MATHEMATICAL ANXIETY AMONG HIGH SCHOOL STUDENTS IN RELATION TO THEIR ACHIEVEMENT IN MATHEMATICS

A

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"SCHOOL STUDENTS IN RELATION TO THEIR ACHIEVEMENT IN MATHEMATICS"

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NA	Numerical Anxiety
MTA	Math Test Anxiety
MAS	Mathematical Anxiety Scale

ABSTRACT

Math anxiety is worry or fear about solving math problems. It is not a distinct medical condition, but a way of describing anxiety that occurs in a specific situation. A person with math anxiety may feel anxious any time they have to use math skills, from classes at school to calculating a restaurant bill. It is also known as Math Phobia. It is a feeling of tension and anxiety that interferes with the manipulation of numbers. Math anxiety or a fear of math is common, and although it can limit performance in certain situations and contexts, it's not linked to intelligence or ability. So, in this context the present study has been conducted to examine the mathematical anxiety among high school students in relation to their achievement in mathematics. The present descriptive study is quantitative in nature. A standardized tool namely Mathematical Anxiety Scale-India by Karimi and Venkatesan (2011) has been used in the study. The tool contains 36 items comprising two factors (17 items of Math Test Anxiety & 19 items of Numerical Anxiety). A sample of 250 students studying in ninth class has been selected through Simple Random Sampling Technique. The data collected were analyzed by using Percentage and Pearson's Coefficient of Correlation. With the help of SPSS, results of the study revealed that there is no significant relationship between mathematical anxiety and their achievement in mathematics in relation to their gender and residential background for both the factors. But there is a significant negative correlation between mathematical anxiety and their achievement in mathematics in relation to their economic status for the factor Math Test Anxiety of high economic status students.

CHAPTER-I

INTRODUCTION

1.1 INTRODUCTION

Mathematics is the main subject in secondary schools. The study of mathematics was initiated to produce an efficient person who is able to apply knowledge of mathematics in everyday life effectively and responsibly in solving various problems and making decisions. Weaknesses among students in learning mathematics in this discipline will affect the efforts of various sectors in making Malaysia a fully developed nation by 2020. Mathematics anxiety is a psychological dimension of learning that is crucial for educators to identify. Much research has been done to investigate the extent of mathematics anxiety in primary school (Sherman & Wither, 2003; Jackson & Leffingwell, 1999; Steele & Arth, 1998; Yüksel-Şahin, 2008) and at the secondary level (Mohamed & Tarmizi, 2010; Karimi & Venkatesan, 2009; Khatoon & Mahmood, 2010). Research has shown that mathematics achievement in students is influenced by psychological factors such as mathematics anxiety. There have been nearly 20,200 previous studies related to MA or math performance (Olmez and Ozel, 2012; Necka et al., 2015; Lukowski et al., 2016; Justicia-Galiano et al., 2017), while few systematic studies focus on exploring the math anxiety-performance link during the previous 19 years. Two previous meta-analyses that were conducted 30 or 40 years ago concluded that there was a small but robust negative math anxiety-performance link in students (Hembree, 1990; Ma, 1999). However, for Ma's review, only 26 studies were included for which students originated from elementary and secondary schools. For Hembree's review, the analysis did not focus on the math anxiety-performance link. Therefore, to guide future studies in math education, an up-to-date meta-analysis exploring the math anxiety-performance link in recent years is needed.

Mathematics Anxiety and Gender

Karimi and Venkatesan (2009), Khatoon and Mahmood (2010) argued that females have higher mathematical anxiety than males. Several studies have been examined to explore the level of mathematical anxiety between male and females. In addition,

female students are often labeled as shy and this characteristic can harm their ability to learn. Male students were found to be more active in a wider range of social activities than female students (Khatoon and Mahmood, 2010). Yuksel-Şahin (2008) study on secondary school students in Turkey reported that the stereotypical view of this issue has a powerful impact. Female students believed boys were blessed with the advantage of mastering mathematics, while the boys felt they were better able to perform in mathematics when compared with their female counterparts. Such beliefs negatively affect the ability of female students and their initial assumptions about mathematics achievement can have a long-term impact on their math achievement. However, other studies do not support this theory. Based on several studies, some researchers have argued that there is no significant difference in mathematics anxiety between males and females (Marsh and Tapia, 2002; Elenchothy, 2007; Mohamed and Tarmizi, 2010). According to Arem (2009), mathematics anxiety is an emotional, mental and physical act related to the mathematical thinking and problem-solving process and resulting from uncomfortable past experiences related to mathematics.

We should acknowledge that the importance and fundamental role of mathematics is undeniable in the history of scientific thought, and even in the course of industrialization and technological developments. However, "mathematics anxiety" is one of the factors, which can be a hindrance on the way of studying mathematics, and positive factors associated with it. More than four decades have passed since the first time the term "mathematics anxiety" has entered into the glossary of psychology terms. During this period, although a more clear perspective has been achieved, there is a long way to understand the structure and its dynamics thoroughly (McCoy 1992; quoted from Shokrani, 2002). "Mathematics Anxiety" is a psychological status, which comes forth in people when dealing with mathematical content whether in teaching and learning situations or in solving mathematical problems and assessing the mathematical behavior (Alam al-Hoda, 2000). Although for many years researchers have investigated the causes of mathematics anxiety, there has not been presented any integrated approach in math anxiety development. Environmental factors have a high impact on human personality development "ego" or its meaning, which is one of the main dimensions of human personality that is influenced by environmental factors. Therefore, the present study aims to address the relationship between the students' mathematics anxiety and their self-esteem and the personality characteristics of their

math teachers. Sherman and Elizabeth Fenma, 1998, indicated in a research that the lack of sufficient background in mathematics to do mathematical activities and low self-esteem in mathematics will reinforce math anxiety. Vayne and colleagues (2004) showed in research that math anxiety is one of the most serious limitations for training, so that it could cause a fear of working with numbers, or understanding of mathematical theories aims (theoretical support) and solving practical problems in everyday life. In a research conducted by Paeinkerton (2005), it became clear that math anxiety develops in children before school by parents and in school by teaching methods. Although many scientists have defined "math anxiety" as irrational and unreasonable fear, in fact, what happened is a real fear resulting from past mathematical experiences (such as learning styles, past experience, teachers personality, poor books, teachers attitudes, classroom environment, time limitations, self-esteem and image that students have from their abilities in math learning as well as the stress and pressures parents and teachers put on students). In another study conducted by Leily Abadi (2004) the results of multivariate analysis of variance (MANOVA) showed that there was a significant difference between girls' and boys' mathematics anxiety, and mathematics anxiety in boys is higher than that of girls. The present study was performed with the aim of determining the level of mathematics anxiety among high school students and its relationship with the students' self-esteem and personality traits of math teachers. Mathematics anxiety is a problem for many people. It can occur in all levels of education from primary school to higher education, and once established, can persist in life, interfering with everyday activities involving numeracy and further learning in mathematics (Oxford & Vordick, 2006). Many students who suffer from math anxiety have little confidence in their ability to do mathematics and tend to take a minimum number of required mathematics courses, greatly limiting their career choice options. This is unfortunate especially as society becomes more reliant on mathematical literacy (Scarpello,2005).

In recent years, mathematics anxiety has emerged as a common phenomenon experienced between primary school students and university students (Peker & Şentürk, 2012). The anxiety, which is a feeling gained through the conditioning of learning-oriented theories, sometimes encourages people to engage in creative-constructive behavior with impulse and in some cases prevents such behaviors (Dursun & Bindak, 2011). Mathematical thinking ability; students to receive

information systematically, make logical predictions, reasonable and accurate comparisons and can make inferences. Therefore, it can be said that the success of the students in the mathematics course will contribute positively to the other courses. In addition, mathematical skills are one of the keys to the success of students in their daily lives (Alkan, 2011). However, the fact that mathematical concepts are abstract and can not be related to daily life by students, and the lack of qualified learning-teaching environments in mathematics education make it difficult to learn the subjects of mathematics, which leads to negative emotions towards mathematics in students (Aydın & Keskin, 2017). An interesting subject for mathematicians and mathematics educators is mathematics anxiety; Richardson and Suinn (1972) describe the use of numbers in daily life and academic studies and the sense of tension and anxiety that prevents the solution of mathematical problems. It is stated that mathematics anxiety may prevent their mathematics achievement among students and cause tensions in daily tasks such as counting money, checking bank accounts, evaluating sales prices, and sharing workload among students (Richardson & Suinn, 1972). Mathematics anxiety is a multi-faceted structure and is intertwined with concepts such as fear, contemplation and uneasiness (Baloglu, 2001). Davarcıoğlu (2008), in his research on the fear of mathematics, explained fear as a feeling of excitement, and fear turned into bodily reactions, such as trembling, flushing, not breathing, heart palpitations, fainting, and so forth. He also stated that mathematical anxiety was the result of his being physically exposed to situations. Aydin et al. (2009) stated that anxiety was a threatened state of fear and tension, and that it was a result of conflict and prevention in individuals, most of the time they stated that they reflect an unknown internal tension and uneasiness. It is stated that mathematics anxiety, which is a disturbing situation on the students, causes the student to be afraid of the course, not to participate in the activities related to the course in time, to decrease the rate of learning with the increase of panic and uneasiness and to hate the mathematics in a continuous failure (Alkan, 2010). Anxiety is defined as a state of uneasiness and anxiety felt by the individual in a general threatening situation (Scovel, 1991; Isık, 1996). Despite its negative aspects, anxiety has stimulating, protective and motivating characteristics of the organism. Persons who prepare themselves against injury, pain, punishment, separation and frustration are the examples that can be given to the motivating characteristics when the anxiety is stimulating and taking precautions, and if it is negative, it is easier to overcome the fear of being protective and unsuccessful.

