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A Literature Study of Mathematical Anxiety Against Mathematics Learning and Explore the Student Mathematical Anxiety

Dwita Elfri Mayani[1]

[1] Department of Mathemtics, Universitas Negeri Yogyakarta, DI Yogyakarta, Indonesia

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Author for correspondence:
Dwita Elfri Mayani
e-mail: dwitaelfri.2022@student.uny.ac.id

Abstract- The purpose of the literature review in this study was to thoroughly evaluate and assess the theories, signs, effects, and initiatives used to help students overcome their math anxieties. The type of research used is a literature study. This study used the systematic literature review (SLR) method. The data collection technique used is the inclusion criterion, and the data analysis technique used is exposition. Based on the findings of several studies, it is clear that mathematical anxiety negatively impacts students' learning outcomes, learning processes, and mathematical abilities, including their ability to solve math problems and other mathematical abilities. Of course, based on these studies, there is a need for efforts to overcome mathematics anxiety, both carried out by teachers and students so that the mathematics learning process can run smoothly. But not all math anxieties produce negativity. Some articles also mention that math anxiety can improve students' mathematical achievement.

1. Introduction

Mathematics is one of the compulsory subjects given from elementary school to college level. One of the objectives of learning mathematics in schools is to train students' thinking skills so that they can think logically, critically, analytically, systematically, and creatively and have the ability to work together effectively. Students are trained to find, manage, and utilize the information they have obtained to face problems in dynamic and competitive daily life (Dzulfikar, 2016). However, in reality, the importance of mathematics is not following the conditions in the field. Several problems occur during the mathematics learning process, such as problems of mathematical ability in solving mathematical problems and psychological problems that can be experienced by students in the process of learning mathematics (Santoso, 2021).

Jayantika (2020) Wu et al. (2012) stated that one of the psychological problems often experienced by

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students in the learning process is anxiety. The anxiety experienced by students in mathematics subjects is referred to as mathematical anxiety (Anita, 2014). Desai et al., 2018; Iossi (2007) explained that mathematical anxiety is a feeling of tension and anxiety that interferes with solving mathematical problems in everyday and academic life. This is in line with what was stated by Tobias Sheila (1980). Mathematics anxiety is a feeling of panic, helplessness, inability to act, and mental inability that occurs in a person when asked to solve a math problem. Fear and worry are psychological symptoms usually caused by a person's inability and helplessness to face problems (Supriatna & Zulkarnaen, 2019; Ulya & Rahayu, 2017). Mathematical anxiety is one aspect that must be considered in learning mathematics (Ashcraft & Moore, 2009; Mutlu, 2019; Supriatna & Zulkarnaen, 2019).

Several research results show that mathematical anxiety plays an important role and has a significant relationship with mathematical ability and the learning outcomes of students (Auliya, 2016; Fitriani & Pujiastuti, 2021). Research conducted by Diana (2020) states that there is a difference between students' ability to understand concepts based on their anxiety level. The ability to understand mathematical concepts of students who have low levels of anxiety is higher than that of students who have medium or high levels of anxiety. Research conducted by Riski (2019) states that there is a significant influence between mathematical anxiety and students' problem-solving abilities. The results showed that students who had low anxiety had better mathematical solving skills, and students who had high anxiety had poor mathematical skills. Research conducted by Ikhsan (2019) states that mathematical anxiety negatively influences mathematics learning outcomes. This negative influence is that if anxiety is high, then student learning outcomes are low, and vice versa. This is reinforced by research conducted by (Mayudana, 2020), which states that there is a strong relationship between mathematical anxiety and learners' math learning outcomes. The higher the level of mathematical anxiety possessed by students, the lower the learning outcomes. This happens when feelings of pressure and anxiety increase as well, which can affect the learning outcomes of students.

