

## FACTORS AFFECTING MATHEMATICAL ANXIETY: A SYSTEMATIC REVIEW OF RELATED LITERATURE

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ABSTRACT

*Mathematical anxiety is a prevalent issue that hinders individual's performance and engagement in mathematical activities. Individuals experiencing mathematical anxiety often exhibit a range of negative emotions and physical symptoms when confronted with mathematical tasks or situations. The aim and objective of the present study is to identify main factors that lead to mathematical anxiety among students. The researcher carried out review of related literature to identify the factors that lead to anxiety towards mathematics among students. The researcher surfed various research databases like Google Scholar, ERIC, Academia for collecting the relevant studies and as such 40 studies were collected. Out of 40 studies, 21 studies which met the criteria of our study were analyzed with the help of Content Analysis technique. Findings of the review of literature suggests that there are various factors that lead to mathematical anxiety among students like cognitive factor, environmental factor, inappropriate teaching methods, learner factor, parental factor and it was found that the most dominating factor that give arise to mathematical anxiety among students is learner factor.*

**Keywords:** Mathematical Anxiety, Mathematical activities, Performance, Students.

### INTRODUCTION

Mathematics is regarded very important globally. It is required not only for scholastic achievement but also for our daily existence. It serves as a gateway to science and technology, both of which are necessary for the social and economic advancement of any nation (Tshabalala & Ncube, 2016; Mbugua, 2012). In this novel universe proficiency in mathematics and heavy sciences is crucial for comprehending courses in science, technology, engineering, and other related professions. Without mathematics, there is no science, without science, there is no modern technology, and without modern technology there is no modern society (Saad et al., 2014). In nations like China, India, and Eastern Europe, mathematics is seen as a pass to prosperity and social advancement. On its own, mathematics has several applications in everyday life. It may help someone grow intellectually since it sharpens the mind and improves reasoning and analytical thinking. When we consider our everyday jobs, mathematics is used by chefs, farmers, carpenters, mechanics, shopkeepers, physicians, and musicians. Consequently, we may state that mathematics is necessary for everyone (Shishigu, 2018). Mathematics is essential to human reasoning and cognitive processes as it helps to comprehend the world around us. Mathematics is acknowledged as a strong subject as it supports STEM fields as well as

the social and medical sciences, physical sciences etc. (Smith, 2004). In this regard, every nation must raise the mathematical competency and abilities of its pupils (Hoyle et al 2015). Mathematics is a fundamental subject that holds great importance at the primary, secondary, and university level but at secondary level more attention should be paid towards mathematics as it helps students to pursue their degrees in mathematics, to get admission in their preferred institution, future job, and higher remuneration (Mujtaba et al., 2014). Since mathematics is considered as a challenging subject, students often develop a feeling of anxiety related to mathematics which ultimately affects their academic achievement (Yenilmez et al., 2007). It is an emotionally crippling negative response to mathematics that leads to a sense of powerlessness or incapacity to solve mathematical problems (Hill et al., 2016). Mathematical anxiety is a condition that impacts students globally at all educational levels, from university students to primary school students (Mahmood 2010). Teachers are quite concerned about students' anxiety when it comes to mathematics because they believe that a high level of worry will lead to a student avoiding mathematics (Anderson, 2007, p. 93). As per the **Annual Status Educational Report (ASER) 2022**, "A National Math problem" was seen after pandemic in India, among children of class 3<sup>rd</sup>, 9.8% were not able to recognize numbers between

1-9, however 27.6% can recognize numbers up to 9 but fail to recognize numbers up to 99 or higher. Only 17.6% can perform basic mathematical operations like subtraction, but cannot do division, and only 8.3% can do division. This report further revealed that only 21.6% students of class V can perform division among private schools and only 38.7% among government schools. The report also revealed that only 41.8% students of class VIII can do division and only 53.8% students studying in private schools can do division. Recently the New National Policy on Education 2020 has put emphasis on enhancing the basic mathematical literacy under **“Foundation Literacy and Numeracy: An urgent & Necessary Prerequisite to learning”** which it is regarded as an essential prerequisite to enhance foundational literacy and basic mathematical operations like addition, subtraction, division, multiplication apart from this highest priority will be given to achieve foundational literacy and numeracy by 2025. Research studies have found that there are many factors that brought to mathematics anxiety such as curriculum weakness, negative experiences in mathematics, pressure and family expectations, teacher’s personality and teaching style, dreams and expectations of family and peer influences (Arem &Marzita, 2002).