Because of these characteristics, Allwright and Bailey (1991) argue that anxiety is not really a feeling to be avoided. Anxiety is often described as a feeling of discomfort (Başarır, 1990). A normal level of anxiety can help people to feel desire, to make decisions, to generate energy in line with the decisions taken, and to improve their performance using this energy. For example, a mid-level concern for a conference helps us better prepare for this conversation and perform better. In cases where we have no anxiety, the result is usually negative, since there is no desire to do the job to be done as well as we can. However, if the anxiety is very intense, it prevents the person from using his / her energy efficiently and directs his / her attention and power to the work he / she will do. The person can not use the full potential and reach the desired performance (Dursun & Bindak, 2011). The main source of anxiety in students is the fear of failure and the loss of self-respect that comes with it. Anxiety can adversely affect students' performance in a number of ways. Anxious students may have difficulty in learning and have difficulty in transferring and using their knowledge. The most common form of anxiety that makes the individual powerless is mathematics anxiety (Pintrich & Schunk, 2002). It is also wrong to link the emergence and development of mathematics anxiety only to the student or the nature of mathematics. Factors such as the working conditions of the student at home and the learning environments in the school, the socio-economic status of the family and the level of education, teacher behaviors, and the quality of teaching are among the factors affecting the mathematics anxiety (Taylor & Fraser, 2003). The fear and anxiety of mathematics begin from the first years of student life. Mothers and fathers can be the model by transferring their fears to their children consciously or unconsciously. Parents, who are models, say that mathematics is difficult, people are afraid of mathematics, while at the same time they say that mathematics skills are very important for a person to be successful in the future (Thomas, 1998). In many studies on the effects of mathematics anxiety, the results of mathematical anxiety of individuals with mathematics anxiety, mathematical success, avoidance of mathematics courses, limitation of career and career choices, guilt and shame were reported (Byrd, 1982; Erktin et al., 2006; Ma, 1999; Richardson & Suinn, 1972; Suinn & Edwards, 1982; Tobias & Weissbrod, 1980). The relationship between mathematics anxiety and mathematics achievement could not be clearly stated in the literature (Baloglu, 2004a; Reyes, 1984). Although many studies have found a negative relationship between these two variables (Hembree, 1990; Ma, 1999; Miller &

Bichsel, 2004; Reyes, 1984; Suinn & Edwards, 1982; Tobias & Weisbrod, 1980), some studies have not shown a remarkable relationship (Fennema & Sherman, 1976; Richardson & Suinn, 1972). Especially in previous mathematics lessons, performance, mathematics attitude and mathematical self-concept are controlled, and the effect of mathematics anxiety is meaningless or diminished (Fennema & Sherman, 1976). Although mathematics is a lesson that is faced by students at almost every level from primary to university, it is perceived as a difficult lesson to be learned by many students.

Mathematical Anxiety and Achievement

According to Sherman and Wither (2003), a five-year study conducted on students from the age of 6 years to the age of 10 years revealed that the level of mathematics anxiety in students is strongly related to student achievement. This is supported by studies by Elenchothy (2007), which showed an inverse relationship between mathematics anxiety and student achievement. His findings were based on the results of Lower Secondary Assessments for students in the district of Klang, Malaysia. This inverse relationship means that students with high mathematics anxiety will realize low achievement in mathematics. The results conform to the findings of Khatoon and Mahmood (2010); Yüksel-Şahin (2008) and Satake and Amato (1995). Students will often feel worried, tired and afraid or feel that mathematics is not important and will generally refuse to learn mathematics, even though it is the primary gateway to engineering, science and technology. According to Arem (2009), students with high mathematics anxiety levels engage in negative thinking about their self ability. These students will exhibit less confidence in working with numbers and mathematical concepts through a problem-solving process. Zakaria (1997) also explained that students with high-performance levels in mathematics have a positive attitude toward mathematics. This is in line with various researchers who reported that teachers' interest and self-confidence play an important role in student success.

Mathematics achievement is seen as an important factor in the professional development of students (Olkun et al., 2005). It is seen that student and teacher candidates and even teachers have negative attitudes towards mathematics and that mathematics is perceived by many individuals as an area that is difficult to teach and learn (Delice et al., 2009). There is an important role for students to develop positive

attitudes towards mathematics lessons and to increase their success (Peker & Mirasyedioğlu, 2003). Mathematics anxiety was defined as feeling anxiety and tension in daily and academic life by solving mathematics problems and using numbers (Bindak, 2005b). Mathematics anxiety is a vital phenomenon of vital importance from primary to university (Newstead, 1998; Yüksel-Şahin, 2008; Vinson, 2001; Uusimaki & Nason, 2004). In a significant part of the studies on mathematics anxiety, the factors that cause anxiety were determined and classified. According to Lazarus (1974), mathematics anxiety is a concept that arises from the interaction of many factors. Berebitsky (1985) showed that teachers who are not proficient in mathematics, who have mathematics anxiety, abstract, symbolize, and mathematical rules are among the factors that make up the mathematics anxiety. Harris and Harris (1987) categorized the factors that could lead to mathematics fear and anxiety on three main axes: student-related, teacher-related and teaching-related (cited in: Baloğlu, 2001), Byrd (1982) explained the causes of mathematics anxiety; classified as situational, personality and personal reasons. The teaching methods used in mathematics education and the effects of mathematics teachers on students; attitude towards mathematics, personality reasons; gender, age and ethnicity can be given as examples of personal reasons (Baloğlu, 2001). As a result of the literature review, it is seen that mathematics anxiety is an important affective factor closely related to many subjects ranging from attitude towards mathematics to success, from avoiding mathematics to career and career choice. In this context, it is important to determine the mathematics anxiety levels of the students and to examine them according to various variables.

1.2 NEED AND SIGNIFICANCE OF THE STUDY

Research has shown that mathematics achievement in students is influenced by psychological factors such as motivation, social competence, self efficacy and mathematics anxiety. Among all these factors mathematical anxiety has been found to be correlated with the achievement in mathematics. Whyte and Anthony (2012) explain mathematics anxiety as the actual situational stress experienced that is specific to personally stressful or fearful circumstances. Research also notes that math anxiety can affect individuals in varying ways, inducing cognitive, affective, or physical reactions. Mathematics anxiety can present itself in a variety of ways. It can

present as a dislike of mathematics or as a worry or pure fear (Wigfield & Meece, 1988; Hart, 1989) due to external pressures placed on a person, such as in a testing situation (Ma, 1999; Krinzinger et al., 2009; Sheffield & Hunt, 2006; Wilson, 2013). Research by Fulya (2008), Elenchoty (2007), Puteh and Khalin (2016), Salwani (2001), Arem (1993) and Tobias (1980), has shown that mathematics anxiety has become one of the factors contributing to the decline of the mathematical achievements of the students. The purpose of the study has been shown to determine mathematics anxiety and mathematics achievement among high school students in Jammu. The proposed study would be helpful for the teachers, teacher educators, students, administrators and policy makers for bringing desirable changes in the education system especially with reference to mathematics education.

1.3 STATEMENT OF THE PROBLEM

'MATHEMATICAL ANXIETY AMONG HIGH SCHOOL STUDENTS IN RELATION TO THEIR ACHIEVEMENT IN MATHEMATICS'.

1.4 OPERATIONAL DEFINITIONS

Mathematical Anxiety: The panic, helplessness and mental disorganization that arises among some people when they are required to solve mathematical problems. In this study, mathematical anxiety refers to scores obtained on *Mathematics Anxiety Scale* (MAS-KAVS) developed by Karimi and Venkatesha (2011).

High school students: High school students in this study refers to the students studying in Ninth class in high schools.

Achievement in mathematics: Achievement in mathematics refers to the marks obtained by students in the subject Mathematics in 8th class annual examination.

1.5 OBJECTIVES OF THE STUDY

1. To study the level of mathematical anxiety among high school students.

2. To study the level of achievement in mathematics of high school students.

3. To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their gender with respect to two factors (Math Test Anxiety and Numerical Anxiety) as well as overall scores on Mathematical Anxiety Scale.

4. To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their residential background with respect to two factors (MTA and NA) as well as overall scores on Mathematical Anxiety Scale.

5. To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their type of family with respect to two factors (MTA and NA) as well as overall scores on Mathematical Anxiety Scale.

6. To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their economic status with respect to two factors (MTA and NA) as well as overall scores on Mathematical Anxiety Scale.

1.6 HYPOTHESES OF THE STUDY

1. There is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their gender.

2. There is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their residential background.

3. There is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their type of family.

4. There is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their economic status.

1.7 DELIMITATION OF THE STUDY

- The study has been delimited to 250 students studying in 9th class from 11 high secondary schools located in Jammu district.

CHAPTER-II

REVIEW OF THE RELATED LITERATURE

2.1 INTRODUCTION

Mathematical anxiety is a situation that happens to some people when facing a mathematical problem. Good feeling towards mathematics brings a good perception about mathematics, and vice versa. Emotions play the most important part in this situation. According to Wondimu et al. (2012) in their study, the uneasy feeling such as panic, cluelessness and helplessness when working on something related to mathematics tends to affect the mathematical performance especially for students. They also found that mathematical self-concept and mathematical anxiety are reciprocally related. Prima et al. (2010) had listed that mathematics anxiety among engineering students manifested such as feeling mathematics is a difficult subject, always failing in mathematics, always writing down in mathematics class, anxious if they don't understand and lost interest in the subject of mathematics. In addition, Kiamanesh (2004) has conducted research on the factors affecting Iranian student's achievement in mathematics. He found out that mathematics self-concept, home background, teaching, and attitude towards mathematics were the most important factors that affected the student's achievement. The early study related to mathematical anxiety was carried out by Richardson and Suinn (1972) who developed a scale measurement called MARS (Mathematics Anxiety Rating Scale) specifically to measure mathematics anxiety.

2.2 REVIEW OF RELATED LITERATURE

A review of related literature (RRL) is a detailed review of existing literature related to the topic of a thesis or dissertation. It involves the systematic identification, location, and analysis of documents containing information related to the research problem. The term is also used to describe the written component of a research plan or report that discusses the reviewed documents. Conducting a literature review establishes your familiarity with and understanding of current research in a particular field before carrying out a new investigation. Review of related literature generates an actual image in front of the researcher about the work that has been carried out in the arcs of

investigation to be taken up by the researcher. Survey of related literature helps in avoiding duplication, guides in carrying out the investigation successfully and makes the researcher familiar with the steps involved in it. It enables him to know the means of getting to the frontiers in the field of his/her research. Unless one has learned what others have done and what still remains to be done, one cannot develop a research project. It will contribute something to the knowledge existing in this field.

Review of related literature provides ideas, theories, explanations or useful hypotheses available for formulating problems and valuable suggestions for significant investigation like method, tried techniques and comparative data useful in the interpretation of results. It stimulates and encourages the investigator to go deep into various aspects of the problem. It forms the formulation upon which all future work will be built. The current research is integrally connected with the past research. This survey could help the researcher in analyzing research in the field of education.

STUDIES CONDUCTED ON MATHEMATICAL ANXIETY AND ACADEMIC ACHIEVEMENT

Woodard (2004) determined the differences in math anxiety scores are related to gender or age, and if there is a relationship between math anxiety scores and achievement scores. A total of 125 developmental math students (33 males, 92 females) from Southwest Virginia Community College participated in the study. Pearson's Product Moment Correlation and *t*-Test were used to analyze the data. A negative relationship between math anxiety and math achievement has been found across all grade levels. In early grades, there is no significant difference in the mathematics anxiety experienced in either gender, but females exhibit more mathematics anxiety in secondary school and in college.

