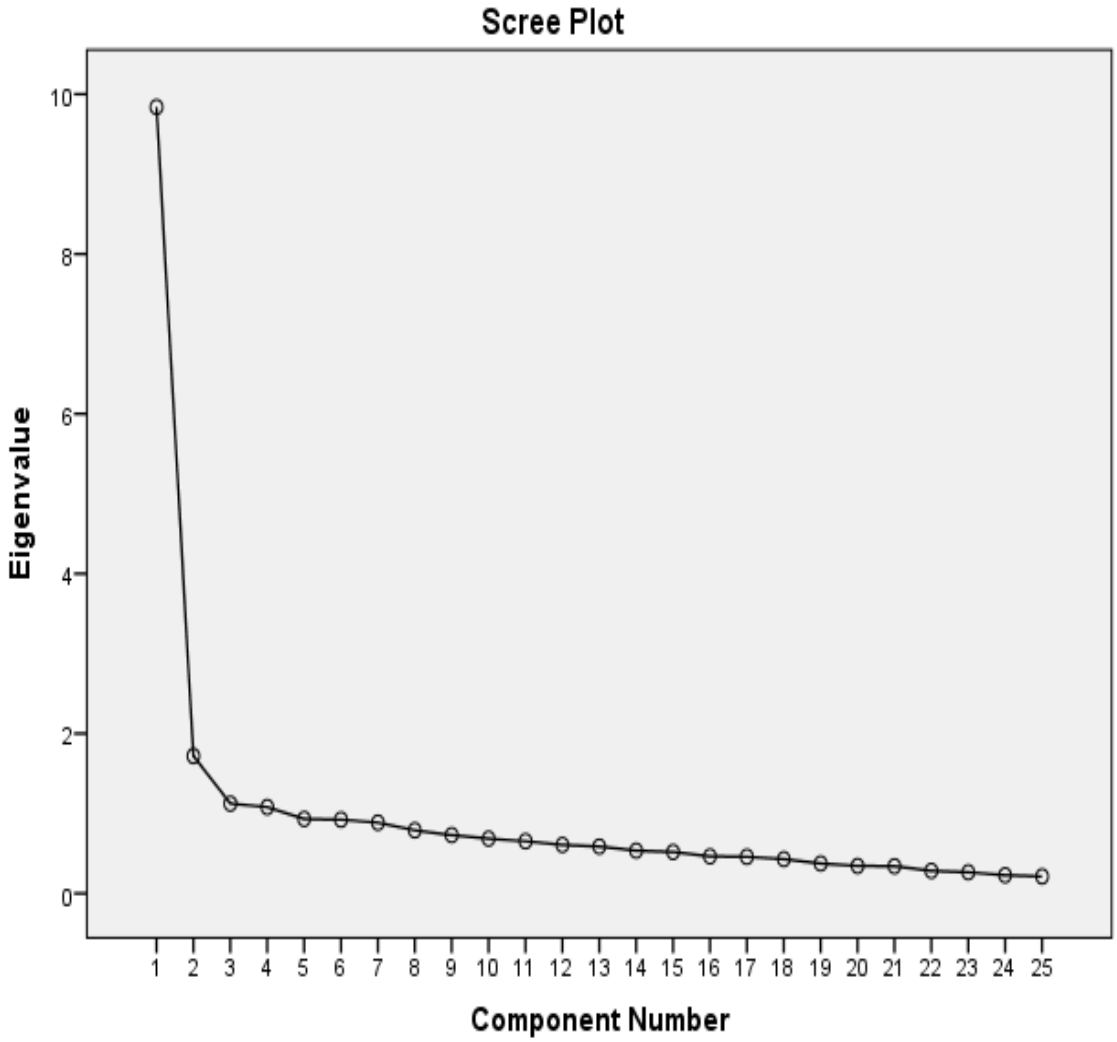
Scree Plot
Eigenvalue
10
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Component Number

Table - 27

Rotated Component Matrix[a]

	Component	
	1	2
MTA13	.802	
MA11	.776	
MA12	.776	.332
MTA2	.750	.301
MA6	.695	.371
MTA11	.678	
MA3	.652	
MTA5	.638	
MA1	.595	
MA4	.583	.357
MTA1	.545	.468
MTA7	.535	.327
MTA6	.509	.479
MTA10	.453	.421
MTA3		.727
MA9		.722
MA10		.681
MA8	.441	.539
MTA4	.442	.521
MTA9		.491
MA2	.375	.491
MA7		.490
MTA8	.314	.455
MTA12		.417
MA5		.400

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

ANNEX – K

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Table for correlation and regression

Table - 28

Correlations

		PMA score	MTA score	Real age	Real experience
PMA score	Pearson Correlation	1	.890**	.049	.049
	Sig. (2-tailed)		.000	.448	.448
	N	242	242	242	242
MTA score	Pearson Correlation	.890**	1	.089	.082
	Sig. (2-tailed)	.000		.169	.203
	N	242	242	242	242
Realage	Pearson Correlation	.049	.089	1	.925**
	Sig. (2-tailed)	.448	.169		.000
	N	242	242	242	242
Realexperience	Pearson Correlation	.049	.082	.925**	1
	Sig. (2-tailed)	.448	.203	.000	
	N	242	242	242	242

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

Table - 29

Correlations

		PMA score	MTA score
PMA score	Pearson Correlation	1	.890**
	Sig. (2-tailed)		.000
	N	242	242
MTA score	Pearson Correlation	.890**	1
	Sig. (2-tailed)	.000	
	N	242	242

