



Cognitive Mechanisms Linking Math Anxiety and Mathematical Problem Solving: A Systematic Review

Dhina Cahya Rohim¹, Wardono^{1*}, Noening Andrijati¹, & Mohamad Maulana Magiman²

Department of Mathematics Education, Universitas Negeri Semarang, Indonesia

Universiti Putra Malaysia Sarawak, Malaysia

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*Corresponding Author:

wardono@mail.unnes.ac.id

ABSTRACT

Mathematics anxiety is related to mathematics performance, but the mechanisms linking it to mathematical problem-solving in elementary school students have not been synthesized in a unified manner. This study aims to analyze the cognitive mechanisms linking math anxiety to mathematical problem-solving in elementary school students, the impact of anxiety on problem-solving processes and outcomes, and the factors influencing this relationship. A Systematic Literature Review method was employed, adhering to PRISMA 2020 guidelines. Searches were conducted via the Scopus database for articles published between 2020 and 2025. Out of 1,203 initial documents, 17 empirical articles met the selection and quality assessment criteria and were subsequently analyzed using narrative synthesis. The results indicate that math anxiety affects problem-solving through interactions among cognitive and emotional processes, including working memory, executive function, attention, mental strategies, perceived difficulty, spatial ability, metacognitive awareness, and resilience. Anxiety disrupts attention, reduces strategy effectiveness, and heightens the perception of difficulty. The magnitude of this impact varies by student characteristics, task demands, and learning context. The relationship between math anxiety and problem-solving is multidimensional; therefore, instruction should strengthen cognitive processes while also helping students manage emotional responses when solving mathematical problems.

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■ INTRODUCTION

Mathematical problem solving is the process of transforming a situation without a direct procedure into a series of actions that produce a solution (Alashwal & Barham, 2025). This process includes understanding the problem, selecting information, forming representations, determining strategies, carrying out calculations, and evaluating answers (Hickendorff, 2021). Therefore, problem solving differs from routine exercises solved by applying familiar algorithms. Success depends on conceptual knowledge, reasoning, language skills, metacognition, and monitoring of solution steps (Ji & Guo, 2023).

Mathematical problem solving is a core competency in basic education because it brings together conceptual knowledge, reasoning, and decision-making in one activity. Students do not just have to do calculations, but need to understand the situation, select relevant information, build representations, determine strategies, and re-evaluate the accuracy of the solution. These demands make problem solving more complex than procedural exercises. Studies

of word problems show that successful problem solving depends on the ability to construct mathematical models, as well as on cognitive resources that support gradual information processing (Hickendorff, 2021). Other studies have also shown that working memory relates to mathematical problem-solving ability, although the strength of the relationship varies by task and participant characteristics (Ji & Guo, 2023).

Math anxiety is an important issue because it can emerge as early as elementary school, when students begin to form judgments about their abilities and learning experiences (Tomasetto, Morsanyi, Guardabassi, & O'Connor, 2020). Math anxiety refers to feelings of tension, fear, worry, or discomfort when someone faces numbers, calculations, or mathematical learning situations (Sagarduy, And, & Antón, 2024). This condition differs from simply disliking math because it involves an emotional response that can impact student engagement. This anxiety can vary depending on the type of task or activity (Demedts, Reynvoet, Sasanguie, & Depaepe, 2022). Anxious students can still get the correct

answer, but it takes longer or uses greater cognitive effort (Sahlan, Alberth, Madil, & Hutnisyawati, 2021).

Math anxiety is a negative emotional response that arises when someone faces numbers, calculations, learning, or mathematical evaluations (Pellizzoni, Cargnelutti, Cuder, & Passolunghi, 2022). These responses can include feelings of tension, fear, worry, and a desire to avoid the task. Math anxiety differs from general anxiety because it is tied to mathematical situations, differs from dislike because it involves emotional activation, and is not synonymous with low ability because students with adequate ability can also experience it (Vanbinst et al., 2020; Dowker et al., 2022). A negative relationship between anxiety and achievement has been found across age groups, but its strength varies according to participant characteristics, type of measure, and task format (Barroso et al., 2022; Caviola et al., 2022).

Math anxiety can be understood as a situational state or a relatively persistent tendency (Ashcraft & Kirk, 2001). Situational math anxiety arises when students face a specific task, whereas math anxiety tendencies describe a more stable response pattern (Cipora, Santos, Kucian, & Dowker, 2022). This distinction is important because a student may feel calm during routine practice but anxious when faced with story problems, time pressure, or evaluations (Sorvo et al., 2022). Anxiety begins to form in elementary education through experiences of success and failure, assessment of abilities, evaluation practices, and social interactions (Uğraş, 2025). The relationship with performance may also develop reciprocally, where experiences of difficulty increase anxiety and subsequent anxiety limits learning engagement (Aldrup et al., 2020; Carey et al., 2016; Cipora et al., 2022).