Noordin and Zakaria (2008) investigated the effects of mathematics anxiety on matriculation students as related to motivation and achievement. Subjects included 88 students who were at the end of their second semester of study. Anxiety and motivation were measured using the *Fennema-Sherman Math Anxiety Scale (MAS)* and *Effectance Motivation Scale (EMS)* respectively. The instrument used to measure achievement was the *Mathematics Achievement Test (MAT*). The ANOVA results showed that the mean achievement scores and motivation scores of low, moderate and

high anxiety groups were significantly different. Findings also revealed a low (r=-0.32) but significant ($p< 0.05$) negative correlation between mathematics anxiety and achievement and also a strong (r=-0.72) significant ($p<0.05$) negative correlation between mathematics anxiety and motivation. The study also revealed a significant low positive correlation (r=0.31) between motivation and achievement.

Yuksel (2008) investigated whether students' mathematics anxiety differed significantly according to a group of variables such as gender, grade level, liking mathematics class, liking mathematics teacher, holding gender stereotypes about performance in mathematics and achievement in math. A total of 249 students (4th and 5th graders) participated in the study. *The Mathematics Anxiety Scale* for elementary school students' and the personal information form were used for data collection. Independent Sample *t*-Test, One-Way ANOVA and Scheffe Test were used to analyze the data. Results showed that students' mathematics anxiety differed significantly according to gender, whether they liked mathematics class or not, whether they linked their mathematics teachers or not and the achievement level in mathematics. Female students reported significantly higher mathematics anxiety than males.

Emin., et al. (2009) explored the mathematics anxiety levels of primary school student teachers with regard to variables including gender, grade level, the type of high school and the university that they graduated from. The data collection tools are the *Mathematics Anxiety Scale* and the personal information form. The sample comprised 219 student teachers of primary school and mathematics student teachers from two universities in Turkey. Thus the findings suggest significant differences in regard to the variables under study which were discussed under the light of the existing international literature.

Venkatesan (2009) investigated the relationship between mathematics anxiety, mathematics performance and Academic hardiness in high school students. The sample comprised 284 (144 males and 140 females) 10th grade high school students from Karnataka state. Pearson correlation analysis and two independent sample *t-Tes*t are used to analyze the data. The results have revealed that mathematics anxiety has significant negative correlation with mathematics performance but no significant correlation is detected with academic hardiness. It is also found that the gender differences in mathematics anxiety are significant, whereas no significant differences

are detected between boys and girls in mathematics performance and academic hardiness. This study found that the performance of students in mathematics can be perceived by mathematics anxiety and females scored slightly higher on this variable but this relation has not been observed with academic hardiness.

Zakaria, Zain, Ahmad and Erlina (2012) studied the relationship between mathematical anxiety and mathematics achievement of students. The study includes 195 students in which 86 were males and 109 were females. The tool used to measure differences was the *Fennema-Sherman Mathematics Attitude Scale.* The data was examined to determine the mean, frequency, *t*-Test and One-Way-ANOVA. There was no significant difference in mathematics anxiety levels among male and female students. The ANOVA test reports that there were significant differences in achievement based on the level of mathematical anxiety. Students who are high achievers have lower levels of anxiety, while low achieving math students have high levels of anxiety.

Hosseini and Khazali (2013) compared the levels of anxiety in male and female students at Tehran elementary schools. For this, 1200 students (600 girls and 600 boys) at middle schools were selected using the random cluster sampling method and tested with *Reynolds and Richmond's Anxiety Scale.* Results of data analysis suggested that female students scored higher in the subscales of anxiety and worry than male students and there is a significant difference in the 95 percent level of confidence between girls and boys and a significant difference was observed between girls and boys.

Kundu and Kar (2018) explored the relationship of mathematical anxiety with the achievement of secondary school students. The study employed a descriptive survey method. The Sample of the study were 310 students of the 10 the grade selected from Purulia district in West Bengal. The data was analyzed by using *t*-test and Pearson correlation. Analysis of the '*t*' test results for gender show that there is no significant difference of anxiety towards mathematics between boys and girls students and rural students are significantly more math anxious than urban students. The correlation test showed a significant and negative relationship between student's mathematics achievement and their mathematics anxiety with correlation value r = -0.667.

Alam and Halder (2018) examined the relation between mathematics anxiety and socioeconomic status of the secondary students with respect to their gender and locality. The researchers applied *Math Anxiety Scale (Bengali medium)* and *Socio-Economic Scale* developed by Halder on 320 students, randomly selected as the sample of the study from secondary schools of Dakshin Dinajpur District in West Bengal. The study reported that there is significant negative correlation between mathematics anxiety and socioeconomic status of the both male and female secondary school students.

Prakash, Rani and Satnarain (2018) explored the mathematical anxiety of 10th class students in relation to their academic achievement. For this study, *Mathematics Anxiety Test* was distributed to 220 students in which 110 boys and 110 girls were given and instructions were given to them for completing the questionnaire and descriptive survey method was used. Results show that boys having high mathematics anxiety have more academic achievement as compared to boys having low mathematics anxiety. There exists a positive correlation between academic achievement and mathematics anxiety of boys & girls of 10th class students.

Macmull and Ashkenazi (2019) studied to examine the direct and indirect influences of parenting styles, math self-efficacy, and the participants' sex on math anxiety. The research population (N = 204) included randomly selected participants, whose native language is Hebrew and were born in Israel. The participants were surveyed about four measures that served as the research tools. They answered questions about demographics, math anxiety, and the parenting style of the child's mother and about math self-efficacy. The results concluded that there were strong correlations between the authoritarian parenting style and math anxiety. The authoritative parenting style had both a direct positive correlation and an indirect negative correlation on math anxiety. This is in contrast to the permissive parenting style which was exclusively found to have a small positive correlation on math anxiety. The participant's sex had both direct and indirect influences on math anxiety. Math anxiety levels, as well as the negative effects of self-efficacy on the level of math anxiety, were higher in females compared to males.

Ambaranti and Retnowati (2019) explored the different student's mathematics anxiety related to gender, school grade, and programs among senior high school students. The

data were obtained from mathematics anxiety questionnaires for 215 students from Bengkulu, Pasaman, Bogor, and Yogyakarta in Indonesia. The data analyzed descriptively and inferentially. The results indicated that high school students had moderate mathematics anxiety. The male students had lower mathematics anxiety than female students, but no significant mean difference. The 12th grade students had higher mathematics anxiety, followed by the 10th and 11th respectively. There is a significant difference in the mean scores of mathematics anxiety based on grade students between the 10th and 11th grade students. It can be concluded that the 11th grade students were more positive in dealing with things related to mathematics. Students at the Social Program had higher mathematics anxiety, but no more significant than Science Program and Chemical Industry Program.

Akbayır (2019) investigated the anxiety levels of high school students towards mathematics lessons according to gender. A total of 89 ninth grade students (29 females and 60 males) from various high schools were enrolled in Van province center in the 2017-2018 academic year. In the study, the data were collected by using the developed "Mathematical Anxiety Scale" of the researcher. In the analysis of the collected data, frequency and percentage values were taken and an independent sample t test was used. According to the results of the study, high school students' mathematics anxiety levels were at medium level. In addition, there were no statistically significant differences in the anxiety levels of female and male students.

Altakhayneh (2020) investigated whether student anxiety about the subject of mathematics has any effect on the achievement of middle-school students in Amman, Jordan. It also aims to investigate whether student gender plays a role. The study sample consists of 180 seventh grade students enrolled in Amman public schools during the 2018/2019 academic year. These are distributed into three levels of anxiety as displayed by the students: low, middle, and high. Then, math anxiety measurements are collected, the validity and reliability for which are verified. The results reveal that there are statistically-significant differences in achievement between the middle level of math anxiety and the two other extremes. It is found that middle anxiety levels have a positive effect on achievement, whereas for low and high math anxiety levels, no differences in achievement are perceived. In addition, no statistically significant differences ($\alpha \leq 0.01$) were found between males and females

with regards to math anxiety; and there is no interaction between the level of math anxiety and gender in achievement.

Kumar and Srivastava (2021) assessed mathematical anxiety and its effect on a set of independent variables (gender, school board, fathers' qualification, mothers' qualification and with respect to their types of family). For this study the researcher has adopted a survey method. The tool used for the data collection was *Mathematics Anxiety Scale* (MAS) developed by Mahmood and Khatoon. Tool was administered on 195 secondary school students drawn randomly from two schools of Patna. For the analysis of data, mean, standard deviation and *'t'* test were used. Results found that there is no significant difference in mathematical anxiety of students with respect to their gender, school board, fathers' qualification and with respect to their type of family.

Luu Thi, et al. (2021) investigated the relationship between mathematics anxiety and gender, grade, career choices, and academic achievement in Grade 10, 11, and 12 students. This study used the Revised Version of the Mathematics Anxiety Rating Scale to survey 1,548 high school students (570 males and 978 females) from high schools in Vietnam. A multivariate analysis of variance (MANOVA) test, Pearson correlation and multiple linear regression were used to analyze data. The results show that there are significant differences in the influence of grade, academic achievement, and students' career choices on mathematics anxiety. Academic coping strategies, gender, grade, and career choices are significant predictors of mathematics anxiety. Grade 12 students have higher levels of mathematics anxiety than others. Students with high average mathematics scores (9.0–10.0) have higher levels of mathematics anxiety than students with lower scores. Besides, students choosing finance and economics or industrial engineering to pursue into higher education also experienced higher levels of mathematics anxiety than others. This study contributes to the general discussion about the nature of mathematics anxiety and the relationship between mathematics anxiety and academic achievement.

Pollack et al. (2021) examined the relations between anxiety, motivation, and competence in mathematics and reading, within and across domains, in an academically-diverse set of 8–13-year-old learners (n = 146). Participants completed standardized assessments of mathematics and reading, anxiety and motivation surveys

for math and reading, and a measure of nonverbal cognitive ability. Results showed high internal consistency for all anxiety and motivation scales (Cronbach's alpha = 0.76–0.91). Pearson correlations showed that within and across domains, participants with higher competence had lower anxiety and higher motivation. Higher anxiety was also associated with lower motivation. Regression analyses showed that for both math and reading, within-domain motivation was a stronger predictor of competence than anxiety.

Escaraz and Ching (2022) studied utilization of the descriptive-correlational research design to test how the math anxiety and mathematics are connected to each other. Forty-two (42) Grade 7 students participated in the study during the school year 2020-2021. It used a researcher-made survey questionnaire on math anxiety and an examination on mathematical representations through modular learning. The math anxiety is indicated by mathematics test anxiety and numerical anxiety both with ten statements. Meanwhile, the examination was focused on the different components of mathematical representation such as pictures, manipulative models, written symbols, real-world situations and oral language. The result showed that students have a high level of anxiety towards mathematics. Although students experience high levels of test and numerical anxiety, their mathematical representations examination showed a 'developing' level of performance. These two inverse results were supported by a no significant relationship between the math anxiety and students' performance in mathematics.