## METHODOLOGY

The aim and objective of the current study was to identify the factors that lead to anxiety among students towards mathematics subject. Keeping this in mind, the researcher carried out a literature review on various data bases like Google Scholar, ERIC, Academia as carried out by Majid & Vijaya Lakshmi (2022), Majid (2021) and Majid & Vijaya Lakshmi (2022). The researcher used the key word ‘Anxiety Towards Mathematics’ and ‘Mathematical Anxiety’ on these above-mentioned research data bases. With the literature review, the researcher was able to collect around 40 studies. Considering the criteria of the current study researchers also followed a well framed inclusion and exclusion criteria, only 21 studies which were carried out during the time period of 2013-2023 were considered for the literature review. The researchers analysed all the research studies by using technique of Content Analysis.

## DISCUSSION

The discussion section presents factors and its components that were used by the researchers to study mathematical anxiety with respect to the study.

**Table 1.1: Factors Affecting Mathematical Anxiety**

Researcher	Title	Factors
Zanabazaret al. (2023)	“A study of factors causing math anxiety among undergraduate students”	Learner related factors, Family related factors, Teacher related factors, School related factors.
Odiri (2023)	“Students Learning Experiences: A case study of cognitive, Environmental & Behavioural dispositions towards math anxiety”	Social factor, Learning experiences, Cognitive factor, Behavioural Factor, contextual factor.
Marks (2022)	“Anxiety in Mathematics: Change the Narrative, Change the Environment”	Social Factor, Negative Experiences, Parental Factor
Mehmat&Hulge (2021)	“Factors that cause students to develop math anxiety and strategies to diminish it”	Lack of knowledge of students from lower classes, Crowded classrooms, Difficulty in understanding logic of the problem, lack of concentration, Inability to read fluently, Ineffective teaching strategies, comparison with successful students, Negative attitude of parents, crowded families, parental pressure, low interest in mathematics.
Vargas (2021)	“A literature Review on math anxiety and Learning Mathematics: A general overview”	Genetic Factor, Environmental Factors, low self-esteem, Difficulty in understanding number sense
Brewster & Miller (2020)	“Missed Opportunity in Mathematical Anxiety”	Cognitive and affective factors, Deadlines, Examinations, poor time management,