The relationship between math anxiety and performance has been widely reported, but is not fully understood. Barroso et al. (2022) found a negative relationship between math anxiety and math achievement. Caviola et al. (2022) also showed that the relationship can vary according to age, task type, and working memory. This variation indicates that the final scores are not sufficient to describe how anxiety relates to students' thinking activities during problem solving. In some students, anxiety may show up as low scores, while in others, it may appear as longer work times, greater effort, or instability in strategies (Radiusman, Juniati, & Khabibah, 2025).

Most previous studies have placed test scores or arithmetic fluency as the primary measure (Shaw et al., 2022). These measures do not fully capture problem

solving, which involves understanding the situation, representing it, selecting a strategy, and evaluating solutions. Research on the demands of word problems confirms that language complexity and the need to construct mathematical models make this task dependent on multiple processes operating simultaneously (Hickendorff, 2021). This condition shows the need for studies that focus specifically on problem solving, not just general mathematical achievement.

Previous research has provided an important foundation for understanding mathematics anxiety. Barroso et al. (2022) mapped the relationship between anxiety and achievement; Finell et al. (2022) examined the role of working memory; and Balt et al. (2022) reviewed interventions to reduce anxiety in school children, but the focus remained scattered across learning outcomes, specific mechanisms, or intervention types. Limited research integrates cognitive mechanisms, problem-solving processes, and factors influencing the relationship between math anxiety and problem solving. The available literature is still fragmented because cognitive mechanisms, problem-solving processes, task characteristics, and factors influencing the relationship are often studied separately (Scheibe, Was, Dunlosky, & Thompson, 2023). Evidence on elementary school students is scattered across various mathematics domains, anxiety instruments, research designs, and country contexts. Some studies use general achievement measures, some assess arithmetic or working memory, while others examine specific tasks without relating them to the overall problem-solving process (Scherer & Beckmann, 2014). This fragmentation makes it difficult for researchers and educators to understand which areas have been consistently supported and which areas still need testing. Systematic reviews are needed to synthesize the evidence, compare patterns of findings, and identify limitations in the available knowledge.

This review focuses on elementary school students because this stage is a crucial period for developing abilities, beliefs, and emotional responses to mathematics. This study examines not only the relationship between mathematics anxiety and learning outcomes but also how this relationship manifests in problem-solving processes. Previous research has described the relationship between mathematics anxiety and achievement, but understanding of its relationship to problem-solving processes remains fragmented (Polydoros et al., 2026; Ven & Prast, 2023). Cognitive mechanisms, task formats, student characteristics, and learning contexts are often examined independently,

while many studies use general achievement or arithmetic fluency as outcomes. No synthesis integrates all these components in elementary school students. This gap is the primary reason for this review, which aims to provide a more comprehensive picture.

This review is novel in its attempt to address a theoretical gap left unresolved by previous reviews. While existing literature primarily highlights the negative relationship between math anxiety and achievement, it has yet to provide an integrated explanation of the cognitive mechanisms linking the two, how these mechanisms alter the problem-solving process and its outcomes, and the factors that amplify or attenuate this influence. Consequently, it remains unclear why students with similar levels of anxiety can exhibit different problem-solving processes and outcomes. Thus, this review not only assesses the relationship between math anxiety and achievement but also elucidates how, and under what conditions, math anxiety affects mathematical problem-solving.

This study aims to synthesize empirical evidence regarding the relationship between mathematics anxiety and mathematical problem solving in elementary school students. This study uses three research questions to address this objective: RQ1. What cognitive mechanisms link math anxiety to mathematical problem solving? RQ2. How does math anxiety affect the processes and outcomes of mathematical problem solving? and RQ3. What factors influence the relationship between math anxiety and problem solving?

METHOD

Research Design

This study used a systematic literature review (SLR) to identify, examine, and synthesize previous research to develop a comprehensive understanding of the topic: the cognitive mechanisms linking mathematics anxiety and mathematical problem solving (Balt et al., 2022). SLR was chosen because evidence regarding this relationship is widespread in studies of mathematics education, cognitive psychology, educational psychology, and child development. Systematic procedures are needed so that searching, screening, quality assessment, data extraction, and synthesis of findings can be carried out transparently and can be traced back.