Not only that, but some research results convey risk factors for anxiety. Mathematics research conducted by Ashcraft & Moore (2009), strategies to minimize mathematical anxiety (Iossi, 2007), Parents' math anxiety (Casad et al., 2015) and not only that according to research conducted by (Arifah & Widjajanti, 2018) states that mathematical anxiety not only has a negative impact but can also improve student learning outcomes. This is supported by research conducted by (Jayantika, 2020), which suggests that math anxiety can increase student math achievement, weaken student math achievement, or not be associated with student math achievement, depending on student characteristics.

Based on the explanation that has been described, mathematical anxiety is an aspect of psychology that has an important role and needs more attention from mathematics teachers because some research results show that mathematical anxiety influences students' mathematical abilities and learning outcomes. The existence of mathematical anxiety in students can adversely affect the learning process because, when students experience mathematical anxiety, they will have difficulty digesting or understanding lessons well (Fista et al., 2019). Therefore, teachers need to know what mathematical anxiety looks like, the Factors that cause math anxiety, the impact caused by it, early symptoms of math anxiety, psychological symptoms, the importance of knowing student characteristics and efforts that can be made to overcome and reduce it in students so that the learning process can run smoothly. This study aims to thoroughly evaluate and assess the theories, signs, effects, and initiatives teachers use to help students overcome their math anxiety in math learning.

2. Methods

The type of research used is a literature review study. This study used the systematic literature review (SLR) method. SLR performs several steps: identifying, reviewing, evaluating, and interpreting all available research results (Triandini et al., 2019). Using systematic literature reviews, researchers systematically review and identify journals, following the steps in each process. The purpose of this research method is to provide a holistic and in-depth view of the research topic and identify knowledge gaps or potential findings that may exist in the literature. A systematic literature review helps build a comprehensive understanding of a particular issue, charts the research progress and lays the foundation for further study.

An effective step in compiling a literature review is to search for general information before looking at specific details. The steps that can be taken are as follows: 1. Problem formulation. The author will explain the topic of the problem completely, precisely, and accurately. 2. Search the literature. An overview of the research topic is obtained from relevant literature. Later, it will be useful if supported

by sufficient knowledge about the subject of study because these sources will explain previous research thoroughly. 3. Evaluate the data. Writers must be good at sorting out information that is needed and not. These data can be qualitative, quantitative, or a combination of both. 4. Conduct analysis and interpretation. Conduct a discussion, then summarize it with packaging that is as attractive as possible (Ridwan et al., 2021).

Systematic literature review research generally does not use research instruments like other research. However, in this systematic literature review, researchers adopt guidelines or protocols used in Juandi (2021) that detail methodological steps and procedures, literature search strategies, and inclusion criteria. This helps ensure that SLRs are carried out systematically and transparently and thus makes a valuable contribution to comprehensiveness.

The data collection technique in this study is the inclusion criterion, which explains the factors chosen to be included in the article to be reviewed. The data analysis technique in this study is the exposition method. The inclusion criteria determined are: (1) articles are the results of mathematics education research; (2) articles published from 2009 to 2024; this is due to differences in curriculum use during that period, where although there are similarities in student-centred learning, there are differences caused by the pandemic affecting the psychological aspects of mathematics education students; and (3) articles obtained from electronic databases such as Google Scholar, DOAJ, Scopus, Elsavier, and national journal URLs. By combining these sources, a systematic literature review can provide a more comprehensive, in-depth, and contextual overview of the effect of mathematical anxiety on learning outcomes. (4) Articles containing qualitative, quantitative, mixed, and development research types; (5) Articles containing research from elementary, junior high, and high school to university levels.