		cultural influences, social factors, negative self-belief about mathematics, low mathematics self-concept, and low mathematics self-efficacy, missed opportunity factor.
Pramana, et al. (2020)	“Mathematical anxiety and the influencing factors among junior high school students of Yogyakarta, Indonesia”	Cognitive factors, low motivation, home environment, social factors, and classroom environment
Azizah et al. (2019)	“Profile of student’s mathematics anxiety”	Personality factors (psychological and emotional), environmental, social intellectual, students fear regarding their abilities, poor teaching methods, incompatible learning styles
Prahmana et al. (2019)	“Mathematical Anxiety among Engineering Students”	Low mathematical self-efficacy, Negative mathematical experiences, Perception of difficulty, Negative classroom environment
Estonanto& Dio (2019)	“Factors causing mathematical anxiety of senior high school students in calculus”	Abstract mathematical concepts, Teacher Factor, Poor skills in comprehension and analysis, lack of confidence
Yuliani et al. (2018)	“Analysis of Mathematical anxiety of junior high school students”	Poor mathematical performance, Negative dispositions towards mathematics, difficulty in understanding mathematics, low self-confidence, low self-esteem, poor methods of teaching
Siswanti& Novita (2018)	“The effect of self efficacy to mathematical anxiety on junior high school students of YDM learning guidance courses”	Lack of interest of mathematics, Negative emotional reaction to math problems, unconfident, difficulty in concentration, lack of self efficacy and individual belief, avoidance behaviour
Luttenberger et al. (2018)	“Spotlight on Math Anxiety”	Myth that maths ability is inborn, culture and education system, low self-efficacy and self-concept, Gender and stereotype, Lack of knowledge about basics of mathematics, Inability to understand mathematical concepts.
Farjadpour et al. (2018)	“A statistical Analysis on the factors influencing mathematics anxiety in undergraduate students of mathematics and engineering”	Gender factor, Cultural factor, Poor school Environment, Family influences, Lack of Motivation and Confidence, Less Self efficacy, Lack of Parental support
Rubinstein et al. (2018)	“A Framework for studying the Heterogeneity of Risk Factors in Math Anxiety”	Cognitive factor, Affective factor, Environmental Factor. Difficulty in understanding number sense, Genetic predispositions, neuro physiological predispositions, parental styles
Mollah (2017)	“Mathematical Anxiety among the school students”	Teachers Anxiety, Societal factors, environmental factors, classroom experience, failure in mathematical tests
Yeasmin (2017)	“Consequences of Mathematical Anxiety on Student Achievement in Mathematics What Does Research Say?”	Depletion of Cognitive resources, Poor Mathematical Performance, Poor Mathematical problem-solving Ability, Low math motivation, Negative classroom experiences, increased cardiovascular and salivary concentration, fear of failure in

		mathematics, Teacher’s math anxiety, parental math anxiety, poor test performance, Ineffective Study Methods, Negative Parental Attitude towards Mathematics
Pellicioni et al. (2016)	“Math Anxiety: A review of its cognitive consequences, psycho physiological correlates and brain bases”	Environmental factors, Genetic Factors, Difficulty in understanding number sense
Beilock& Moloney (2015)	“Math Anxiety: A factor in Math Achievement not to be Ignored”	Cognitive factors and Negative attitude about mathematics, Low self-belief, crowded classroom, poor mindset of learner
Finlayson (2014)	“Addressing Math Anxiety in Classroom”	Fear of failure, students lack of knowledge, non-engagement, lack of self-confidence, Poor teaching Strategies, Difficulty in understanding mathematical equations, rote memorization, poor problem-solving abilities, fixed curriculum
Shaikh (2013)	“Mathematical Anxiety factors and their influence on performance in Mathematics in selected schools in Bangkok”	Cognitive factors, psychological factors, physical factors, Environmental factors, poor mathematical performance, Poor Comprehension skills, Poor Analytical and problem-solving skills

**Table 1.2: Frequency of mathematical anxiety factors as used by the researchers**

Factors	Frequency																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
<b>CF</b>		1				1							1			1		1	1		1	<b>7</b>
<b>ITM</b>	1						1	1						1	1					1		<b>6</b>
<b>EF</b>	1	1			1	1			1			1	1	1	1		1				1	<b>11</b>
<b>LF</b>	1			1	1			1	1	1	1	1		1		1		1	1	1	1	<b>14</b>
<b>PF</b>	1		1	1								1	1			1						<b>6</b>
<b>Total</b>	<b>4</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	

CF = Cognitive Factor, IAM = Inappropriate Teaching Methods, EF = Environmental factor, LF = Learner Factor, PF = Parental Factor

