

MATHEMATICS ANXIETY IN SCHOOLS: AN ANALYSIS OF CAUSES AND POSSIBLE STRATEGIES BASED ON EVIDENCE FROM TEACHERS AND STUDENTS

Anneke Primadiana¹, *Bambang Avip Priatna Martadiputra², Tatang Herman³

¹⁻³ Universitas Pendidikan Indonesia, Indonesia

bambangavip@upi.edu

ABSTRACT Mathematics anxiety is a psychological condition that affects students' learning processes and is characterized by feelings of anxiety, tension, or fear when dealing with mathematics. This study aims to analyze the causes of students' mathematics anxiety and identify possible strategies to address it based on evidence from students and teachers. This research employed a qualitative approach with a case study design, supported by descriptive data from a mathematics anxiety questionnaire. The participants were 39 students from Class XI F at SMAN 17 Bandung, with six students selected for interviews based on their anxiety levels. Data were collected through the Mathematics Anxiety Rating Scale (MARS) questionnaire, semi-structured interviews with students and teachers, and classroom observations. The questionnaire data were analyzed descriptively, while interview and observation data were analyzed thematically. The results showed that 66.67% of students experienced moderate anxiety, 25.64% experienced low anxiety, and 7.69% experienced high anxiety. The dominant indicator was cognitive disturbance at 59%, followed by negative attitudes toward mathematics at 58% and somatic symptoms at 54%. The factors causing mathematics anxiety included internal factors, such as insufficient mastery of prerequisite material, learning style, and fear of making mistakes, as well as external factors, such as fast-paced learning, curriculum pressure, peer competition, and parental expectations. The possible strategies to reduce mathematics anxiety include cognitive support through self-regulated learning and heterogeneous group learning, emotional support through positive affirmation and collaborative learning, and pedagogical adaptations through multimodal learning, remedial instruction, and constructivist approaches. These findings highlight the importance of integrating psychological and pedagogical support to reduce mathematics anxiety in school mathematics learning.

Keywords: mathematics anxiety, mathematics learning, students, teachers, qualitative case study

ABSTRAK Kecemasan matematika merupakan kondisi psikologis yang memengaruhi proses belajar siswa dan ditandai dengan perasaan cemas, tegang, atau takut ketika berhadapan dengan matematika. Penelitian ini bertujuan untuk menganalisis penyebab kecemasan matematika siswa dan mengidentifikasi strategi yang dapat digunakan untuk mengatasinya

berdasarkan bukti dari siswa dan guru. Penelitian ini menggunakan pendekatan kualitatif dengan desain studi kasus, yang didukung oleh data deskriptif dari angket kecemasan matematika. Partisipan penelitian adalah 39 siswa kelas XI F SMAN 17 Bandung, dengan enam siswa dipilih sebagai informan wawancara berdasarkan tingkat kecemasan matematika mereka. Data dikumpulkan melalui angket Mathematics Anxiety Rating Scale (MARS), wawancara semi-terstruktur dengan siswa dan guru, serta observasi kelas. Data angket dianalisis secara deskriptif, sedangkan data wawancara dan observasi dianalisis secara tematik. Hasil penelitian menunjukkan bahwa 66,67% siswa mengalami kecemasan sedang, 25,64% mengalami kecemasan rendah, dan 7,69% mengalami kecemasan tinggi. Indikator yang paling dominan adalah gangguan kognitif sebesar 59%, diikuti oleh sikap negatif terhadap matematika sebesar 58% dan gejala somatik sebesar 54%. Faktor penyebab kecemasan matematika meliputi faktor internal, seperti kurangnya penguasaan materi prasyarat, gaya belajar, dan rasa takut melakukan kesalahan, serta faktor eksternal, seperti tempo pembelajaran yang cepat, tekanan kurikulum, persaingan antarteman, dan harapan orang tua. Strategi yang dapat digunakan untuk mengurangi kecemasan matematika meliputi dukungan kognitif melalui self-regulated learning dan pembelajaran kelompok heterogen, dukungan emosional melalui afirmasi positif dan pembelajaran kolaboratif, serta adaptasi pedagogis melalui pembelajaran multimodal, remedial, dan pendekatan konstruktivis. Temuan ini menegaskan pentingnya integrasi dukungan psikologis dan pedagogis untuk mengurangi kecemasan matematika dalam pembelajaran matematika di sekolah.