The article selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020. This guideline documents the number of records found, excluded, assessed for eligibility, and included in the final synthesis (Prill, Karlsson, Ayeni, & Becker, 2021). The application of PRISMA 2020 clarifies the relationship between search strategies, eligibility criteria, reasons for

exclusion, and the articles that form the basis of the review (Page et al., 2021)

Meta-analysis was not performed because the selected articles exhibited heterogeneity in study design, participant characteristics, math anxiety instruments, types of mathematical tasks, cognitive mechanisms, and data analysis techniques. Combining effect sizes from disparate studies risks producing estimates that do not reflect each study's original context. Findings were synthesized through a theme-based narrative synthesis, following the Synthesis Without Meta-analysis guidelines, particularly in grouping studies, presenting patterns of findings, and explaining sources of heterogeneity (Campbell et al., 2020).

Search Strategy

The literature search was conducted in Scopus by searching titles, abstracts, and keywords at <https://www.scopus.com>. Scopus was chosen because of its broad academic coverage (Miao & Azman, 2026). Beyond its extensive coverage, Scopus indexes sources through a structured selection and quality-evaluation process, enabling a more controlled literature corpus. Using a single database also ensures consistency in search syntax, indexing, filtering criteria, and metadata structure, making the study identification process more transparent and systematic (Gusenbauer, 2022).

The search process is used to obtain relevant sources to answer the Research Question and other related references (Haddaway, Page, Pritchard, & McGuinness, 2022). The research questions are based on the study's predetermined focus and needs. In this study, the research questions include: RQ1: What cognitive mechanisms explain the relationship between mathematics anxiety and problem solving? RQ2: How does mathematics anxiety affect the problem-solving process and outcomes? RQ3: What factors influence the relationship between mathematics anxiety and problem solving?

The search strategy was built from four concept groups: mathematics anxiety, mathematical problem solving, cognitive mechanisms, and the elementary education population. The OR operator connects synonyms or conceptually adjacent terms, while the AND operator connects primary constructs. This structure allows the search to cover a range of terminology without losing focus. The search keyword sequence is ("math anxiety" OR "mathematics anxiety") AND ("mathematical problem solving" OR "math problem solving" OR "word problem solving" OR "arithmetic word problem" OR "mathematical reasoning") AND ("working memory" OR "executive function" OR "executive functions" OR

"attentional control" OR "cognitive load" OR "strategy use" OR "perceived difficulty" OR "problem representation") AND ("primary school" OR "elementary school" OR "primary education" OR "school-aged children").

Inclusion and Exclusion Criteria

During the study selection stage, this study used inclusion and exclusion criteria to ensure

that the selected articles were relevant to the research objectives and research questions (RQ). Inclusion criteria were used to determine which studies met the requirements and were worthy of further analysis, while exclusion criteria were used to eliminate studies that were irrelevant or inconsistent with the research focus. The inclusion and exclusion criteria used in this study are presented in Table 1.

Table 1. Inclusion and Exclusion Criteria

Aspect	Inclusion Criteria	Exclusion Criteria
Publication Year	Articles published between 2020 and 2025	Articles published outside the 2020–2025 period
Subject Area	Articles classified in the field of Mathematics	Articles not classified in the field of Mathematics
Language	Articles written in English	Articles written in languages other than English
Access	Full-text articles available for download	Articles that are not open access or could not be downloaded
Topic Relevance	Articles addressing cognitive mechanisms, math anxiety, and mathematical problem solving	Articles not relevant to the research topic
Duplication	Non-duplicate articles	Duplicate articles
Research Design	Quantitative empirical studies and mixed-methods studies	Conceptual articles, review articles, and non-empirical studies

After a selection process based on inclusion and exclusion criteria was conducted, a number of articles were identified that met the requirements for further analysis. The results of the PRISMA data search can be seen in Figure 1.

The initial search yielded 1,203 records. A publication year restriction of 2020–2025 left 702 records, excluding 501 records published outside that period. A Mathematics field filter left 81 records, excluding 621 records from other fields. A document type filter retained 68 journal articles and excluded 13 non-article documents. An English-language restriction yielded 65 articles, excluding three non-English articles.

The full-text review excluded 51 articles because they were not in English, did not involve elementary school students, were irrelevant to the research focus, or were not empirical studies. Following this selection process, 17 articles met all the criteria and were retained for final analysis and synthesis.

Quality assessment was conducted to ensure the selected articles were of adequate quality and relevance. The assessment used a series of questions aligned with the research focus. This stage assesses the clarity of objectives, the nature of the research, the appropriateness of the topic, and the

appropriateness of the research subjects. Quality assessment is necessary to ensure that the articles used not only meet the initial selection criteria but also provide relevant and accountable evidence to answer the research questions. Each article that passed screening was evaluated using four quality assessment questions. These questions were as follows:

QA1: Is the article the result of empirical research?