**Factor wise Analysis**

**(I) Cognitive Factor**

Anxiety in mathematics can result from the exhaustion of cognitive resources. Odiri (2023) choose high and low performing students through semi – structured interview, mathematical anxiety questionnaire and interview. The study reported that three components of learning process such as cognitive, contextual and behavioural aspect affect the student math related anxiety. Prahmana et al., (2020) examined mathematical anxiety and influencing factors in a descriptive study with a sample of 2163 students. The researchers reported

that fear of not being able to solve difficult mathematical problems, sensation of confusion or disarray, concentration problem while addressing cognitive factor leading to mathematical anxiety as well as home environment, interaction with parents and siblings, classroom environment can also cause mathematical anxiety. Rubinstein et al., (2018) reported that anxiety in mathematics arises from a variety of factors and cognitive factor is one of them. The parental styles can also be the factors that contribute to mathematical anxiety. Yeasmin (2017) focused on multiple dimensions of mathematical anxiety by utilizing secondary

sources like research papers, government records, theses, and journals published both domestically and internationally and finally concluded that poor performance in mathematics may be the result of anxiety related cognitive factors. When student performance in standardized mathematics tests remains low, it can also lead to mathematical anxiety. Beilock & Maloney (2015) reported that those with greater levels of math anxiety may not represent or process numbers in the same manner as people with lower levels of anxiety. The researchers reported that cognitive predispositions and negative attitude towards mathematics which mainly includes low self-concept related to mathematics, parental negative attitude related to this subject and overcrowded classrooms and boring teaching methods were the prominent factors that lead to mathematical anxiety. Shaikh (2013) in a descriptive study by using the Math Anxiety Opinionnaire revealed that cognitive, psychological, physiological and environmental factors were the main Mathematics Anxiety factors that influence on performance in Mathematics. Further, it was found that even pupil who do well in mathematics might have math anxiety.

### **(II) Inappropriate Teaching Methods:**

Inappropriate and boring teaching methods adopted by the teacher for teaching mathematics can also contribute in developing mathematical anxiety among students. Zhanabazar et al., (2023) studied factors causing math anxiety among undergraduate students with a sample of 916 students selected through convenience sampling and reported that learner, family, school related factors poor teaching methods, poor communication between student and teacher, heavy workload and use of outdated resources are responsible for causing mathematical anxiety among students. Further it was found that inappropriate teaching methods adopted by the teacher for teaching mathematics like memorizing formulas and procedures, excessive focus on speed and accuracy, insufficient use of ICT, less emphasis on understanding of concepts can cause students to feel boredom in mathematics class and this thing ultimately leads to mathematical anxiety and avoidance of mathematics. Mehmat & Hulya (2021) while analysing factors that cause students to develop math anxiety and strategies to diminish it found that insufficient knowledge of effective teaching strategy, negative attitude towards mathematics, low interest in mathematics, lack of knowledge of students from lower classes,

Difficulty in understanding logic of the problem, lack of concentration, Inability to read fluently, comparison with successful students, Negative attitude of parents, crowded families, parental pressure are the important factors that increase the chances of developing mathematical anxiety among students. Estonanto & Dio (2019) reported that students poor understanding and analytical abilities, teachers influence, and the complexity of Calculus, abstract mathematical concepts, teacher factor, Poor skills in comprehension and analysis, lack of confidence were the main causes of their mathematics anxiety and poor teaching methods adopted by the teacher can also cause mathematical anxiety among students. Yuliana et al (2018) reported that when students have to complete arithmetic projects and face math assessments, they become most anxious, because focus remains on memorization of mathematical concepts without having conceptual understanding, students often feel insecure while answering arithmetic problems because they are unaware of formulas that are used in these problems. Students comprehension of the content in mathematics textbooks is inadequate, all these things happen when teachers use poor strategies and methods for teaching this subject. Findings of the study further revealed that students often show little interest in pursuing a career in mathematics. Finlayson (2014) reported that fear of failure, students lack of knowledge, non-engagement, lack of self-confidence, poor teaching strategies, difficulty in understanding mathematical equations were the main factors that lead to mathematical anxiety.