Mitchell and George (2022) investigated the prevalence of mathematics anxiety among 62 fourth and sixth grade primary level students (aged nine to 12 years). The results indicated that the prevalence of mathematics anxiety was high among the sample of grade four students while the prevalence rate was considerably lower among the sample of sixth graders. Small, non-significant positive and negative correlations were recorded between mathematics performance and mathematics anxiety for grade four and six students, respectively. The data relating to mathematics anxiety and mathematics performance were collected using the modified abbreviated math anxiety scale (mAMAS) and a teacher-made mathematics test, respectively. Gender differences relating to mathematics anxiety were also non-significant.

Hendral and Hidayati (2023) assessed the correlation between self-efficacy and mathematics anxiety. Data conducted from 46 studies (n= 48447), found a small-to-large, negative and positive and significant correlation between self-efficacy and mathematics anxiety. Based on analysis using the random-effect model concluded that there was a significant negative relationship between self-efficacy and mathematics anxiety. The results showed that the higher self-efficacy, the lower mathematics anxiety.

2.3 CONCLUSION

Mathematics anxiety is a psychological dimension of learning that is crucial for educators to identify. It is defined as a feeling of tension and apprehension that interferes with math performance ability, the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations. From the above studies it is clear that mathematical anxiety and achievement in mathematics are significantly correlated to each other (Woodard, 2004; Noordin & Zakaria, 2008; Yuksel, 2008; Venkatesan, 2009; Prakash, Rani & Satnarain, 2018; Macmull & Ashkenazi, 2019; Altakhayneh, 2020; Hendral and Hidayati 2023). Studies by Kumar and Srivastava (2021); Zakaria, Zain, Ahmad and Erlina (2012); Woodard (2004); Akbayır (2019); Luu Thi (2021); Escaraz & Ching (2022); Mitchell and George (2022) reported no significant gender difference in mathematical anxiety among high school students.

CHAPTER-III

RESEARCH METHODOLOGY

3.1 INTRODUCTION

Research methodology is a systematic way to solve a problem. Essentially, the procedure by which researchers go about their work of describing, explaining and predicting phenomena is called research methodology. Its aim is to give the work plan of research a logical direction. It is necessary for a researcher to design research methodology for the selected problem. It is important for the researcher to know not only the research tools necessary for the research undertaken but also the methodology. Research methods are of utmost importance in a research process. They indicate the various steps to be adopted for solving a research problem.

The decisions about the method or methods to be employed always depend upon the nature of the problem selected and the kind of data necessary for its solution. Whatever the method to be employed, it is essential that it should be described otherwise it will lose its significance and effectiveness. Thus, if the method methodology cannot be clearly described, chances are that the results of the study will be vague and general. The present chapter throws light on the research methodology being adopted for the present study. Here the design of the study i.e. sample for the study and collection of the data and statistics used for analyzing the data are discussed.

3.2 DESIGN OF THE STUDY

The design of the research is the actual blueprint of the procedure for the completion of various research steps and thus reaching valid conclusions. A well conceived, adequately planned and executed design helps greatly in permitting to rely both on observations and inferences.

3.2.1 Method

Research methods are the strategies, processes or techniques utilized in the collection of data or evidence for analysis in order to uncover new information or create better

understanding of a topic. In view of the objective of the present study, the descriptive survey method was used. In this method a detailed description of the existing phenomenon is collected with the intent of employing data to justify current conditions and practices or to make intelligent plans for improving them. It is used to collect factual information to help the researcher to insight the objectives of research that involves the use of a variety of questions for collecting data.

3.2.2 Population

A research population is also known as a well defined collection of individuals composed of people with common characteristics. Population refers to any collection of specified groups of human beings such as objects, educational institutions, time units and geographical areas. The population for the present study consisted of all students of 9th class studying in high schools located in Jammu City.

3.2.3 Variables of the Study

A variable, as the name implies, is one thing that varies. It may be weight, height, anxiety levels, income, body temperature and so on. Each of these properties varies from one person to another and also has different values along a continuum. It could be demographic, physical or social and include religion, income, occupation, temperature, humidity, language, food, fashion, etc. Some variables can be quite concrete and clear, such as gender, birth order, types of blood group etc while others can be considerably more abstract and vague. In the present study, there are total seven variables which have been given below:

- Gender
- Residential Background
- Type of Family
- Economic Background
- Marks Obtained
- Mathematical Anxiety

- Achievement

3.2.4 Sample of the Study

In the present study the sample of 250 students has been selected through the Simple Random Sampling Technique from 11 high schools located in Jammu City. Out of 250 students, 122 were females and 128 were males. The details of the sample selected from 11 high school students has been given in the table below:

Table 3.1

Details of the Sample Selected

S.No.	Name of School	Number of Females	Number of Males
1.	Oriental Academy Jammu	26	14
2.	Govt. Girls High School Kachi Chawni Jammu	14	7
3.	Cooperative Public High School Jammu	6	3
4.	Arya Public School Jammu	1	7
5.	Govt. Girls High School Dogra Hall Jammu	3	4
6.	Govt. Girls High School Mubarak Mandi Jammu	22	0
7.	Lawrence Public School Jammu	13	6
8.	Govt. Sri Ranbir High Secondary School Jammu	0	39
9.	Jagriti Mission School Talab Tillo Jammu	18	13
10.	Govt. High School City Chowk Jammu	5	9
11.	Model Academy School Jammu	14	26
Total		122	128

3.3 TOOL EMPLOYED

For the purpose of accomplishment of objectives, a standardised tool namely *Mathematical Anxiety Scale - India* (Appendix-A & Appendix-B) developed by Karimi and Venkatesan (2011) have been used.

3.3.1 Mathematical Anxiety Scale India (MAS-I)

Mathematical Anxiety Scale India (MAS-I) developed by Ayatollah Karimi and S.Venkatesan (2011) provides the most theoretical and useful measure of Mathematical anxiety. The MAS-I provides students with a tool for identifying causes of their Mathematical anxiety and in turn teachers with a diagnosis of their greatest hurdles for improving the Mathematical literacy of their students. Through the use of this tool, students and teachers are able to work together towards improving Mathematics courses and increasing Mathematical literacy.

3.3.2 Scoring

Mathematical Anxiety Scale Indian version consists of 36 items. It covers two factors (17 items on Math Test Anxiety and 19 items on Numerical Anxiety).

Table 3.2

Interpretative Norms of MAS-I Scores

Percentile	**Z Scores**	**Interpretation**	**Mathematics anxiety range**
Below 4	Below -2	Definitely Below Average	Below 46
4-17	-1 to -2	Below Average	46-66
18-86	+1 to -1	Average	67-110
87-97	+1 to +2	Above Average	111-130
98-99	Above +2	Moderate to Severe Mathematics Anxiety	130

Regarding the mentioned categories, the raw score below 46(4%) is located below-2 (Z scores). The students with these scores are interpreted as 'Definitely Below Average' in their felt mathematics anxiety. At the other end, a raw score greater than 131 (98 %) on MAS-I located above +2 (Z scores) is indicative of Moderate to Severe' or pathological mathematics anxiety thereby indicating a requirement for.

3.3.3 Validity and Reliability of MAS

The results of reliability coefficients expressed as Alpha Cronbach values on internal consistency of the MAS-I for the overall and two sub scales are : 0.80 for factor one, 0.88 for factor two and 0.84 for total scores respectively. Convergent validity as assessed through two correlation studies between the overall scores of MAS-I and MARS-Suinn in India indicated (r: 0.88), with TAI (r: 0.77) and with mathematics performance (r: -0.44).

3.4 ADMINISTRATION OF THE TOOL

Investigator visited all the selected schools personally for the collection of the data. First of all the investigator approached the heads of the institutions and the problem was fully explained to them. The tool was administered in the classroom. An attempt was made to explain the purpose of the study in order to ensure reliable responsiveness. The students were informed that their responses will be kept confidential and therefore, be frank, honest and sincere while answering the questions. After giving the necessary instructions, the investigator distributed the copies of the tool. Every attempt was made by the investigator to remove the doubts and difficulties. It was also made clear to the examiner that there is no time limit but they have to complete it at the earliest. The students were directed to read this statement one by one to mark the most suitable response for the respective questions. After filling up the responses all the copies were selected back from the students including this sample and thus data was collected.

3.5 STATISTICAL TECHNIQUES USED

Statistical techniques involved in carrying out a study include planning, designing, collecting data, analyzing, drawing meaningful interpretation and reporting of the research findings.

In the present study, following statistical techniques were used :

- Percentage
- Pearson’s Coefficient of Correlation

CHAPTER-IV

ANALYSIS AND INTERPRETATION OF DATA

4.1 INTRODUCTION

Analysis of data meant categorizing, manipulating and summarizing the data to obtain answers to the research questions. The purpose of analysis is to reduce data into intelligible and interpretable form so that meaningful results can be arrived at. The analysis and interpretation of data involve the objective material in the possession of the researcher and his subjective reactions and desire to drive from the data the inherent meanings in their relation to the problem. The mass data collected through the use of various tools, need to be systematized and organized, i.e. edited, classified and tabulated before it can serve the purpose. Here editing implies the checking of gathered data for accuracy, utility and completeness; classifying refers to the dividing of information into different categories of classes or heads, for use; and tabulating denotes the recording of the classified material in accurate mathematical terms.

A systematic and scientific treatment of the tabulated data is essential for drawing valid conclusions. It involves breaking complex factors into simpler parts and putting them in a new arrangement for the purpose of interpretation. Collection of data has no meaning unless it is tackled, properly and analyzed and interpreted by sophisticated techniques. Barr says that analysis is an important phase of the classification and summarization of data. So the interpretation is considered as one of the most important steps in the total procedure of research (Kumari,2019).

In this study, data has been collected from 250 high school students of Government and Private schools studying in class ninth of Jammu. Data has been collected by administering the Mathematical Anxiety Scale developed and standardized by Karimi and Venkatesan (2011).

4.2 RESULTS AND FINDINGS

The resulting data have been analyzed using statistical techniques like Percentage and Pearson's Coefficient of Correlation. Findings based on the research question and followed by data analysis have been given below:

4.2.1 Research Objective 1

To study the level of mathematical anxiety among high school students studying in 9th class.

In order to study the level of mathematical anxiety among students studying in 9th class, the number and percentages have been computed for students having high, moderate and low levels of mathematical anxiety. The resulting data have been given in table 4.1

Table 4.1

Range of Z -scores, Number and Percentage of Students having Different levels of Mathematical Anxiety

S.No.	**Z Scores**	**Level of Mathematical Anxiety**	**No.(% age) of Students**
1.	Below -2	Definitely Below Average	7(2.8%)
2.	-1 to -2	Below Average	31(12.4%)
3.	+1 to -1	Average	175(70%)
4.	+1 to +2	Above Average	32(12.8%)
5.	Above +2	Moderate to Severe	5(2%)

Table 4.1 reveals that 7(2.8%) students have been found to have definitely below average level of anxiety, 31(12.4%) students have below average level of mathematical anxiety, 175(70%) students have average level of anxiety, 32(12.8%) students have above average level of anxiety and 5(2%) students have moderate to severe level of anxiety towards mathematics. Thus, it can be concluded that the majority of the students 175(70%) have an average level of mathematical anxiety.