Kata-kata kunci: kecemasan matematika, pembelajaran matematika, siswa, guru, studi kasus kualitatif

INTRODUCTION

Mathematics is one of the subjects that plays a role in developing reasoning skills and solving everyday problems (Afriansyah et al., 2019). This means that learning mathematics has a vital role in helping students solve problems in daily life. However, mathematics learning can also cause tension, discomfort, or other symptoms that interfere with students' learning (Anggoro et al., 2019). If students continuously experience these symptoms when learning mathematics, they may develop mathematics anxiety (Kusmaryono et al., 2020). Mathematics anxiety is one of the factors considered to be related to students' mathematical achievement, especially their ability to solve mathematical problems (Ahmad et al., 2025).

According to Jolejole-Caube et al. (2019), mathematics anxiety is a condition in which students respond to mathematical tasks with feelings of tension and fear. According to Ashcraft (2002), mathematics anxiety is a feeling of tension, anxiety, or fear experienced by someone when faced with a mathematical problem. According to Richardson and Suinn in Agustina (2024), the developers of the Mathematics Anxiety Rating Scale (MARS) stated that mathematics anxiety is a feeling of tension and anxiety that interferes when manipulating numbers and solving mathematical problems in various ordinary and academic situations.

According to Ashcraft and Moore (2009), there are three indicators of mathematics anxiety: (1) attitude, namely negative feelings toward mathematics, such as fear or hatred; (2) cognitive, namely mental disturbances when working on mathematics,

such as going blank or having difficulty concentrating; and (3) somatic, namely physical symptoms such as a pounding heart, trembling, or sweating. Meanwhile, according to Cooke and Hurst in Agustina (2024), mathematics anxiety consists of four components: (1) mathematics knowledge/understanding, which is related to thoughts that one does not know enough about mathematics; (2) somatic, which is related to the condition of the individual's body, such as sweating or heart palpitations; (3) cognitive, which is related to changes in cognition when dealing with mathematics, such as not being able to think clearly or forgetting things that are usually remembered; and (4) attitude, which is related to attitudes that arise when someone experiences mathematics anxiety, such as lacking confidence or being reluctant to do what is asked. Based on these two opinions, this study uses three indicators of mathematics anxiety, namely attitude, cognitive, and somatic indicators, in accordance with the opinion of Ashcraft and Moore.

Based on the explanations above, mathematics anxiety can be understood as a psychological condition characterized by feelings of anxiety, fear, tension, or discomfort when faced with situations involving calculations, numbers, and mathematical problems. The characteristics of mathematics anxiety include feelings of anxiety and tension when dealing with mathematical problems, numbers, and calculations.

Mathematics anxiety has been a focus of research in educational psychology and mathematics pedagogy for decades. Understanding mathematics anxiety in students is crucial because of its broad impact, not only on academic achievement. Recent studies have shown that mathematics anxiety is negatively correlated with mathematics achievement across cultures, genders, and developmental stages, with a stronger relationship observed in elementary school (Scheman et al., 2025). Furthermore, mathematics anxiety does not only affect academic achievement (Foley et al., 2017), but also disrupts students' arithmetic fluency from elementary school age, which can lead to cumulative gaps in mathematics skills (Scheman et al., 2025). In addition to affecting students' academic performance, mathematics anxiety also influences students' negative perceptions of mathematics, hinders learning motivation, and reduces students' self-confidence (Ma, 2025).

Recent research also reveals that mathematics anxiety can significantly reduce students' engagement in mathematics learning, where anxiety functions as a mediator between students' internal factors, such as their ability to overcome difficulties, and their engagement in learning (Liu et al., 2026). Thus, a thorough understanding of mathematics anxiety is crucial for designing appropriate interventions and creating supportive learning environments. Factors that cause mathematics anxiety are diverse, including less enjoyable learning methods, the perception of mathematics as a difficult and frightening subject, and pressure to achieve high grades. This is in line with Dowker et al. (2016), who stated that

mathematics anxiety stems from various factors, including inadequate teaching, social pressure, and previous negative experiences.