3. Results and Discussion

Iossi (2007) explained that mathematical anxiety is a state of stress and worry that prevents one from solving mathematical issues in academic and real-world contexts. According to Ashcraft (Hidayat & Ayudia, 2019), Mathematics performance is hampered by mathematical anxiety, which is a state of tension, anxiety, and fear. According to a study by Tobias Sheila (1980), attempting to solve a mathematical issue might cause panic, helplessness, impotence to act, and mental control. The sensation of stress, dread, or worry experienced when attempting to solve mathematical problems or learn mathematics, together with various symptoms, is known as mathematical anxiety (Hadi et al., 2020). Psychological symptoms such as elevated heart rate, sweaty hands, panic, stress, abdominal pain, dizziness, inability to concentrate, and more are brought on by feelings of powerlessness and inadequacy (Diana et al., 2020). Khatoon and Mahmood (Dzulfikar, 2016) demonstrated that kids from primary through higher school experience math anxiety. Additionally, as education levels rise, anxiety levels rise as well (Supriatna & Zulkarnaen, 2019).

Tobias (Smail, 2017) According to research, three things make kids anxious about arithmetic, including the following: 1). Students subjected to forced authority believe that teachers are the only sources of information. 2) The dread of expressing one's thoughts refers to pupils' reluctance to pose inquiries or offer explanations in front of the class for concern that they could be incorrect and embarrassed. 3. When exams might make students anxious and stressed. In addition, according to Hadfield and McNeil (Smail, 2017), a variety of elements, which can be categorized as environmental, intellectual (mental), and individual, contribute to math anxiety. a) Environmental aspects, such as student engagement in mathematics-learning activities in class and the mathematics teacher's personality. b). Mental aspects, such as the capacity for abstract thought and sophisticated reasoning in mathematical topics. b) Personal characteristics, such as self-worth, physical fitness, learning style, level of confidence, attitude toward arithmetic, and prior experiences that were closely related to math (Lazarus, Averill, and Fitzgerald (Auliya, 2016)).

Additionally, anxiety frequently results from traumatic experiences and unfavourable views toward mathematics that a person has. Freedman (Jayantika, 2020) describes mathematical phobia as "an emotional response to mathematics based on negative past experiences that harm learning in the future". According to this quotation, arithmetic anxiety is an emotional response from unpleasant experiences that harm later learning. This is in line with Yusof dan Tall (Auliya, 2016), It claims that unfavourable attitudes toward mathematics typically arise when students struggle with math problems or during tests; if this occurs repeatedly, the bad attitude will eventually give way to mathematical anxiety. Numerous signs of mathematical anxiety exist.

According to Holmes (Lestari and Yudhanegara, 2018), The following are some signs of mathematical

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anxiety:

a) Mood is Feelings of tension, concern, fear, anxiety, and uneasiness are indicative
b) The motor is characterized by tension in motor movements, including shaking and a tense or rushed demeanour.
c) Cognitive, which is characterized by trouble focusing and decision-making when tackling difficulties.
d) Sematic, characterized by heart conditions like elevated heart rate and cold hands.

According to Istikomah & Wahyuni (2018), Three parts, namely cognitive, emotive, and physiological factors, make up the indicators of mathematical anxiety. Cognitive factors include self-ability, self-confidence, trouble concentrating, and fear of failure. Anxiety, tension, motion sickness, and profuse perspiration are affective elements. Headaches and an elevated heart rate are physiological effects.
Mathematical anxiousness can make it tough for students to accept and comprehend what the teacher is conveying regarding mathematical concepts and to concentrate during the learning process (Hakim & Adirakasiwi, 2021). Mathematical anxiety can make it harder for students to focus during the learning process and absorb and understand what the teacher is communicating regarding mathematical topics. (Ardani et al., 2021). Additionally, anxiety inhibits a student's learning ability since it impacts their self-control, incentive to act, enthusiasm, learning motivation, and propensity to put off learning (MZ et al., 2018). According to Menurut Jalal (2020), The following are some effects that mathematical anxiety may have: Students' capacity to grasp mathematics, their ability to solve problems, and their learning outcomes in mathematics are all significantly impacted by: a) Concerning the cognitive domain, which involves dependence on others and trouble remembering and applying mathematical processes; In the somatic domain, symptoms include increased heart rate when the teacher conducts a quiz or exam suddenly, feeling dizzy and nauseous when presenting assignments in front of the class and b) In the domain of mathematical representation, where it is difficult to express opinions in frame; c) In the attitude domain, where being very careful in solving problems and doing negative actions like cheating when running out of ideas to solve the math problem being done;
The following research in Table 1 findings can serve as alternatives or inspiration for teachers looking to help pupils who are anxious about math:

Table 1. An Example of a Table

No	Research title	Result
1	Ashcraft & Moore (2009). Mathematics Anxiety and the Affective Drop in Performance.	The authors' assessment of math anxiety risk factors and some considerations for coping with math-anxious students comes to a close.
2	Wang et al. (2018). Anxiety is not enough to drive me away: A latent profile analysis on math anxiety and math motivation.	These findings emphasize the significance of individualized therapies for these diverse groups and highlight the need to move beyond linear connections across global dimensions to address complexities in emotion-motivation-cognition interactions in mathematics learning.
3	Mutlu (2019). Math Anxiety in Students With and Without Math Learning Difficulties.	Showed that the math anxiety levels of students with math learning difficulties were no different from those of low-achieving students. However, the results illustrate a considerable difference between the poor and medium achievers' average math anxiety ratings.
4	Casad et al. (2015). Parent-child math anxiety and math-gender stereotypes predict adolescents' math education outcomes.	These results fill in the gaps in the research on the impact of parental math anxiety on children's math anxiety and math anxiety as performance-affecting mechanisms. The findings have implications for treatments to lessen arithmetic anxiety in parents and get rid of gender stereotypes in math classrooms.
5	Wu et al. (2012). Math anxiety in second and third graders and its relation to mathematics achievement.	These findings provide new insights into the origins of the development of math anxiety and further underscore the need to recover from math anxiety and its detrimental consequences on young children's math achievement.
No	Research title	Result
6	Arifah & Widjajanti (2018). Mathematics Anxiety: Causes and the Effects on Student's	The result of this study is that mathematical anxiety can be seen as progressive thinking or regressive

	Mathematics	thinking. Math anxiety is influenced by math instruction, students' attitudes toward mathematics, students' past math experiences, and students' beliefs. Math anxiety can facilitate students' math achievement, weaken students' math achievement, or not be associated with a student's mathematical achievement, depending on the diversity of student characteristics. Nevertheless, most articles state that math anxiety has a weakening relationship with student achievement.
7	Nugroho & Widjajanti (2019) Ethnomathematics: humanistic learning to manage math anxiety	Ethnomathematics emerged as a bridge throughout student culture, and there is a gap between formal and practical mathematics. Students will learn mathematics more easily and joyfully with ethnomathematics because the subject is directly tied to their daily lives and culture. Therefore, ethnomathematics learning can help teachers manage math anxiety.
8	Anglia et al. (2024). Identification of students' mathematical anxiety in mathematics learning	This literature review presents an analysis and overview of recorded papers about mathematical anxiety in mathematics learning based on the research data included in the study and further divided into four groups according to moderating variables: year of study, level of analysis, sample size and research methodology in each area of math anxiety. This study examines the following factors that are associated with mathematical anxiety: (1) mathematical aptitude; (2) media and technologies utilized in mathematics education; (3) approach and technique learning; (4) gender disparity; and (5) profile of mathematics.
9	Umayah (2019). Penerapan Model Discovery Learning dalam Mengatasi Kecemasan Matematika Siswa SMP	Learning mathematics with the Discovery Leaning models has a positive influence on reducing students' mathematical anxiety.
10	Ulya & Rahayu (2017). Pembelajaran Etnomatematika Untuk Menurunkan Kecemasan Matematika	The average level of mathematics anxiety using ethnomathematical nuanced probing-prompting learning was lower than the average level of mathematics anxiety with expository learning, and there was a decrease in mathematics anxiety in students by 48% using probing-prompting learning.
11	Maharani et al. (2018). Media Pembelajaran Matematika Berbasis Kartun untuk Menurunkan Kecemasan Siswa	The level of anxiety in students after using cartoon-based learning media decreased the percentages for high anxiety level (down from 41% to 0%), moderate anxiety level (down from 35% to 24%), and low anxiety level (down from 24% to 76%) reduced.
12	Ansari & Saleh (2019). Pengaruh Collaborative Teaching dan Pengetahuan Awal Terhadap Kecemasan Matematis Siswa	The average mathematical anxiety level of students who use collaborative teaching and learning is at ideal or moderate levels, compared to the mathematical anxiety level of students who use ordinary learning, which is at a severe level.
13	Wahyudy et al. (2019). Penerapan Pendekatan Concrete-Pictorial-Abstract (CPA) dalam Menurunkan Kecemasan Matematis Siswa Sekolah Dasar	There was a decrease in mathematical anxiety in students who learned better using the CPA approach than students who used conventional learning.