4.2.2 Research Objective 2

To study the level of achievement in mathematics of high school students studying in 9th class.

In order to study the level of achievement in mathematics of the students studying in 9th class, the number and percentage have been computed for scores of students. The resulting data have been given in the table 4.2

Table 4.2

Range of Z -scores, Number and Percentage of Students having Different levels of Achievement in Mathematics

S.No.	Range of Z-Scores	Level of Achievement	No. (% age) of Students
1.	Below -2	Poor	6(2.4%)
2.	-1 to -2	Below Average	34(13.6%)
3.	+1 to -1	Average	142(56.8%)
4.	+1 to +2	Above Average	68(27.2%)
5.	Above +2	High	0(0.0%)

Table 4.2 indicates that 6(2.4%) students have been found to have poor level of achievement, 34(13.6%) students have below average level of achievement, 142(56.8%) students have average level of achievement, 68(27.2%) students have above average level of achievement and 0(0%) students have high level of achievement in mathematics. Thus, it can be concluded that the majority of the students 142 (56.8%) have an average level of achievement in mathematics.

4.2.3 Research Objective 3

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to gender (Male and Female).

In order to study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to gender (Male and Female), Pearson's Coefficient of Correlation has been computed for both the groups (male and female) and the results have been given in table 4.3.

Table 4.3

Pearson's Coefficient of Correlation between Mathematical Anxiety and Achievement in Mathematics among High School Students in relation to Gender (Male and Female)

	Male (N= 128)	**Female (N=122)**
Math Test Anxiety	-0.109	0.014
Numerical Anxiety	-0.171	-0.121
Overall Mathematical Anxiety	-0.151	-0.062

Table 4.3 shows that the values of r (0.014, -0.121, -0.062) for relationship between math test anxiety with achievement in mathematics, numerical anxiety with achievement in mathematics and overall mathematical anxiety with achievement in mathematics in relation to gender have not been found to be significant at 0.05 level of significance among high school students. In the light of this finding, Hypothesis 1 stating no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their gender has not been rejected.

4.2.4 Research Objective 4

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to residential background (Rural and Urban).

In order to study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to residential background (Rural and Urban), Pearson's Coefficient of Correlation has been computed for both the groups (rural and urban) and the results have been given in the table 4.4.

Table 4.4

Pearson's Coefficient of Correlation between Mathematical Anxiety and Achievement in Mathematics among High School Students in Relation to Residential Background (Rural and Urban).

	Achievement in Mathematics	
	Rural (N=90)	**Urban (N=160)**
Math Test Anxiety	-0.117	-0.015
Numerical Anxiety	-0.194	-0.098
Overall Mathematical Anxiety	-0.179	-0.060

Table 4.4 shows that the values of r (-0.015, -0.098, -0.060) for relationship between math test anxiety with achievement in mathematics, numerical anxiety with achievement in mathematics and overall mathematical anxiety with achievement in mathematics in relation to residential background have not been found to be significant at 0.05 level of significance among high school students. In the light of this finding, Hypothesis 2 stated that there is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to residential background has not been rejected.

4.2.5 Research Objective 5

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to type of family (Joint and Nuclear).

In order to study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to type of family (Joint and Nuclear). Pearson's Coefficient of Correlation has been computed for both the groups (joint and nuclear) and the results have been given in the table 4.5.

Table 4.5

Pearson's Coefficient of Correlation between Mathematical Anxiety and Achievement in Mathematics among High School Students in Relation to Type of Family (Joint and Nuclear)

	Achievement in Mathematics	
	Joint (N=97)	**Nuclear (N=153)**
Math Test Anxiety	-0.057	-0.043
Numerical Anxiety	-0.133	-0.156
Overall Mathematical Anxiety	-0.106	-0.108

Table 4.5 shows that the values of r (-0.043,-0.156,-0.108) for relationship between math test anxiety with achievement in mathematics, numerical anxiety with achievement in mathematics and overall mathematical anxiety with achievement in mathematics in relation to the type of family have not been found to be significant at 0.05 level of significance among high school students. In the light of this finding, Hypothesis 3 stating that there is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their type of family has not been rejected.

4.2.6 Research Objective 6

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to Economic Status.

In order to study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to economic status (low and high), Pearson's Coefficient of Correlation has been computed for both the groups (low and high) and the results have been given in table 4.6.

Table 4.6

Pearson's Coefficient of Correlation between Mathematical Anxiety and Achievement in Mathematics Among High School Students in Relation to Economic Status (Low and High)

	Achievement in Mathematics	
	Low (N=200)	**High (N=50)**
Math Test Anxiety	-0.086	-0.437*
Numerical Anxiety	-0.049	-0.253
Overall Mathematical Anxiety	-0.005	-0.064

***Correlation is significant at 0.05 level of significance.**

Table 4.6 shows that the values of r (-0.253,-0.064) for the relationship between numerical anxiety with achievement in mathematics and overall mathematical anxiety with achievement in mathematics in relation to economic status have not been found to be significant at 0.05 level of significance among students belonging to families with economic status at the high school stage. But the relationship between math test anxiety and achievement in mathematics is found to be negative, high and significant at 0.05 level of significance among high school students belonging to high economic status. In the light of this finding, Hypothesis 4 stating no significant relationship between math test anxiety and achievement in mathematics among low economic status students has not been rejected. But it has been rejected for high economic status students for the factor Math Test Anxiety.

CHAPTER - V

FINDINGS, CONCLUSIONS, EDUCATIONAL IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.1 INTRODUCTION

After processing the data, obtaining and interpreting the result in previous chapter (IV), the findings have been delimited and discussed in the present chapter. These findings can be generalized to the extent of representatives of the sample and methodology employed in the study. In this chapter, the results are discussed to show how these findings are concurrent with some of the empirical studies already conducted in the field. At places, some of the observations did not concur with the findings of the same investigators. Keeping the major findings in view, the educational implications of the study have been worked out. As such some suggestions have been given for the further research. This chapter is therefore, devoted to focusing the findings, conclusion, discussion of results of the study and for indicating their implications and suggestions for further studies or research. These are presented below in the same sequence :

- Major Findings
- Conclusions and Discussions
- Educational Implications
- Suggestions and further research

5.2 MAJOR FINDINGS

5.2.1 Research Objective 1

To study the level of mathematical anxiety among high school students studying in 9th class.

In the present study, it has been found that 7(2.8%) students have been found to have definitely below average level of anxiety, 31(12.4%) students have below average level of mathematical anxiety, 175(70%) students have average level of anxiety, 32(12.8%) students have above average level of anxiety and 5(2%) students have moderate to severe level of mathematical anxiety. Thus, it can be concluded that the majority of the students 175(70%) have an average level of mathematical anxiety.

5.2.2 Research Objective 2

To study the level of achievement in mathematics of high school students studying in 9th class

In the present study, it has been found that 6(2.4%) students have been found to have poor level of achievement, 34(13.6%) students have below average level of achievement, 142(56.8%) students have average level of achievement, 68(27.2%) students have above average level of achievement and 0(0%) students have high level of achievement in mathematics. Thus, it can be concluded that the majority of the students 142(56.8%) have an average level of achievement in mathematics.

5.2.3 Research Objective 3

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to gender (Male and Female)

In the present study, it has been found that the values of r (0.014, -0.121, -0.062) for relationship between math test anxiety with achievement in mathematics, numerical anxiety with achievement in mathematics and overall mathematical anxiety with achievement in mathematics have not been found to be significant at 0.05 level of significance among high school students. Hence, there is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to gender.

5.2.4 Research Objective 4

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to residential background (Rural and Urban)

In the present study, it has been found that the values of r (-0.015, -0.098, -0.060) for relationship between math test anxiety with achievement in mathematics, numerical anxiety with achievement in mathematics and overall mathematical anxiety with achievement in mathematics have not been found to be significant at 0.05 level of significance among high school students. Hence, there is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to residential background.

5.2.5 Research Objective 5

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to type of family (Joint and Nuclear)

In the present study, it has been found that values of r (-0.043,-0.156,-0.108) for the relationship between math test anxiety with achievement in mathematics, numerical anxiety with achievement in mathematics and overall mathematical anxiety with achievement in mathematics have not been found to be significant at 0.05 level of significance among high school students. Hence, there is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to type of family.

5.2.6 Research Objective 6

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to Economic Status (Low and High)

In the present study, it has been found values of r (-0.253,-0.064) for the relationship between numerical anxiety with achievement in mathematics and overall mathematical anxiety with achievement in mathematics have not been found to be

significant at 0.05 level of significance among students having high achievement in mathematics at the high school stage. But the relationship between math test anxiety and achievement in mathematics is significant at 0.05 level of significance among high school students. Hence, there is a significant relationship between mathematical anxiety and achievement in mathematics among high economic status for the factor math test anxiety among high school students.

5.3 CONCLUSIONS AND DISCUSSION

On the basis of interpretation of the results drawn in the present study the investigator lays down the following conclusions :

1. The present study revealed that the majority of the students 212 (84.8%) have an average to severe levels of mathematical anxiety. Emin., et al. (2009) also studied the mathematical anxiety levels of primary school student teachers with regard to variables including gender, grade level, the type of high school and the university that they graduated from.

2. Majority of the students 142(56.8%) have an average level of achievement in mathematics.

3. The present study revealed that there is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to gender. Studies by Kundu and Kar (2018) also reported similar results stating no significant difference. Woodward (2004), Zakaria, Zain, Ahmad and Erlina (2012), Prakash, Rani and Satnarain (2018) reported results contrary to the study stating significant relationship.

4. The present study revealed that there is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to residential background. Studies by Kundu and Kar (2018) reported contrary results that showed a significant and negative relationship between student's mathematics achievement and their mathematics anxiety.

5. The present study indicates that there is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to the type of family. Kumar and Srivastava (2021) also reported similar results stating no significant relationship.

6. The present study indicates that there is a significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to economic status for the factor math test anxiety. Studies by Kundu and Kar (2014), Alam and Halder (2018) reported similar results.

5.4 EDUCATIONAL IMPLICATIONS

1. It is found that most of the students have an average to severe level of mathematical anxiety. To decrease the level of anxiety, teachers and parents should make serious efforts by counseling the students.

2. To help in developing good academic achievement among students. Effective measures like formative assessment, remedial classes, feedback sessions etc should be taken by policymakers, administrators, teachers and stakeholders.

3. Educational Institutions should consider implementing programs or interventions aimed at reducing mathematical anxiety among students, as it can significantly impact their overall math performance.