The above issues raise important questions about why many students are afraid of mathematics and how mathematics learning can help them overcome this anxiety. Previous research has made significant contributions to understanding mathematics anxiety from various perspectives. Most studies have focused on cognitive factors and their impact on academic achievement (Foley et al., 2017; Scheman et al., 2025). Other research highlights affective and motivational factors, including the relationship between mathematics anxiety, self-efficacy, and learning engagement (Wang et al., 2024; Liu et al., 2026). Dowker's studies have also identified factors that cause mathematics anxiety, such as previous negative experiences, social pressure, and less supportive teaching methods (Dowker et al., 2016; Ma, 2025; Scheman et al., 2025). However, several important gaps remain. First, previous studies have focused more on students' perspectives (Kusmaryono et al., 2020), while the role of teachers as a mediating factor has not been explored in depth. Teacher awareness of mathematics anxiety has been shown to play a crucial role in creating an inclusive and supportive learning environment (Evangelopoulou, 2024). Second, existing interventions have not sufficiently integrated pedagogical and psychological approaches simultaneously, although research shows that combined interventions involving mathematical skills and relaxation are more effective than single interventions (Scheman et al., 2025). Therefore, this article fills this gap by analyzing the causes of mathematics anxiety and possible solutions based on combined evidence from teachers and students.

Based on this background, this study focuses on the phenomenon of mathematics anxiety in schools through an analysis of its causes and possible solutions based on evidence from teachers and students. This study aims to analyze the causes of students' mathematics anxiety and identify possible solutions to address it.

METHODS

Type of Research (Design or Stages of Research)

This study on mathematics anxiety used a qualitative approach. A qualitative approach explores and understands the meaning of individuals or groups in relation to social or human problems (Creswell, 2023). This approach was used because mathematics anxiety involves complex feelings, beliefs, and personal experiences, so it allows for the exploration of in-depth narratives from participants (El-far et al., 2024). Qualitative research also helps reveal how individuals cope with mathematics anxiety (Pizzie & Kraemer, 2017). The design of this study was a case study, which is one of the designs in a qualitative approach (Creswell, 2023). The case study method allows for an in-depth analysis of the dynamics of anxiety (Ramirez et al., 2018). In addition, several factors, such as achievement pressure, social pressure, and self-

perception of mathematics, can be explored through interviews and observations (Luttenberger et al., 2018).

Subject, Location, and Time

The participants in this study were 11th-grade students of SMAN 17 Bandung in Bandung City. The students who participated were from Class XI F. Class XI F was selected because this class took advanced mathematics subjects, so the students studied two mathematics subjects: compulsory mathematics and advanced mathematics. Students who take advanced mathematics usually have higher motivation but may also experience different anxiety compared to students who only take compulsory mathematics (Choe et al., 2019). Advanced mathematics subjects have a higher level of difficulty, thus influencing students' coping strategies (Pizzie & Kraemer, 2017). Students who take both compulsory and advanced mathematics courses can provide insight into how they adapt to different demands (Maloney et al., 2015). In addition, students who study advanced mathematics tend to have a higher growth mindset, but anxiety may still arise due to competitive pressure (Dowker & Sheridan, 2022). Based on these considerations, Class XI F was considered relevant as the research context because the students were more likely to experience more complex mathematics anxiety.

The participants consisted of 39 students from Class XI F, including 18 male students and 21 female students. Observations and interviews involved six student subjects selected based on screening through a mathematics anxiety questionnaire. The mathematics anxiety questionnaire was adapted from Agustina (2024). From the screening, six subjects were obtained, namely two students with high anxiety levels (SE and MR), two students with moderate anxiety levels (RU and MA), and two students with low anxiety levels (AZ and DN). These six names are pseudonyms or code names used to protect the privacy of the research participants.

This research was conducted from May 7 to May 23, 2025.

Research Instruments and Data Collection

a. Research Instruments

This study used three main instruments.