No	Research title	Result
14	Amam & Lismayanti (2020). Perangkat Project-Based Learning berbantuan ICT: Optimalisasi	The development of ICT-assisted PBL devices in the research is said to be valid in optimizing learners'

	Kemampuan Pemecahan Masalah dan Kecemasan Matematis Siswa	ability to solve and manage mathematical anxiety.
15	Prasetyawan (2018). Keefektifan pendekatan CTL dan discovery ditinjau dari prestasi, kemampuan berpikir kritis dan kecemasan matematika	In terms of learning achievement, critical thinking abilities, and students' mathematics anxiety, contextual teaching and learning (CTL) and discovery approaches are effective.
16	Setiani (2016). Mengurangi Kecemasan Matematis dan Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa Mts dengan Pendekatan PBL	(a) Improved mathematical problem-solving ability of learners with problem-based learning (PBL) is better than that of learners with expository learning. (b) Students who employ Problem-Based Learning (PBL) have superior math problem-solving skills than students who study through expository methods. (c) There is a decrease in students' mathematical anxiety with a problem-based learning (PBL) approach than with expository learning.
17	MZ et al. (2018). Pembelajaran Kooperatif Dalam Mereduksi Kecemasan Matematis Siswa (Math Anxiety)	Theoretically and based on the results of other studies that have been conducted, cooperative learning can reduce learners' mathematical anxiety.
18	Widiarti & Hernadi (2019). Penerapan Metode Pembelajaran Bermain Peran untuk Menurunkan Kecemasan Siswa terhadap Matematika	The application of role-playing learning methods can reduce the level of anxiety in students toward mathematics.

Using various learning models, such as the Accelerated Learning Cycle (ALC) learning model, cooperative, collaboration teaching, ethnomathematical learning, discovery learning, and the use of various approaches, strategies, and learning methods, such as the use of Problem-Based Learning (PBL) approach, Constructivist teaching, are just a few alternatives that teachers can use to help students who are experiencing mathematical anxiety. Teachers can employ these many models, approaches, techniques, methods, media, and learning resources, and research has shown that doing so can help students who struggle with arithmetic anxiety during the learning process. (Syariah et al., 2018). An effort to overcome and lessen anxiety can be made by using engaging techniques while learning mathematics, creating a rich environment and delivering mathematics material that is more easily understood, such as connecting mathematical material or concepts to everyday life and using supporting media or applications, such as the use of GeoGebra in mathematics learning—learners' mathematical aptitude (Santoso, 2021).