4. It is found that no student has a high level of achievement in mathematics. These findings suggest that there is a need for a variety of teaching strategies that cater to different learning styles and paces for improving the achievement in mathematics.

5. This study did not find a significant relationship between mathematical anxiety and achievement in mathematics based on gender, it's essential to continue monitoring and addressing any gender-based disparities in math performance. Efforts should be made to ensure that both male and female students receive equal opportunities and support in their math education.

6. This study revealed a significant relationship between math test anxiety and achievement in mathematics among high school students, particularly related

to high economic status. This suggests that students from high economic backgrounds might face unique challenges in math education. Schools should consider providing additional support and resources to students with high economic status to help them cope with math test anxiety and improve their math performance.

5.5 SUGGESTIONS FOR THE FURTHER RESEARCH

1. A sample of 250 students studying in five government and five private higher secondary schools of district Jammu was taken in the present study. Similar study can be conducted on a larger sample to assess the mathematical anxiety among high school students.

2. A similar study can be conducted on students studying in Kendriya Vidyalayas, Navodaya Vidyalayas, Sainik schools etc.

3. A similar study can be conducted on college and university students.

4. A similar study can be conducted with respect to other demographic variables such as age, qualification, marital status etc.

5. Other psychological variables such as creativity, motivation can be studied in relation to mathematical anxiety.

6. A similar study can be conducted on higher secondary school students of other districts of Jammu division.

7. A qualitative study can be undertaken with regard to this research.

SUMMARY

TITLE: MATHEMATICAL ANXIETY AMONG HIGH SCHOOL STUDENTS IN RELATION TO THEIR ACHIEVEMENT IN MATHEMATICS.

SUPERVISOR **INVESTIGATOR**

Prof. Nishta Rana **Taniya Dogra**

A. THE PROBLEM

Mathematics anxiety, which is defined as "a feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551), is an important component of the affective domain that plays a key role in students' engagement with mathematics (Dowker et al., 2019; Ersozlu & Karakus, 2019; Maloney & Beilock, 2012). As a result of this, over the last few years there has been increased scholarly attention involving a wide range of jurisdictions (Morsanyi et al., 2016). Some of the facets of mathematics anxiety that have been explored in previous research include its prevalence among different samples, relationship to psychological and educational constructs such as mathematics performance and working memory (Ersozlu & Karakus, 2019; Luttenberger et al., 2018; Paechter et al., 2017), and the avoidance of certain career paths (Van Mier et al., 2019).

B. NEED AND SIGNIFICANCE OF THE STUDY

Research has shown that mathematics achievement in students is influenced by psychological factors such as mathematics anxiety, social competence, motivation etc. Among all these factors mathematical anxiety has been found to be negatively correlated in relation to their achievement in mathematics. Whyte and Anthony (2012) explain mathematics anxiety as the actual situational stress experienced that is specific to personally stressful or fearful circumstances. Research also notes that math anxiety can affect individuals in varying ways, inducing cognitive, affective, or physical reactions. Mathematics anxiety can present itself in a variety of ways. It can present as a dislike of mathematics or as a worry or pure fear (Wigfield & Meece,

1988; Hart, 1989) due to external pressures placed on a person, such as in a testing situation (Ma, 1999; Krinzinger et al., 2009; Sheffield & Hunt, 2006; Wilson, 2013). Research by Fulya (2008), Elenchoty (2007), Puteh and Khalin (2016) Salwani (2001). Arem (1993) and Tobias (1980), has shown that mathematics anxiety has become one of the factors contributing to the decline of the mathematical achievements of the students. In this backdrop, this study has been proposed to assess the mathematical anxiety among high school students in relation to their achievement in mathematics with respect to gender, residential background, type of family and economic status. The proposed study would be helpful for the teachers, teacher educators, students, administrators and policy makers for bringing desirable changes in the education system especially with reference to mathematics education.

C. OBJECTIVES OF THE STUDY

1. To study the level of mathematical anxiety among high school students.

2. To study the level of achievement in mathematics of high school students.

3. To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their gender with respect to two factors (Math Test Anxiety and Numerical Anxiety) as well as overall scores on Mathematical Anxiety Scale.

4. To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their residential background with respect to two factors (MTA and NA) as well as overall scores on Mathematical Anxiety Scale.

5. To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their type of family with respect to two factors (MTA and NA) as well as overall scores on Mathematical Anxiety Scale.

6. To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their economic status

with respect to two factors (MTA and NA) as well as overall scores on Mathematical Anxiety Scale.

D. HYPOTHESES OF THE STUDY

1. There is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their gender.

2. There is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their residential background.

3. There is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their type of family.

4. There is no significant relationship between mathematical anxiety and achievement in mathematics among high school students in relation to their economic status.

E. SAMPLE OF THE STUDY

In the present study the sample of 250 students has been selected through the Stratified Random Sampling Technique from 11 high schools located in Jammu City. Out of 250 students, 122 were females and 128 were males. The details of the sample selected from 11 high school students.

F. TOOL EMPLOYED IN THE STUDY

For the purpose of accomplishment of objectives, the following tool have been used :

Mathematical Anxiety Scale - India developed by Karimi and Venkatesan (2011). A tool contains 36 items in two dimensions.

- Math Anxiety Scale (MAS)
- Numerical Anxiety (NA)

G. RESULTS

In order to accomplish the objectives of the study, the following statistical techniques were used namely Percentage and Pearson's coefficient of Correlation.

Research Objective 1

To study the level of mathematical anxiety among high school students studying in 9th class.

In order to study the level of mathematical anxiety among students studying in 9th class, the number and percentages have been computed for students having high, moderate and low levels of mathematical anxiety. The resulting data have been given in table 1.

Table 1

Range of Z -scores, Number and Percentage of Students having Different levels of Mathematical Anxiety

S.No.	**Z Scores**	**Level of Mathematical Anxiety**	**No.(% age) of Students**
1.	Below -2	Definitely Below Average	7(2.8%)
2.	-1 to -2	Below Average	31(12.4%)
3.	+1 to -1	Average	175(70%)
4.	+1 to +2	Above Average	32(12.8%)
5.	Above +2	Moderate to Severe	5(2%)

Research Objective 2

To study the level of achievement in mathematics of high school students studying in 9th class.

In order to study the level of achievement in mathematics of the students studying in 9th class, the number and percentage have been computed for scores of students. The resulting data have been given in table 2.

Table 2

Range of Z -scores, Number and Percentage of Students having Different levels of Achievement in Mathematics

S.No.	**Range of Z-Scores**	**Level of Achievement**	**No. (% age) of Students**
1.	Below -2	Poor	6(2.4%)
2.	-1 to -2	Below Average	34(13.6%)
3.	+1 to -1	Average	142(56.8%)
4.	+1 to +2	Above Average	68(27.2%)
5.	Above +2	High	0(0.0%)

Research Objective 3

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to gender (Male and Female).

In order to study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to gender (Male and Female), Pearson's Coefficient of Correlation has been computed for both the groups (male and female) and the results have been given in table 3.

Table 3

Pearson's Coefficient of Correlation between Mathematical Anxiety and Achievement in Mathematics among High School Students in relation to Gender (Male and Female)

	Male (N= 128)	**Female (N=122)**
Math Test Anxiety	-0.109	0.014
Numerical Anxiety	-0.171	-0.121
Overall Mathematical Anxiety	-0.151	-0.062

Research Objective 4

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to residential background (Rural and Urban).

In order to study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to residential background (Rural and Urban), Pearson's Coefficient of Correlation has been computed for both the groups (rural and urban) and the results have been given in the table 4.

Table 4

Pearson's Coefficient of Correlation between Mathematical Anxiety and Achievement in Mathematics among High School Students in Relation to Residential Background (Rural and Urban).

	Achievement in Mathematics	
	Rural (N=90)	**Urban (N=160)**
Math Test Anxiety	-0.117	-0.015
Numerical Anxiety	-0.194	-0.098
Overall Mathematical Anxiety	-0.179	-0.060

Research Objective 5

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to type of family (Joint and Nuclear).

In order to study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to type of family (Joint and Nuclear). Pearson's Coefficient of Correlation has been computed for both the groups (joint and nuclear) and the results have been given in the table 5.

Table 5

Pearson's Coefficient of Correlation between Mathematical Anxiety and Achievement in Mathematics among High School Students in Relation to Type of Family (Joint and Nuclear)

	Achievement in Mathematics	
	Joint (N=97)	**Nuclear (N=153)**
Math Test Anxiety	-0.057	-0.043
Numerical Anxiety	-0.133	-0.156
Overall Mathematical Anxiety	-0.106	-0.108

Research Objective 6

To study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to Economic Status.

In order to study the relationship between mathematical anxiety and achievement in mathematics among high school students in relation to economic status (low and high), Pearson's Coefficient of Correlation has been computed for both the groups (low and high) and the results have been given in table 6.

Table 6

Pearson's Coefficient of Correlation between Mathematical Anxiety and Achievement in Mathematics Among High School Students in Relation to Economic Status (Low and High)

	Achievement in Mathematics	
	Low (N=200)	**High (N=50)**
Math Test Anxiety	-0.086	-0.437*
Numerical Anxiety	-0.049	-0.253
Overall Mathematical Anxiety	-0.005	-0.064

***Correlation is significant at 0.05 level of significance.**

E. EDUCATIONAL IMPLICATIONS OF THE STUDY

1. It is found that most of the students have an average to severe level of mathematical anxiety. To decrease the level of anxiety, teachers and parents should make serious efforts by counseling the students.

2. To help in developing good academic achievement among students. Effective measures like formative assessment, remedial classes, feedback sessions etc should be taken by policymakers, administrators, teachers and stakeholders.

3. Educational Institutions should consider implementing programs or interventions aimed at reducing mathematical anxiety among students, as it can significantly impact their overall math performance.

4. It is found that no student has a high level of achievement in mathematics. These findings suggest that there is a need for a variety of teaching strategies that cater to different learning styles and paces for improving the achievement in mathematics.

5. This study did not find a significant relationship between mathematical anxiety and achievement in mathematics based on gender, it's essential to

continue monitoring and addressing any gender-based disparities in math performance. Efforts should be made to ensure that both male and female students receive equal opportunities and support in their math education.

6. This study revealed a significant relationship between math test anxiety and achievement in mathematics among high school students, particularly related to high economic status. This suggests that students from high economic backgrounds might face unique challenges in math education. Schools should consider providing additional support and resources to students with high economic status to help them cope with math test anxiety and improve their math performance.

F. SUGGESTIONS FOR FURTHER RESEARCH

1. A sample of 250 students studying in five government and five private higher secondary schools of district Jammu was taken in the present study. Similar study can be conducted on a larger sample to assess the mathematical anxiety among high school students.