### **(III) Environmental Factor:**

Vargas (2021) in a review-based study related to maths anxiety and learning of mathematics found that environmental variables that particularly include education of the parents, the home and family environment, the parenting style, and technical instruction. Content, teacher education level, low socioeconomic status of parents contributes to mathematical anxiety. Prahmana et al (2020) examined mathematical anxiety and influencing factors in a descriptive study and reported that classroom culture, social stereotypes are the major environmental factors that lead to mathematical anxiety. Prahmana et al., (2019) explored mathematical anxiety among engineering students with a sample of 47 engineering students reported that environmental factors like social reinforcement to hate mathematics, social

stereotypes can contribute to mathematical anxiety. Rubinstein et al., (2018) in a framework for studying the heterogeneity of risk factors in math anxiety stated that unpleasant environmental experiences to students regarding mathematics, negative classroom learning experiences while solving mathematical problems may exacerbate mathematical anxiety. Faujadpouret al. (2018) while studying factors that influence mathematics anxiety reported that gender stereotyping, crowded classrooms etc is a main factor that contribute to mathematical anxiety. Mollah (2017) in review based study related to mathematical anxiety among school students concluded that environmental factor be it home environment and school environment in addition to this unpsychological teaching methods adopted by the teacher, negative experiences in classroom, test pressure can contribute to mathematical anxiety. Shaikh (2013) in a descriptive study on mathematical anxiety factors and their influence on performance in Mathematics reported that, apart from cognitive, psychological factors its only environmental factor that is the leading factor that contributes to mathematical anxiety.

#### **(IV) Learner Factor:**

Odiri (2023) in a case study of cognitive, environmental & behavioural dispositions towards math anxiety and by adopting mathematical anxiety questionnaire, and interviews reported that apart from cognitive, contextual factors, behavioural factors of learner like some learners get angry by their inability to understand certain mathematical ideas and their lack of mathematical expertise leads to math anxiety. Zanabazaret al., (2023) studied factors causing math anxiety among undergraduate students and reported that learner, family, school related factors poor teaching methods, poor communication between student and teacher, heavy workload and use of outdated resources are responsible for causing mathematical anxiety. Further it was reported that learner related factors like poor mathematical skills, nervousness, negative emotions can cause mathematical anxiety. Brewster & Miller (2020) in a review based research study found that math anxiety usually causes a negative effect on the physiological and cognitive functioning of an individual. Study highlighted that despite cognitive and affective factors, deadlines, examinations, poor time management, cultural influences, social factors, negative self-belief about mathematics, low mathematics self-concept, and low mathematics

self-efficacy, missed opportunity factor that means learner is good in other academic subjects but performs badly in mathematics can cause mathematical anxiety because learner remained quite worried and stressed about this condition. Azizah et al (2019) in a descriptive quantitative study examined profile of student's mathematical anxiety and reported that environmental, social, intellectual, poor teaching methods, incompatible learning styles as well as lack of mathematical competency, lack of self-belief, ignoring academic tasks were some of the personal factors of the learner that lead to mathematical anxiety. Siswanti & Djalal (2018) with a sample of 75 students of grade vii, viii and ix of YDM learning guidance course revealed that negative self-belief, lack of ability to solve mathematical problem on the part of learner, negative emotional reaction to solve mathematical problems were the main contributing factors to mathematical anxiety. Further study revealed that due to mathematical anxiety individual becomes less interested in mathematics and starts avoiding it. Yeasmin (2017) reported that low math performance, cognitive factors, low math performance on standardised tests can result in mathematical anxiety apart from this learner's low intrinsic motivation, students perceived classroom environment, low self-efficacy can lead to mathematical anxiety. Beilock & Maloney (2015) in a review-based study related to Math Anxiety revealed that mathematical anxiety is a multifaceted phenomenon that arises due to a combination of cognitive predispositions, exposure to negative as well as poor environment and poor mind set of learners related to this subject that mathematics. Finlayson (2014) while addressing mathematical anxiety in the classroom conducted a survey on 70 pre service teachers enrolled in 16 month B.Ed courses reported that main factors that contribute to mathematical anxiety are poor teaching strategies, fixed curriculum as well as difficulty in understanding mathematical equations, rote memorization, poor problem solving abilities, fear of failure, student lack of knowledge, non-engagement, lack of self-confidence on the part of learner can contribute to mathematical anxiety.