Additionally, there are several things that students can do to overcome their fear of math, including trying to shift their unfavourable perception of the topic by stating that math is an easy subject to learn rather than a tough one Disai et al. (2018). Because of this, students are less scared to try to understand math teachings at first. Moreover, Disai et al. (2018) stated that kids must be self-motivated and highly confident in completing math-related tasks or difficulties. Freeman (Syafri, 2017) When pupils experience math anxiety, provide them with ten strategies to overcome it, starting with (1) Changing one's attitude toward math. (2) Ask questions. Kids who have trouble studying arithmetic should get used to asking questions. (3) Remember that learning mathematics requires courage on the part of the students because it is unfamiliar or new knowledge. (4) don't emphasize rote memorization or rely completely on your recollection when learning mathematics. (5) Read math books as thoroughly as you can, which means that if students run into difficulties while learning mathematics, it is advised that they go over the content again. They should also use more than one mathematics book to understand the concepts being covered better. (6) Use one's preferred method or learning style for mathematics. (7) If you encounter material you don't understand, seek assistance. You can do this by approaching the teacher or organizing a study group with friends. (8) Make learning mathematics a relaxing and enjoyable experience. (9) Students might inspire themselves by telling themselves, "I love math." (10) Create and create a sense of accountability whether something succeeds or fails.

In this study, we found that there are several important things that teachers need to master in managing students' math anxiety. (1) Factors that cause math anxiety include insecurity, fear of failure, and pressure from the environment. (2) Early symptoms of math anxiety can be seen from decreased interest in maths lessons, tension when doing problems, and avoiding situations involving maths. 3) Psychological symptoms typically associated with math anxiety include negative thoughts, physical tension, and difficulty concentrating. (4) An unsupportive learning environment, such as pressure from

parents or peers, can also cause math anxiety. (5) It Is important to recognize student characteristics to assist teachers in designing learning approaches that suit their individual needs. Teachers must also consider approaches, methods, and learning models to reduce math anxiety, such as cognitive-affective approaches, technology use, and problem-based learning. (6) Building students' attitudes towards maths also plays an important role; Therefore, building a positive attitude towards this subject is an important step to reduce math's anxiety.

4. Conclusion

Mathematical anxiety is a state of tension, anxiety, and fear that students go through and that gets in the way of their ability to understand the subject. Attitudinal, cognitive, and sematic factors are the three mathematical measures of anxiety. An attitude is characterized by a sense of apprehension when undertaking a task. Concentration issues, confusion, and the inability to decide how to approach a topic are traits of cognitive disorders. Semantic symptoms include rapid heartbeat and profuse hand sweating. Multiple elements, including environmental, intellectual (mental), and personal aspects, contribute to mathematical anxiety—environmental elements, such as student engagement in learning activities in the classroom and math teachers' personalities. High-level abstraction and logic skills in mathematical topics are related to mental aspects. Individual characteristics directly associated with mathematics include self-worth, attitude toward mathematics, good physical condition, learning style, self-confidence, and prior experience.

Students who experience mathematical anxiety may have psychological symptoms like racing hearts, perspiring palms, panic attacks, tension headaches, nausea, and difficulties concentrating during subsequent math classes. Teachers can employ learning that differs in the use of models, tactics, approaches, methods, media, or learning gadgets that are appropriate and in line with the characteristics of learners to overcome mathematical fear. Additionally, people other than teachers take the initiative to reduce arithmetic anxiety. However, students must also play a part in conquering their math phobia. To overcome their mathematical anxiety, students need to adopt a positive attitude and eliminate any preconceived notions about mathematics.

In a literature review study of students' math anxiety, several new aspects are needed to expand the study. First, it is important to pay attention to the role of technology in managing math anxiety. Further research could explore how mobile apps, educational software, or online learning platforms can be used as tools to improve math skills while reducing anxiety. In addition, cultural and social aspects must also be considered in depth. Factors such as gender differences, socioeconomic background, and cultural stereotypes can influence students' math anxiety levels. Therefore, further research could explore how these factors interact with math anxiety and effective strategies for overcoming it. Finally, the role of the learning environment and social support is also important. Studies can evaluate how interactions between teachers, peers, and families can affect students' math anxiety and intervention strategies that engage these elements to create a supportive learning environment and reduce students' anxiety about math. Expanding the scope of research in this regard can provide a better understanding of the complexity of students' math anxiety and give a more effective guide for developing inclusive learning interventions and approaches.

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