1) Mathematics Anxiety Questionnaire

The mathematics anxiety questionnaire was adapted from the Mathematics Anxiety Rating Scale (MARS) in Agustina (2024), with modifications according to the school context. The mathematics anxiety questionnaire measured three indicators of anxiety based on Ashcraft and Moore (2009), namely attitude, cognitive, and somatic indicators. The attitude indicator refers to negative attitudes toward mathematics, the cognitive indicator refers to concentration problems, and the somatic indicator refers to physical symptoms such as heart palpitations. The questionnaire used a Likert scale of 1–5, with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

2) Semi-Structured Interviews with Students and Teachers

The interview guide was developed based on mathematics anxiety theory (Dowker et al., 2016) and teacher experience (Luttenberger et al., 2018). The questions covered students' mathematics learning experiences, anxiety-inducing situations, and coping strategies. Interviews were conducted with teachers and students. Six students were interviewed: two students with high anxiety levels (SE and MR), two students with moderate anxiety levels (RU and MA), and two students with low anxiety levels (AZ and DN).

3) Classroom Observation

Classroom observations focused on teacher-student interactions and students' emotional responses during mathematics learning (Ramirez et al., 2018). The observations also focused on the six students who had been identified through questionnaire screening. Classroom observations used observation sheets that included the teacher's teaching methods and students' behavior during learning, such as discussing with group members while completing group assignments.

b. Data Collection Techniques

1) Questionnaire

The questionnaire was administered offline by distributing the mathematics anxiety questionnaire to students. The questionnaire consisted of 24 questions and took approximately 15–20 minutes to complete.

2) Interview

The interviews were conducted face to face for approximately 10–15 minutes and were recorded for transcription.

3) Observation

One advanced mathematics meeting was observed for 3 × 45 minutes.

c. Instrument Validation

Validation was conducted to ensure that the instruments were theoretically appropriate and suitable for the research context. The instruments were reviewed by one expert lecturer in the pedagogical studies course who has expertise in educational psychology. In addition, triangulation was carried out by comparing data from questionnaires, interviews, and observations to verify the findings (Creswell, 2023).

Data Analysis Techniques

a. Analysis of Mathematics Anxiety Questionnaire Data

Questionnaire data were processed using a Likert scale of 1–5. The total score was calculated to determine students' anxiety levels. Students were then categorized into three levels of anxiety as follows:

High: high score on the questionnaire, for example $\geq 75\%$ of the maximum score.

Medium: medium score, for example 50–74% of the maximum score.

Low: low score, for example $\leq 49\%$ of the maximum score (Agustina, 2024).

After categorizing students, the percentage of students at each anxiety level was calculated. Then, the dominant indicator, namely attitude, cognitive, or somatic, was identified based on the questionnaire results.

b. Semi-Structured Interview Data Analysis

Interview recordings were transcribed verbatim (Braun & Clarke, 2006). Thematic analysis was conducted by identifying patterns and themes from students' and teachers' answers. The stages of analysis included: (1) familiarization, namely reading the transcripts repeatedly; (2) generating initial codes, namely coding important parts such as fear of being wrong, pressure on grades, and boring teaching methods; (3) grouping codes into themes, such as pedagogical factors and psychological factors; and (4) defining and reporting the themes in a coherent narrative.

c. Observation Data Analysis

Behavioral records were documented using teacher and student observation sheets to record teacher-student interactions and students' emotional responses. The focus was on the six students who had been identified through the questionnaire. Qualitative analysis was conducted by comparing observation notes with interview and questionnaire results. Patterns of anxiety-triggering situations were then identified, such as during tests or presentations in front of the class.

d. Data Triangulation

Method triangulation was carried out by combining questionnaire, interview, and observation results to validate the findings. Source triangulation was also conducted by comparing student and teacher perspectives to gain a holistic understanding.

e. Analysis Conclusion

The data collection and analysis techniques enabled this study to identify the causes of mathematics anxiety from various perspectives and to provide evidence-based solutions relevant to the learning context at school.