#### **(V) Parental Factor:**

Zanabazaret al (2023) studied factors causing math anxiety among undergraduate students reported that learner, family, school related factors poor teaching methods, poor communication between student and

teacher, heavy workload and use of outdated resources are responsible for causing mathematical apart from this parental factor which includes parents fear or anxiety with mathematics, parent's hesitation about child's poor mathematical skills can lead to math anxiety. Marks (2022) in a review based study related to anxiety in mathematics reported that societal pressures, early education, parental pressure, inadequate knowledge of parents related to mathematics contribute to mathematical anxiety. Prahmana et al., (2020) in a descriptive study reported that parents often complain about their child's low maths scores. Most of the parents think their kid is not very good in maths and when children get frustrated with mathematics, parents tell them to leave this subject. All these factors can also enhance anxiety issues among students related to mathematics. Rubinstein et al. (2018) revealed

that math anxiety can be caused by a number of factors, including cognitive, which are examined from a developmental and dynamic standpoint. In addition to genetic predispositions, neural predispositions, parental factor which includes parental practice like expecting high grades from their children can cause anxiety related to mathematics. Yeasmin (2017) focused on various aspects of mathematical anxiety and reported that math anxiety may be caused due to cognitive factors, low math performance on standardized tests, poor math performance can also lead to increased cardiovascular activity and salivary cortisol concentration that enhance mathematical anxiety. The study further revealed that parental factors like lack of support in family, parental negative attitude towards mathematics can cause mathematical anxiety among children.

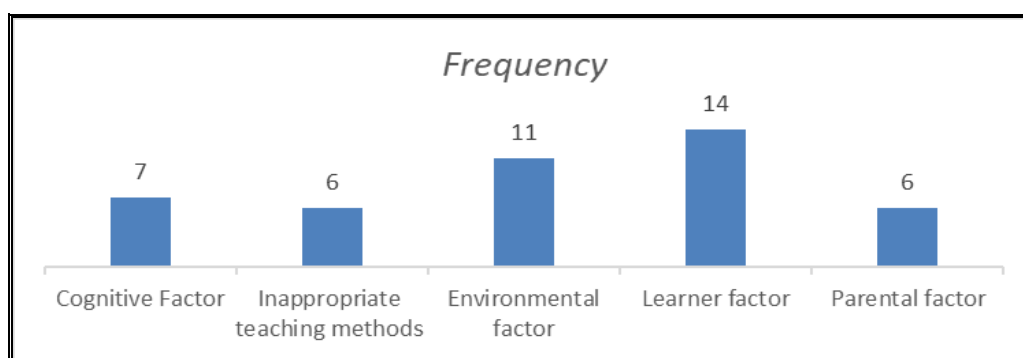


Fig 1.3: Frequency of factors as used by the researchers

## CONCLUSION

Based on small scale literature review related to factors affecting mathematical anxiety where the studies carried out between 2013 to 2023 were focused. The aim and objective of the present study is to identify main factors that lead to mathematical anxiety among students. The researcher carried out review of related literature to identify the factors that lead to anxiety towards mathematics among students. The researcher surfed various research databases like Google Scholar, ERIC, Academia for collecting the relevant studies and as such 40

studies were collected. Out of 40 studies, 21 studies which met the criteria of our study were analysed with the help of Content Analysis technique. Findings of the review of literature suggests that there are various factors that lead to mathematical anxiety among students like cognitive factor, environmental factor, inappropriate teaching methods, learner factor, parental factor and it was found that the most dominating factor that give arise to mathematical anxiety among students is learner factor.

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