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

Table - 30

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.890[a]	.792	.791	.28987	.792	915.021	1	240	.000

a. Predictors: (Constant), MAscore

Table - 31

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	76.883	1	76.883	915.021	.000[b]
	Residual	20.166	240	.084		
	Total	97.048	241			

a. Dependent Variable: MTAscore
b. Predictors: (Constant), MAscore

Table - 32

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.384	.066		5.801	.000
	PMA score	.875	.029	.890	30.249	.000

a. Dependent Variable: MTAscore

ANNEX – L

Mathematics Anxiety in Secondary School Teachers of Bangladesh: An Exploratory Study

Inferential Statistics

Table - 33

Group Statistics

	Gender of the Teacher	N	Mean	Std. Deviation	Std. Error Mean
PMA score	Male	193	2.1442	.61054	.04395
	Female	49	2.3929	.74302	.10615

Table - 34

Independent Samples Test for Gender of the Teacher

PMA score	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2 tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	5.458	.020	-2.432	240	.016	-.24864	.10226	-.4500	-.0472
Equal variances not assumed			-2.164	65.38	.034	-.24864	.11488	-.4780	-.0192

Table - 35

Group Statistics

	Gender of the Teacher	N	Mean	Std. Deviation	Std. Error Mean
MTA score	Male	193	2.2635	.58375	.04202
	Female	49	2.4600	.79205	.11315

Table - 36

Independent Samples Test for Gender of the Teacher

MTA score	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	7.764	.006	-1.94	240	.053	-.19652	.10093	-.3953	.0023
Equal variances not assumed			-1.62	61.85	.109	-.19652	.12070	-.4378	.0447

Table - 37

Group Statistics

	School Location of the Teachers	N	Mean	Std. Deviation	Std. Error Mean
PMA score	Urban	142	2.1555	.58255	.04889
	Rural	100	2.2500	.72552	.07255

Table - 38

Independent Samples Test for School Location of the Teachers

PMA score	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	5.04	.026	-1.12	240	.263	-.09448	.08425	-.2604	.0714
Equal variances not assumed			-1.08	182.84	.282	-.09448	.08749	-.2670	.0781

Table - 39

Group Statistics

	School Location of the Teachers	N	Mean	Std. Deviation	Std. Error Mean
MTA score	Urban	142	2.2844	.59450	.04989
	Rural	100	2.3300	.68970	.06897

Table - 40

Independent Samples Test for School Location of the Teachers

MTA score	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.938	.33	-.55	240	.583	-.04560	.08296	-.2090	.1178
Equal variances not assumed			-.53	192.67	.593	-.04560	.08512	-.2134	.1222

Table - 41

Group Statistics

	professional education	N	Mean	Std. Deviation	Std. Error Mean
PMA score	Bed or Med	178	2.2018	.61255	.04591
	None	64	2.1745	.73504	.09188

Table – 42

Independent Samples Test for professional education

PMA score	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	2.59	.10	.290	240	.772	.02730	.09429	-.1584	.2130
Equal variances not assumed			.266	96.25	.791	.02730	.10271	-.1765	.2311

Table - 43

Group Statistics

	professional education	N	Mean	Std. Deviation	Std. Error Mean
MTA score	Bed or Med	178	2.3051	.61080	.04578
	None	64	2.2981	.70161	.08770

Table - 44

Independent Samples Test for professional education

MTA score	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.95	.32	.076	240	.940	.00702	.09268	-.1755	.1895
Equal variances not assumed			.071	99.38	.944	.00702	.09893	-.1892	.2033

Table - 45

Group Statistics

	Training in mathematics	N	Mean	Std. Deviation	Std. Error Mean
PMA score	Yes	111	2.0278	.40923	.03884
	No	131	2.3359	.76641	.06696

Table – 46

Independent Samples Test for Training in mathematics

PMA score	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2 tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	28.30	.000	-3.80	240	.000	-.30810	.08107	-.4678	-.1484
Equal variances not assumed			-3.98	204.79	.000	-.30810	.07741	-.4607	-.1554

Table - 47

Group Statistics

	Training in mathematics	N	Mean	Std. Deviation	Std. Error Mean
MTA score	Yes	111	2.1767	.43199	.04100
	No	131	2.4105	.75058	.06558

Table - 48

Independent Samples Test for Training in mathematics

MTA score	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	21.582	.00	-2.89	240	.004	-.23374	.08064	-.392	-.074
Equal variances not assumed			-3.02	213.03	.003	-.23374	.07734	-.386	-.081

Table – 49

Group Statistics

	Subject at degree level	N	Mean	Std. Deviation	Std. Error Mean
PMAscore	degree with math	120	2.0076	.36747	.03355
	degree without math	122	2.3784	.79304	.07180

Table - 50

Independent Samples Test for Subject at graduation level

PMA score	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	48.536	.00	-4.65	240	.000	-.37078	.07968	-.5277	-.2138
Equal variances not assumed			-4.67	171.29	.000	-.37078	.07925	-.5272	-.2143

Table - 51

Group Statistics

	Subject at degree level	N	Mean	Std. Deviation	Std. Error Mean
MTA score	degree with math	120	2.1359	.41307	.03771
	degree without math	122	2.4678	.76102	.06890

Table - 52

Independent Samples Test for Subject at graduation level

MTA score	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	29.01	.000	-4.20	240	.000	-.33195	.07890	-.4873	-.1765
Equal variances not assumed			-4.22	187.25	.000	-.33195	.07854	-.4868	-.1770