FINDING AND DISCUSSION

Students' Mathematics Anxiety Level

Based on the MARS questionnaire adapted from Agustina (2024), the distribution of mathematics anxiety among 39 students in Grade XI F was as follows:

1. High: 7.69% (3 students, including SE and MR)
2. Moderate: 66.67% (26 students, including RU and MA)
3. Low: 25.64% (10 students, including AZ and DN)

The dominant indicator was cognitive anxiety, with 59% of students experiencing mental disturbances during mathematics lessons and examinations, such as going blank or having difficulty concentrating. This was followed by the attitude indicator, with 58% of students experiencing negative feelings toward mathematics, such as

fear or dislike of mathematics. The somatic indicator appeared in 54% of students, marked by physical symptoms such as heart palpitations, trembling, or sweating.

These findings are in line with Ashcraft and Moore (2009), who state that mathematics anxiety is often related to cognitive disturbances and negative perceptions. The anxiety experienced by Grade XI F students who studied advanced mathematics is also relevant to Choe et al. (2019), considering the complexity of the material. In addition, competitive pressure, as explained by Dowker and Sheridan (2022), may intensify somatic symptoms, especially during examinations.

Causes of Mathematics Anxiety Based on Student and Teacher Perspectives

a. Cognitive Factors

Students with high anxiety, SE and MR, reported frequently going blank during examinations, especially when the material had not been previously mastered. MR stated, "If suddenly given a question that hasn't been studied, I immediately go blank." However, during learning activities, SE and MR were able to overcome this condition by asking the teacher or friends, which helped them solve the given problems.

Students with moderate anxiety, such as RU, admitted having difficulty understanding concepts without visual examples because of their audio-visual learning style. When RU did not understand the material learned at school, RU tried to review it at home using YouTube. RU stated, "I have to watch YouTube first if I don't understand it in class."

b. Pedagogical Factors

MR and RU stated that the fast pace of learning was one of the triggers of their anxiety. From the teacher's perspective, some students had not mastered the prerequisite material. One teacher stated, "Students don't master the prerequisite material, but the curriculum demands accelerated learning." In addition, time pressure was also a factor that caused anxiety. MR stated, "I panic when there are surprise exams." From SE's perspective, classmates' ambition also contributed to anxiety. SE stated, "My friends are ambitious, which puts pressure on me."

c. Socio-Emotional Factors

Regarding social comparison, SE stated, "I stay quiet when my friends ask me what my mathematics test score is." Meanwhile, DN stated, "My parents are aiming for an A because I'm going to study engineering." SE and MR also experienced physical symptoms, such as heart palpitations, and MR experienced trembling hands during examinations.

These findings are consistent with Ramirez et al. (2018), who explain that mathematics anxiety is triggered by a combination of cognitive factors, such as going blank during examinations, and situational factors, such as time pressure. SE and MR also experienced negative perceptions of their own abilities, which is in line with Ashcraft and Moore (2009). From the pedagogical aspect, the findings show the

importance of contextual support and scaffolding for prerequisite material, as emphasized by Luttenberger et al. (2018). Some students did not understand the prerequisite material, so the teacher reviewed it by approaching students individually during group learning. The teacher also ensured that each student understood the material being learned. Furthermore, classmates' ambition or competitive pressure in the classroom became one of the factors that contributed to anxiety, as stated by SE. This condition was also intensified by the pressure to complete dense curriculum material, as explained by Dowker and Sheridan (2022).

Multiple Evidence-Based Solutions

a. Cognitive Intervention

Students with low anxiety, AZ and DN, used self-regulated learning strategies. AZ studied difficult questions before examinations, while DN practiced independently with various types of questions before examinations. Before the lesson, the teacher conducted a diagnostic test and divided students into heterogeneous groups based on the test results. Each group consisted of students with diverse abilities. The teacher also explored prerequisite material for each topic and ensured that students understood the material.

b. Emotional Support

The teacher frequently provided positive affirmations to students. For example, the teacher often said, "Mistakes are part of learning." This positive affirmation helped reduce students' anxiety and fear of making mistakes, as experienced by SE. The teacher also implemented group learning, and students found this activity enjoyable. MA stated, "Learning with friends makes it more comfortable."

c. Adaptation of Teaching Methods

The teacher implemented fun learning activities and conducted remedial classes. SE recommended learning through a multimodal approach because of the need for audio-visual support. SE stated, "I need an explanatory video."