QA2: Is the research objective clearly stated?

QA3: Does the research address math anxiety, cognitive mechanisms, or mathematical problem solving?

QA4: Are the research subjects elementary school students?

The assessment results were used to determine each article's suitability for data extraction and synthesis. Articles that met most criteria were retained because they were deemed relevant to the study's focus. Conversely, articles that did not meet the main criteria or did not provide sufficient information were not used as the primary basis for the analysis. This procedure helped maintain the accuracy of the extracted data and increased the credibility of the systematic literature review results (Wanabuliandari, Wardono, & Susilo, 2025).

Table 2. Quality Assessment Structure

Code	Quality Assessment Question	Yes	Partially	No
QA1	Is the article the result of empirical research?	1	0.5	0
QA2	Is the research objective clearly stated?	1	0.5	0
QA3	Does the research address math anxiety, cognitive mechanisms, or mathematical problem solving?	1	0.5	0
QA4	Are the research subjects elementary school students?	1	0.5	0

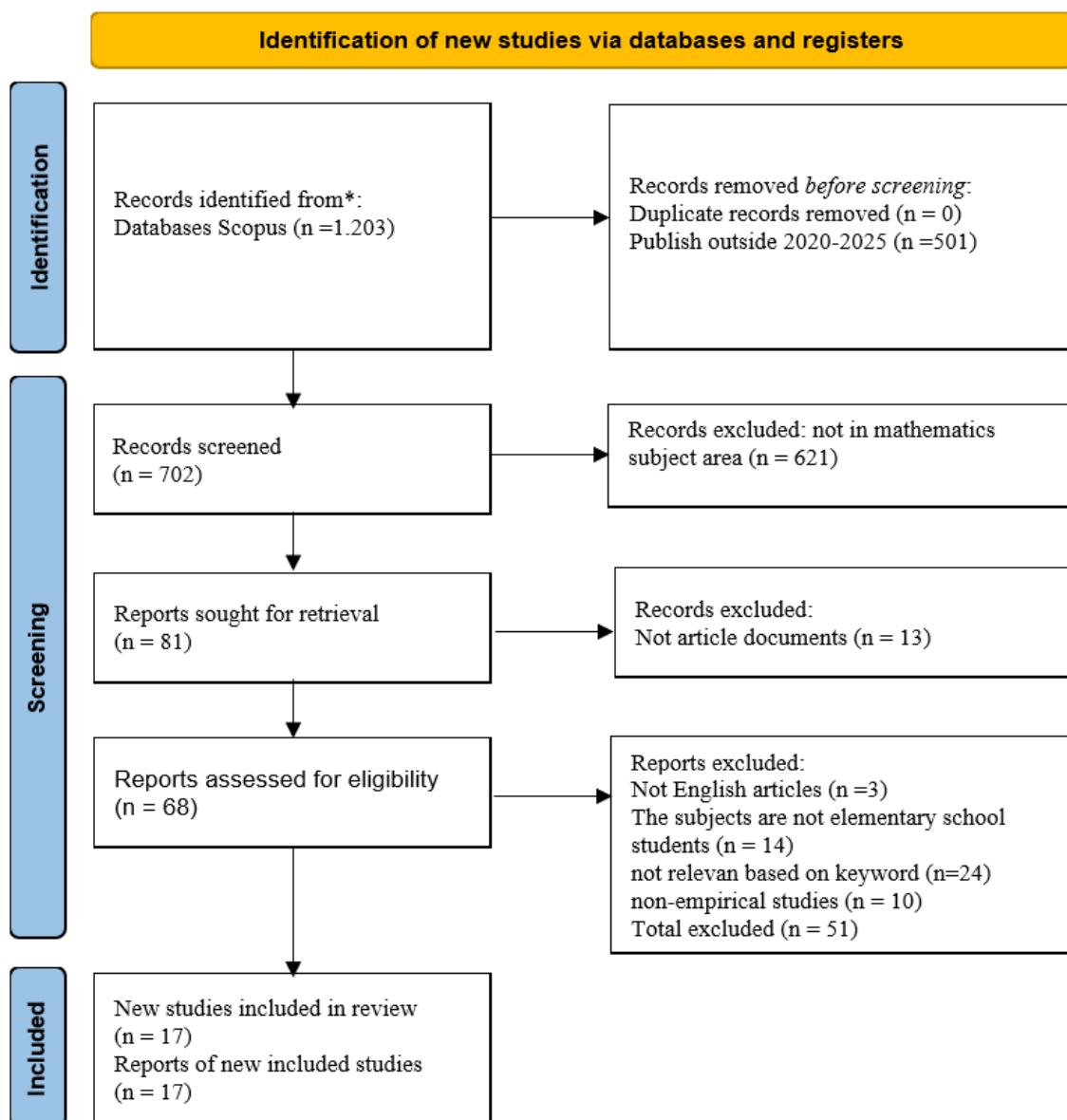

Figure 1. PRISMA flow diagram

Table 2 describes the questions used in the article selection process.