2. A similar study can be conducted on students studying in Kendriya Vidyalayas, Navodaya Vidyalayas, Sainik schools etc.

3. A similar study can be conducted on college and university students.

4. A similar study can be conducted with respect to other demographic variables such as age, qualification, marital status etc.

5. Other psychological variables such as creativity, motivation can be studied in relation to mathematical anxiety.

6. A similar study can be conducted on higher secondary school students of other districts of Jammu division.

7. A qualitative study can be undertaken with regard to this research.

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Appendix-A

Manual For
Mathematics Anxiety Scale-India (MAS-I)

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I

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Contents Of Mathematics Anxiety Test (MAT):
1 manual, 100 consumable question booklets

THE MATHEMATICS ANXIETY SCALE-INDIA (MAS-I)

1.0 INTRODUCTION

Anxiety is a biological response to protect human beings from harm. All humans experience normal anxiety at some level and to certain extent. Some individuals experience this emotion with sufficient intensity or duration to produce psychophysiological dysfunction. Fear and anxiety, although distinct, have been recognized and analyzed as part of human experience since times immemorial (May, 1977; Spielberger et al, 1972). The concept of anxiety, as "normal" response to adversity or threat of adversity is not new. While anxiety was previously recognized as general states of uneasiness or troubled mind; in 17th century, the term 'anxiety' was started to be used to describe feelings of fearfulness accompanied by physical symptoms like tightness in chest (Tobia, 1993). There is a broad range of normal anxiety that is considered to be healthy or even necessary under normal circumstances. Pathological anxiety is characterized by its excess, pervasiveness and uncontrollability. Anxiety has three components: (1) identification of potential threat or harm; (2) psychological features of alarm, dread, or fear; and, (3) physiological response including autonomic discharge and motor activity.

Available literature in psychology provides several conceptualizations of mathematics anxiety. Kennedy and Tipps (1990) define math anxiety as 'fearful, negative, emotional reaction to mathematics'. Hendel and Davis (1978) conceptualize mathematics anxiety as 'an effective response that includes avoidance of math, subsequent failure to learn basic math skills, and thus negative career and school-related decisions'. Richardson and Suinn (1972) provide a widely accepted definition as 'feelings of tension and anxiety that interfere with manipulation of numbers and solving mathematical problems in a wide variety of ordinary life and academic situations'. Mathematics anxiety maybe also analyzed using a three-system approach, which includes the dimensions of physiology, self-report, and overt behavior (Lang, 1968).

The 'Mathematics Anxiety Rating Scale' (MARS) ((Richardson and Suinn, 1972) appears to be the most commonly used instrument to assess mathematics anxiety. This is despite disagreement over the factorial nature of the tool and, consequently, the construct of mathematics anxiety. The authors of this scale report mathematics anxiety as a unidimensional construct dominated by a single homogeneous factor to "evaluative test taking and problem-solving mathematics situations". However, other researchers have found contradictory results by obtaining from 2-6 factors underlying the construct of mathematics anxiety.

Among related variables, age is reported as influential aspect in mathematics anxiety especially before 18 years (or the so-called 'developmental period')(Ebadi and Karimi, 2003) even though these findings are inconsistent with growing grade levels of students. Bush (1991) mentions that mathematics anxiety originates during students' early educational experiences. Hembree (1990) found that mathematics anxiety increase during junior high grades, reache its peak in Grade 9-10, and levels off during senior high grades. This implies that there is some relationship between mathematics anxiety and grade levels. The abstract nature of mathematics in grades 9-10 may contribute to the creation of mathematics anxiety (Bush, 1991).

Attempts have been on to understand the nature of relationship between mathematics achievement and mathematics anxiety. Hembree (1990) and Richardson and Suim (1972) observed that high levels of mathematics anxiety were significantly related to lower levels of mathematics achievement. Consequently, the effect of mathematics anxiety on academic outcome, although inconclusive, appears to merit continued investigation. No agreement has been reached on the possible relationship between math and test anxiety. Some researchers propose that general test anxiety accounts almost fully for math anxiety (Meece et al., 1982), while others contend that the two types of anxiety are different (Brush, 1978). Another suggestion is that math anxiety is a subtype of test anxiety (Richardson and Woolfolk, 1980). These multifaceted conceptualizations provide the most comprehensive explanation for the relationship between math anxiety and test anxiety. It is hypothesized that if a person exhibits distress behavior across testing situations, then poor performance on math exams may reflect high levels of general test anxiety. If a person experiences anxiety and performs poorly only in innate-related situations, then it maybe a situation-specific problem. General test anxiety may or may not coexist with math anxiety and both types of anxiety can occur in isolation.

Race appears to play a role in math anxiety. Asian and Native American males had high math anxiety as African American and Hispanic females were rated high too. In the Bemstein, Reilly and Cote-Bonanno study cited in Preis and Biggs (2001), Asian and Native American male college students had high math anxiety than the females, while Caucasian females scored higher than Caucasian males. However, Ashcraft and Kirk (2001) failed to find significant relationship between gender and math anxiety. Developmental math students were found to be more math anxious than other college students, while nontraditional students have more anxiety about college in general, including math (Preis and Biggs 2001). However, the correlation between math anxiety and verbal achievement or aptitude is -0.06 and - 0.17 with IQ (Ashcraft and Kirk 2001). Cooper and Robinson (1991) reported that mathematics self-efficacy or perceived mathematics ability served as a potentially causal factor of mathematics anxiety.

Attitude as part of student's disposition, has significant relationship with mathematics anxiety. Students with mathematics anxiety have accepted that they will fail in any mathematics situation. Ashcraft and Kirk (2001) note that parents form impressions of their child's interest and abilities in general on the basis of their own beliefs. Parents communicate their beliefs and attitudes about mathematics and its utility through their individual practices. The outcome of these communicated attitudes is one in which students take on their parents' mathematics anxiety (Bush, 1991). In sum, this brief outline on mathematics anxiety suggests a vast potential and possibility for research in this area particularly in South Asian countries including India. Research in this area is severely constrained by lack of locally standardized measuring instruments on mathematics anxiety.

2.0 Review of Existing Scales:

The available psychological instruments to measure mathematics anxiety broadly fall into two categories: (a) Unidimensional Scales; and, (b) Multi-dimensional Scales.

2.1 Unidimensional Scales

The group of researchers believe mathematics anxiety is a unitary dimension involving negative affective reactions to mathematics. In this approach, the first 94-item 'Mathematics Anxiety Scale' (MARS)(Richardson and Suinn, 1972) was intended for use with school and college students. The items were divided into two parts: one half for the situations in ordinary life and another half related to academic situations. The MARS has become a mother scale for development of other smaller or abbreviated forms.

The 'Mathematics Anxiety Scale for Adolescents' (MARS-A) is one such derivative (Suinn, 1982). Alexander an Maratrray (1989) changed and replaced some items of the original MARS for use in college students and created a psychometrically equivalent 25 item version. Brush (1978) administered the 94-item MARS on 109 undergraduates majoring in humanities, social science or physical science to isolate two factors: 45 items covering 'problem solving anxiety' and 31 items associated with 'evaluation anxiety'. Rounds and Handle (1980) administered another 78-item MARS questionnaire on 350 female participants undergoing a treatment program. The results of their factor analysis showed two types of anxiety: 'test and numerical anxiety'. In 1982, Plake and Parker developed and used a 24-item version of this questionnaire on 170 graduate students enrolled into a program on 'introduction to mathematics course'. They found 16 items of the revised MARS related to activity or process of studying mathematics. This factor was labeled as 'learning mathematics anxiety'. The remaining eight items were concerned with the 'evaluation anxiety'.

Another form of MARS was revised by Alexander and Cobb (1987) having 31 items that reflected apprehension about taking a mathematics test, receiving the results or other course related activates. This factor is labeled 'math test' and 'course anxiety'. The second component defined by 7 items reflected fear and apprehension about executing a numerical task. This factor was labeled numerical anxiety. Ferguson (1985) used 30 MARS items from the Rounds and Hendel (1980) study to find three factors of mathematics anxiety in participation of this study involving 365 undergraduates enrolled in mathematics classes of college. They found ten items identified as 'heavily loaded' on mathematics test anxiety and ten items identified as loaded on numerical anxiety. The remaining ten items were referred as related to 'abstract' mathematics topics.

Bessant (1995) altered some items to administer 80-item MARS on 171 university students and found six components of mathematics anxiety, such as, 'general evaluation anxiety', 'every day numerical anxiety' and 'passive observation anxiety', 'performance anxiety', 'mathematics test anxiety' and 'problem-solving anxiety'.

2.2 Multidimensional Scales

The second group of researchers believe that mathematics anxiety has two dimensions: worry (cognitive component of mathematics anxiety) and emotionality (affective dimension of mathematics anxiety). Wigfield and Meece (1988) started this trend with the development of a new tool called 'Mathematics Anxiety Questionnaire' (MAQ) having an item pool based on two dimensions: worry and emotionality. The questionnaire was standardized on a population of 750 students between grade 6-12. A factor analysis on data extracted 11 items. The scales can be used individually or as a total package to assess a variety of situations toward mathematics anxiety. Psychometric properties of this tool has showed considerable amount of concurrent validity with their scores (0.84) and reliability scores at 0.95 by Cronbach's Alpha.

3.0 MATHEMATICS ANXIETY SCALE-INDIAN VERSION

Despite the availability of few scales to measure mathematics anxiety in the west, the phenomenon as related to the Indian scene opens up bright vistas for research.

3.1 Need & Rationale

With all the existing scales for measurement of mathematics anxiety; it may appear, at first quick look, whether there is any need to develop one more scale only to swell their numbers. For one thing, the existing scales are all developed and standardized on Western population. It is unclear if any cultural factors could influence mathematics anxiety in young school students. If so, there is no culturally relevant or appropriate measure as yet available to do so in Indian scene. There are indications that the components of mathematics anxiety since the development of MARS might have changed or possibly they maybe not culturally relevant across continents. Bessant (1995), for example, found that some of items in MARS pertain solely to the United States. The scale has also been criticized for its length and complexity of items (Wigfield and Meece, 1988). There are possibilities for exploring age, gender and schooling differences in experience of mathematics anxiety by students (Bessant, 1995; Ferguson 1985; Plake and Parker, 1982). In addition, some of these scales are developed and standardized on Western students majoring in psychology, statistics, or humanities (Bessant, 1995; Alexander and Cobb, 1987; Ferguson, 1985; Plake and Parker, 1982; Brush, 1978). Their norms may not be relevant for other populations. Math anxiety is measured in two ways. The first is by self examination and evaluation of anxiety when presented with various types of mathematical situations, possibly with the help of a pre-fabricated anxiety scale. A degree of anxiety is determined and usually falls under categories such as "very anxious", "moderately anxious", and so on. The other method of measuring anxiety is by a second party, who is usually someone who is trained to see physiological signs of anxiety and the actions associated with them. Psychiatrists and psychologists are an ideal outside opinion to diagnose such a problem. The formal development and standardization of a scale for measuring mathematics anxiety in the Indian context can hopefully spur greater interest among school psychologists and researchers in this doman.