The self-regulated learning strategies used by AZ and DN are in line with Pizzie and Kraemer (2017), who explain the effectiveness of proactive coping in reducing students' mathematics anxiety. The heterogeneous group division conducted by the teacher is also in line with Maloney et al. (2015), who explain that peer collaboration can increase students' self-confidence. Positive affirmations and remedial activities provided by the teacher can support growth mindset feedback, namely feedback that focuses on students' learning process and development, thereby reducing mathematics anxiety. This is in line with Foley et al. (2017). However, the absence of specific school programs for mathematics anxiety, such as special counseling, indicates a gap that needs to be addressed, as emphasized by Cooke and Hurst in Agustina (2024).

Relationship of Findings to Mathematical Pedagogy

The findings show that mathematics anxiety is not only influenced by students' psychological factors, but also by pedagogical practices in the classroom. Based on interviews and observations, students with high levels of anxiety, namely MR and SE, felt afraid when asked to present in front of the class because they did not fully understand the material being studied. This condition was related to their lack of mastery of prerequisite material.

Teachers acknowledged that the demands of a dense curriculum, which included four chapters in four months, encouraged them to use expository teaching in order to cover all the material. According to Vygotsky's Zone of Proximal Development theory, mathematics learning should begin from students' level of understanding through scaffolding, rather than merely pursuing curriculum targets (Ramirez et al., 2018). Luttenberger et al. (2018) also explain that mathematics anxiety increases when teachers fail to identify students' initial misconceptions. Therefore, diagnostic tests before new material begins are important. This practice had been implemented by the teacher to divide learning groups heterogeneously. According to Namkung et al. (2019), formative assessment can reduce students' anxiety by providing immediate feedback. When students obtain high scores, their self-confidence may increase, which can help reduce mathematics anxiety.

Students with moderate anxiety, such as RU and MA, relied on YouTube to understand mathematics concepts that they did not fully understand during classroom instruction. The teacher also maximized the use of visual aids, such as GeoGebra graphs. According to multimedia learning theory, students understand more easily when information is presented through a combination of text and visuals (Mayer, 2012). Pizzie and Kraemer (2017) also explain that students with high anxiety are more responsive to virtual manipulation-based learning, such as GeoGebra. This is in line with the teacher's practice of using GeoGebra to present graphs in class.

Students with low anxiety, such as AZ and DN, enjoyed mathematics because the teacher gave them opportunities to explore different solutions. This is in line with the constructivist approach, which emphasizes the thinking process rather than only the final right or wrong answer. Boaler (2019) showed that classes implementing open-ended tasks tend to have lower anxiety. The teacher also supported this practice by providing open-ended opportunities and process feedback through appreciation.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results and discussion, it can be concluded that most students in Class XI F experienced moderate mathematics anxiety, with a percentage of 66.67%. The dominant indicator was cognitive disturbance, such as going blank during examinations and having difficulty concentrating, followed by negative attitudes toward mathematics and somatic symptoms. The causes of mathematics anxiety

involved both internal and external factors. Internal factors included students' learning styles, insufficient mastery of prerequisite material, and fear of making mistakes when solving mathematical problems. External factors included the fast pace of learning, curriculum demands, competitive pressure among classmates, and parental expectations regarding students' academic achievement and future study plans. The findings also show that several strategies can be used to reduce mathematics anxiety, including self-regulated learning, heterogeneous group learning, positive affirmation, collaborative learning, multimodal learning, remedial instruction, and constructivist approaches.

Based on these findings, teachers are encouraged to conduct diagnostic tests before introducing new material, provide process-oriented feedback, use multimodal learning media such as videos, graphs, and GeoGebra, and form heterogeneous learning groups to support students with different levels of understanding. Schools can also support anxiety reduction by providing counseling services, teacher workshops, curriculum flexibility, and digital learning resources that help students learn independently. Students are encouraged to develop self-regulated learning, use alternative learning resources, and communicate with teachers or counselors when experiencing emotional pressure related to mathematics. Further research may expand the research context to other classes or schools, examine the effectiveness of the proposed strategies, and use mixed methods to obtain a deeper understanding of the relationship between mathematics anxiety and students' academic achievement.

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