The assessment utilized three categories: Yes = 1, Partially = 0.5, and No = 0. The maximum score for each article was 4.

Articles were retained for analysis if they achieved a total score of ≥ 3.0 . In addition, articles had to score 1 on QA1 and QA4, as this research specifically synthesizes empirical studies involving elementary school students.

Articles with a total score of < 3.0 or those failing to meet the criteria for QA1 and QA4 were excluded from the synthesis. Based on the quality assessment results, the 17 articles that passed screening scored ≥ 3.0 and met the QA1 and QA4 criteria. Therefore, no additional articles were excluded during the quality assessment.

Data Analysis

Data analysis was conducted using a theme-based narrative synthesis. Findings from each article were extracted and grouped according to RQ1, RQ2, and RQ3, then compared to identify patterns, differences, and trends in the results.

RESULTS AND DISCUSSION

Geographic Distribution of Included Studies

The geographic distribution of articles was used to assess the context in which the evidence base was developed in this review. The concentration of research in a particular country may influence findings, as mathematics anxiety and mathematical problem-solving develop within different curricular environments, teaching practices, learning cultures, and assessment demands. Therefore, the country distribution reflects not only the location of the research but also how well the synthesis results represent the diversity of educational contexts. The geographic distribution of included studies is presented in Figure 2.