3.2 General Description

The MAS provides the most theoretically comprehensive and useful measure of Mathematics anxiety to date. The MAS is a tool that students can use to determine where their anxiety of Mathematics comes from, teachers can use to determine how to structure their class, academic counselors can use to determine which style of instruction will best fit their student, and researchers can use when further exploring relationships with and within Mathematics anxiety.

The MAS provides students with a tool for identifying causes of their Mathematics anxiety, and in turn teachers with a diagnosis of their greatest hurdles for improving the Mathematical literacy of their students. The MAS linked a communication gap between students and teachers. Through use of the SAM, students and teachers are able to work together towards improving Mathematics courses and increasing Mathematical literacy.

3.3 Administration and Scoring

The 37-item Mathematics Anxiety Scale-Indiam version has been empirically derived from 96 items in its original count erpart. It covers two factors (19 items on 'maths test anxiety' and 18 items in 'numerical anxiety'). It can be administered individually or on a group of students. Although not a timed or speed test, the maximum time needed for completion of the scale is about one hour. The items are given below. The questions are presented along with a Likert scale of 1-5 to measure anxiety from 1 (not at all) to 5 (very much). To find out the overall 'anxiety score' of a given subject, the total selected points must be added (the score is the corresponding number of response on the five point scale. The range of score on this scale for a subject can vary between 37 (minimum) to 185 (maximum).

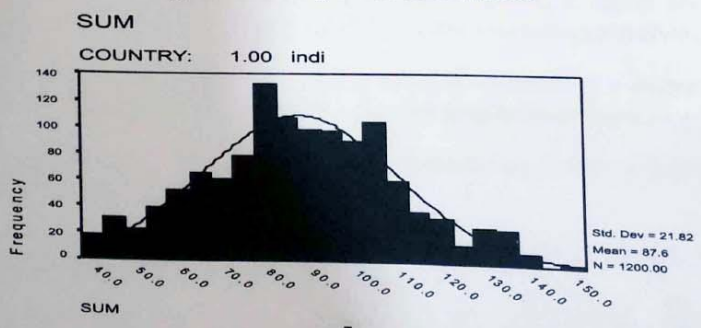
3.4 Norms/Conversion Charts

The demonstrative norm of the scores for high school students in India are as below:

Index	Raw Scores
N	1200
Mean	87.57
Median	87.00
Mode	82.00
Std. Deviation	21.82
Variance	476.01
Skewness	0.04
Std. Error of Skewness	0 .07
Kurtosis	0-.31
Std. Error of Kurtosis	0.14
Range	110.00
Minimum	38.00
Maximum	148.00
Sum	105087.00

When MAS-I was developed om high school student population (N: 1200) in India, the derived mean score was 87.57 (SD: 21.82). The Skewness (.044) and Kurtosis (-.311) are in the boundary of normality cure. The range of scores for the tested population is between 38 (Minimum) to 148 (Maximum). The scores are depicted on a histogram below.

Figure 1 : Histogram of MAS-I scores



5

The following interpretation table may be used to categories the level of mathematics anxiety in the students.

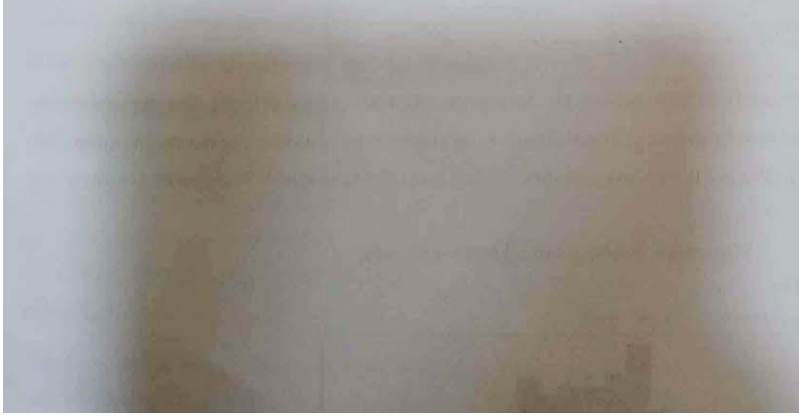
Interpretative norms of MAS-I scores

Percentile	Z scores	Interpretation	Mathematics anxiety range
Below 4	Below -2	Definitely Below Average	Below 46
4-17	-1 to -2	Below Average	46-66
18-86	+1 to -1	Average	67-110
87—97	+1 to +2	Above Average	111-130
98—99	Above +2	Moderate to Severe Mathematics Anxiety	130 -

Regarding the mentioned categories, the raw score below 46 (4 %) is located below -2 (Z scores). The students with these scores are interpreted as 'Definitely Below Average' in their felt mathematics anxiety. At the other end, a raw score greater than 131 (98 %) on MAS-I located above +2 (Z scores) Is indicative of 'Moderate to Severe' or pathological mathematics anxiety thereby indicating a requirement for

3.5 Reliability & Validity

The results of reliability coefficients expressed as Alpha Chronbach values on internal consistency of the MAS-I for the overall and two sub scales are: 0.80 for factor one, 0.88 for factor two and 0.84 for total scores respectively. Convergent validity as assessed through two correlation studies between the overall scores of MAS-I and the MARS-Suinn in India indicated (r: 0.88), with TAI (r: 0.77) and with mathematics performance (r: -0.44).



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THE MATHEMATICS ANXIETY SCALE-INDIA (MAS-I)

Dr. Ayatollah Karimi Ph.D

&

Prof. S. Venkatesan

Name: _____ Gender: _____

Age: Marks of maths in 8th class Class: _____

School: _____ Stream: Type of family (Joint/Nuclear)

Residential Background (Urban/Rural): Economic Status/Monthly Income:

Instructions:

Given below are some statements on what or how you think, feel frightened or behave with fear, tension, stress, anxiety, or apprehension in situations involving the performance of mathematics, arithmetic and/or number work at home or school.

*Read each of them carefully, understand them and If the statement describes how you usually feel or is true of you under any five of the experiences given, then put a **'X'** mark in the appropriate box corresponding to the numbers provided against each statement. Do not leave any statement unanswered.*

1 - indicates 'not at all',
2 - indicates 'somewhat, sometimes, or occasionally',
3 - indicates 'normally, usually or genrally',
4 - indicates 'many times, often or frequently', and
5 - indicates 'very much, often or always' respectively.

Please note that there are no 'right' or 'wrong' answers to these statements. It is not a test of intelligence. It is all about just how you feel or think about mathematics, arithmetic and/or number work. There is no time limit, but do not waste too much time on each statement. Try to answer them as quickly and honestly as possible. Your answers will be kept confidential.

DO NOT TURN THE PAGE UNLESS YOU ARE TOLD TO DO SO

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Domain 1: Math Test Anxiety	1	2	3	4	5
I feel apprehensive, anxious, stressed or tense upon					
1. Being asked to explain how you arrived at a particular answer for a problem.	☐	☐	☐	☐	☐
2. Receiving the final math grade of my report card.	☐	☐	☐	☐	☐
3. Thinking about an upcoming math test five minutes before.	☐	☐	☐	☐	☐
4. Picking up my math textbook to begin working.	☐	☐	☐	☐	☐
5. Hearing two of my friends talking about the best way to figure out the actual cost of a product.	☐	☐	☐	☐	☐
6. Thinking about an upcoming math test one day before.	☐	☐	☐	☐	☐
7. Signing up for a course in Algebra.	☐	☐	☐	☐	☐
8. Being given a homework assignment of many difficult math problems, which is due the next time.	☐	☐	☐	☐	☐
9. Thinking about an upcoming math test one hour before.	☐	☐	☐	☐	☐
10. Taking an examination (final) in a math course.	☐	☐	☐	☐	☐
11. Thinking about an upcoming math test one week before.	☐	☐	☐	☐	☐
12. Waiting to get a math test returned on which you expected to do well.	☐	☐	☐	☐	☐
13. Being called on to answer a question in a math class on a topic you have spent some time studying.	☐	☐	☐	☐	☐
14. Picking up your math textbook to begin working on a homework assignment.	☐	☐	☐	☐	☐
15. Studying for a math test.	☐	☐	☐	☐	☐

(1. Not at all, 2. Occasionally, 3. Usually, 4. Often, 5. Always)

2

		1	2	3	4	5
16.	Watching a teacher work an algebra problem on the blackboard.	☐	☐	☐	☐	☐
17.	Walking into the class for math test.	☐	☐	☐	☐	☐
18.	Solving a problem such as: If x = 11, and y = 3, then the result of x/y is equal to?	☐	☐	☐	☐	☐
19.	Having someone watch you as you add up a column of numbers.	☐	☐	☐	☐	☐

Domain Two: Numerical Anxiety		1	2	3	4	5
I feel apprehensive, anxious, stressed or tense upon						
1.	Being asked to add up 976 + 777 in my head.	☐	☐	☐	☐	☐
3.	Having someone watch me as I divide a 5 digit number by a 2 digit number.	☐	☐	☐	☐	☐
4.	Listening to another student explain a math formula.	☐	☐	☐	☐	☐
5.	Watching someone use a graph to explain something.	☐	☐	☐	☐	☐
6.	Being given a set of multiplication problems to solve on paper.	☐	☐	☐	☐	☐
7.	Receiving a math textbook.	☐	☐	☐	☐	☐
8.	Being given a set of subtraction problems to solve on paper.	☐	☐	☐	☐	☐
9.	Watching someone work with a calculator.	☐	☐	☐	☐	☐
10.	Figuring out my grade average for last term.	☐	☐	☐	☐	☐
11.	Figuring the sales tax for something that costs more than 100 Rupees.	☐	☐	☐	☐	☐
12.	Watching a statistics textbook.	☐	☐	☐	☐	☐
13.	Being given a set of division problems to solve on paper.	☐	☐	☐	☐	☐

(1. Not at all, 2. Occasionally, 3. Usually, 4. Often, 5. Always)

3

	1	2	3	4	5
14. Being asked to remember the telephone numbers of three people I met.	☐	☐	☐	☐	☐
15. Having to use the tables in the back of a math book.	☐	☐	☐	☐	☐
16. Hearing friends estimate the chances on a game.	☐	☐	☐	☐	☐
17. Reading a cash register receipt after I buy something.	☐	☐	☐	☐	☐
18. Listening to my friends compute the shared expenses of a trip including meals , transportation, etc.	☐	☐	☐	☐	☐

.....oooOOOooo.....

(1. Not at all, 2. Occasionally, 3. Usually, 4. Often, 5. Always)

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RESEARCH METHODOLOGY

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