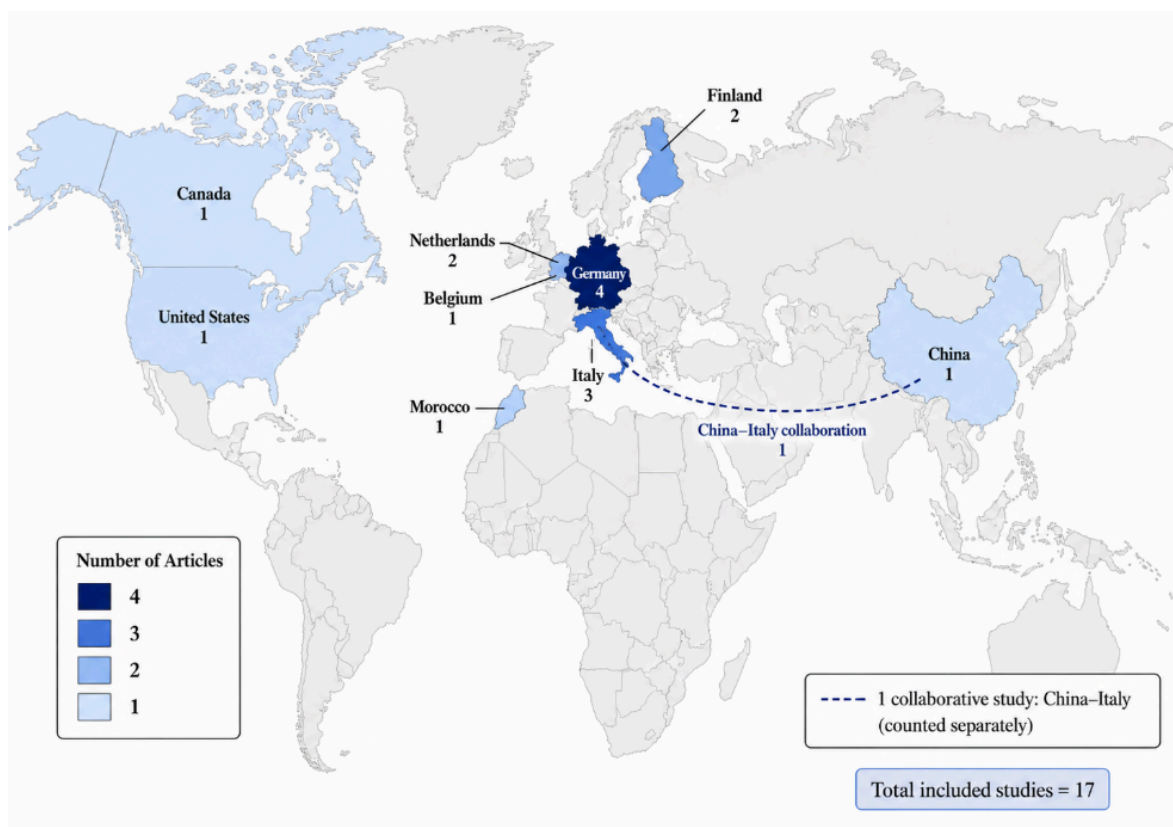


Figure 2. Geographic Distribution of Included Studies

Figure 2 shows that most research was conducted in Germany (four articles), followed by Italy (three articles). Finland and the Netherlands each had two articles. The United States, China, Morocco, Canada, and Belgium each had one article, while one study used a comparative China–Italy context. This distribution indicates that European countries still dominate the empirical evidence in this study. Twelve of the 17 articles originated

from Europe. This dominance suggests that understanding the cognitive mechanisms linking mathematics anxiety to mathematical problem solving is largely based on the European educational context.

Cognitive Mechanisms Linking Mathematics Anxiety and Mathematical Problem Solving

The synthesis of RQ1 identified working memory as the most frequently

tested mechanism. Attention, mental strategies, perception of difficulty, spatial ability, metacognitive awareness, and resilience formed additional pathways. These mechanisms do not operate in isolation because task demands determine the cognitive resources most needed, while student characteristics determine the ability to maintain those resources when anxiety arises. The synthesis indicates that mathematics anxiety affects problem-solving through three

key processes: managing cognitive resources, forming problem representations, and regulating students' responses to tasks. Working memory, attention, and executive functions help students retain information and organize steps toward a solution. When anxiety rises, some of these resources may be consumed by worries and irrelevant thoughts, making it more difficult for students to retain critical information or coordinate the problem-solving process.

Table 3. Cognitive Mechanisms Discovered

Author	Study Design	Sample Size	Instruments/ Measures	Main Finding	Cognitive Mechanism	Mechanism Effect
Cuder et al. (2023)	Quantitative correlational study	185	Mathematics anxiety questionnaire, visuospatial working memory task, math fluency, and mathematical reasoning measures	The anxiety, working memory relationship varies by task demands.	Working memory	Supports information storage and processing during problem solving.
Orbach & Fritz (2022)	Quantitative correlational study	403	State anxiety, general anxiety, sustained attention test, and arithmetic achievement test	Sustained attention predicts arithmetic fluency and moderates anxiety effects.	Sustained attention	Maintains focus and reduces anxiety-related interference.
Möhring et al. (2024)	Quantitative correlational study	163	Mathematics anxiety questionnaire, mental rotation task, arithmetic tasks, and problem-solving strategy measures	Math anxiety is negatively related to achievement, with strategy use explaining performance differences.	Mental strategies	Improves the efficiency and accuracy of problem solving.
(Doz et al. (2023)	Quantitative correlational study	202	Mathematics anxiety measure, perceived difficulty rating, and arithmetic word-problem-solving task	Math anxiety affects performance directly and indirectly through perceived difficulty.	Perceived difficulty	Higher perceived difficulty is associated with lower word-problem accuracy.
Lennon-Maslin & Quaiser-	Quantitative correlational study	131	Math self-concept questionnaire, Child Spatial Anxiety Questionnaire, perceived difficulty	Spatial ability and spatial anxiety are related to	Spatial ability	Supports mental representation and spatial processing.

Author	Study Design	Sample Size	Instruments/ Measures	Main Finding	Cognitive Mechanism	Mechanism Effect
Pohl (2024)			rating, and Mental Rotation Task	mental rotation performance.		
Halme et al. (2024)	Cross-sectional group-comparison study	119	Fraction arithmetic task, state anxiety measure, and natural number bias classification	Natural number bias is linked to lower fraction anxiety despite poor performance.	Metacognitive awareness	Influences awareness of errors and actual performance.
Doz et al. (2024)	Quantitative correlational study	185	Ego-resiliency, mathematics anxiety, visuospatial working memory, arithmetic tasks, and word-problem-solving tasks	Ego-resiliency affects achievement indirectly through math anxiety and working memory.	Resiliency	Protects cognitive resources and reduces anxiety effects.

The table shows that math anxiety affects problem-solving through a series of interrelated cognitive processes. Working memory, executive function, and sustained attention help students retain information, maintain focus, and strategize during problem-solving (Cuder et al., 2023). Anxiety can interfere with these functions, increase perceived difficulty, and reduce the use of efficient strategies, lowering accuracy and fluency (Doz et al., 2023). Spatial abilities support the formation of visual representations, while metacognitive awareness explains why anxiety levels do not always align with actual performance (Beek, Ven, Weijer-Bergsma, & Kroesbergen, 2025). Resilience acts as a protective factor because it helps students maintain emotional regulation and maintain cognitive resources when facing difficult math tasks (Doz et al., 2024).

Working memory is the most dominant mechanism because students need to store and process information simultaneously when solving problems. Anxiety can reduce this capacity, making it more difficult for students to understand information, organize their steps, and maintain accurate answers, especially for word problems and fractions (Cuder et al., 2023; Doz et al., 2024; Ven & Prast, 2023). Attention and executive function also determine a student's ability to maintain focus, ignore irrelevant information, and choose appropriate strategies. Students with better attention control tend to better suppress anxiety's impact on math

performance (Orbach & Fritz, 2022; Wei et al., 2024). Anxiety can also reduce the use of more efficient mental strategies and increase the perception that the problem is too difficult, resulting in decreased problem-solving accuracy (Doz, Cuder, et al., 2023; Möhring et al., 2024).

Spatial skills help students form mental representations, understand fractions, and process quantitative relationships. Anxiety can hinder the use of these skills, while language reinforcement and spatial activities can help reduce anxiety (Lennon-Maslin & Quaiser-Pohl, 2024; Ridgley et al., 2025; R. Zhang et al., 2024). Other findings suggest that anxiety does not always reflect actual ability. Students who are unaware of misconceptions may feel less anxious even if their answers are incorrect (Halme et al., 2024). Resilience acts as a protective factor because it helps students manage stress and maintain cognitive function while working on math tasks (Doz et al., 2024).

Thus, math anxiety relates to problem solving through disruptions in working memory, attention, executive function, spatial ability, strategy selection, and perceived difficulty, while resilience helps mitigate its impact. The extent of each mechanism's influence is determined by student characteristics and task demands.

The Effect of Mathematics Anxiety on the Problem-Solving Process and Outcomes

The impact of math anxiety on problem-solving depends, in part, on a student's

ability to maintain attention on relevant information. Orbach & Fritz (2022) showed that sustained attention strongly predicts arithmetic performance and moderates the relationship between anxiety and performance. In students with low attentional control, anxiety more easily diverts cognitive resources from the primary task toward intrusive thoughts, thereby limiting the capacity to retain numerical information, suppress distractions, and monitor problem-solving steps. This condition increases processing load before accuracy declines noticeably. These findings align with evidence indicating that perceived difficulty serves as an indirect pathway between math anxiety and word problem performance, while strategy use helps explain variations in mathematical achievement. Thus, low attentional efficiency helps explain why anxiety is more disruptive to tasks that require concentration and coordination across multiple problem-solving steps. The analysis showed that math anxiety affects problem-solving by disrupting cognitive processes and reducing result quality. At the processing stage,

anxiety diverts attention, increases perceptions of difficulty, reduces the use of efficient strategies, and increases the time and effort required to solve problems. This impact is most pronounced on tasks that require information integration, such as word problems, fractions, and timed arithmetic (Doz et al., 2023; Möhring et al., 2024; Orbach & Fritz, 2022; Ven & Prast, 2023).

At the outcome stage, anxiety was generally associated with lower accuracy, arithmetic fluency, and problem-solving success. These relationships were not always uniform (Bouzid, Mohammed, Abdellah, Mohammed, & Abdellah, 2021). Some students maintain their scores through longer work times and greater effort, while others show low anxiety despite making errors because they are unaware of their misconceptions (Halme et al., 2024; Lennon-Maslin & Quaiser-Pohl, 2024). Longitudinal evidence also suggests that low arithmetic performance may precede the onset of anxiety, so the relationship between anxiety and performance is potentially bidirectional (Orbach & Fritz, 2022).

Table 4. The Effect of Mathematics Anxiety on the Problem-Solving Process and Outcomes

Dimension	Pattern of Influence	Conditions of the Findings	Supporting Articles
Process	Disrupts focus and attentional efficiency	The effect is stronger when attentional control is low	Orbach & Fritz (2022)
	Reduces the use of efficient mental strategies	Evident in arithmetic problem solving	Möhring et al. (2024)
	Increases the subjective perception of task difficulty	Acts as an indirect pathway to lower word-problem accuracy	Doz et al. (2023); (Bouzid et al., 2021)
	Increases completion time and cognitive effort	Scores do not always decline because some students compensate through greater effort	Lennon-Maslin & Quaiser-Pohl (2024)
	Lowers expectations and influences responses to feedback	Short-term performance may improve even when emotional responses worsen	Van der Beek et al. (2025) (Maulyda, Sugiman, & Wuryandani, 2025)
Outcome	Associated with lower arithmetic accuracy	The strength of the relationship depends on strategy use and task demands	Möhring et al. (2024); Wei et al. (2024)
	Associated with lower arithmetic fluency	Influenced by attention, working memory, grade level, and prior ability	Cuder et al. (2023); Orbach & Fritz (2022); Song et al. (2021); Van der Ven et al. (2023)
	Associated with lower word-problem accuracy	More evident in tasks that require the integration of multiple sources of information	Doz et al. (2023, 2024); Van der Ven et al. (2023)

Dimension	Pattern of Influence	Conditions of the Findings	Supporting Articles
	Associated with variation in fraction performance and spatial ability	Influenced by spatial ability and awareness of misconceptions	Halme et al. (2024); Lennon-Maslin & Quaiser-Pohl (2024); Zhang et al. (2024)
	Reduces the benefits of intervention for some students	Evident among students with developmental dyscalculia	Kohn et al. (2020); (Vanbinst et al., 2020) (Cipora et al., 2022)

The findings confirm that math anxiety is related not only to low scores but also to how students process information during problem solving.

Factors Influencing the Relationship between Mathematics Anxiety and Problem Solving

The synthesis for RQ3 indicates that the impact of math anxiety on problem-solving varies among students and is influenced by individual factors, task characteristics, and the learning context. This pattern supports the principles of Attentional Control Theory, which posits that anxiety can impair a student's ability to control attention and efficiently utilize cognitive resources. The RAMPS framework developed by Scheibe et al. (2023) reinforces this explanation by positioning attention, working memory, metacognition, and anxiety as interconnected processes during mathematical problem-solving. Empirical findings by Sánchez-Pérez et al.

(2024) further demonstrate that the ability to sustain attention and self-regulate is associated with lower math anxiety and better performance in children aged 7–12.

The findings of this review extend the existing explanation by showing that anxiety-related impairment does not depend solely on a student's cognitive abilities. Task demands can increase processing load, while the learning environment can either exacerbate or mitigate anxiety responses. Wang et al. (2024) found that teacher support is linked to math anxiety through the quality of the teacher-student relationship. Thus, the synthesis results do not contradict Attentional Control Theory; instead, they show that anxiety's influence on problem-solving emerges from the interaction among attentional control capabilities, task demands, and the learning environment. A description of the findings is presented in Table 5.

Table 5. Factors Influencing the Relationship between Mathematics Anxiety and Problem Solving

Category	Factor	Pattern of Influence	Supporting Articles
Individual	Working memory and attention	Stronger cognitive capacity may reduce anxiety-related interference, although the effect depends on the type of task	Cuder et al. (2023); Orbach & Fritz (2022); Van der Ven et al. (2023)
	Prior ability	Lower prior ability may precede the development of mathematics anxiety	Pavlova et al. (2025); Song et al. (2021); Van der Ven et al. (2023)
	Resiliency and self-concept	Higher resiliency and more positive self-concept are associated with lower anxiety and more stable performance	Doz et al. (2024); Van der Beek et al. (2025)
	Gender	Gender differences are more consistently observed in anxiety levels than in mathematical ability	Doz et al. (2023). Kohn et al. (2020); Lennon-Maslin & Quaiser-Pohl (2024)
Task Characteristics	Complexity	Tasks requiring the integration of multiple sources of information are more sensitive to anxiety-related interference	Doz et al. (2023, 2024); Van der Ven et al. (2023)

Category	Factor	Pattern of Influence	Supporting Articles
	Time pressure	Tasks requiring rapid responses are more sensitive to the effects of mathematics anxiety	Cuder et al. (2023); Orbach & Fritz (2022)
Contextual	Feedback and learning environment	Feedback may improve short-term performance while increasing anxiety, whereas supportive and enjoyable learning environments strengthen engagement	Bouزيد et al. (2021); Van der Beek et al. (2025)
	Family and culture	Parental anxiety and cultural context are associated with children's anxiety levels and mathematics performance	Vanbinst et al. (2020); Wei et al. (2024)

Gender is more consistently related to emotional responses than actual abilities. Doz et al. (2023) found girls were more anxious, with no differences in accuracy on story problems. Lennon-Maslin and Quaiser-Pohl (2024) reported higher anxiety in girls, but their math scores were better and their processing time was longer. Vanbinst et al. (2020) also found differences in anxiety without corresponding differences in performance. Age and initial ability influence the development of

the relationship. Pavlova et al. (2025) show that anxiety profiles can persist across class transitions. Tanjung et al. (2024) found that initial arithmetic fluency predicted subsequent anxiety. Experienced difficulties can shape negative expectations and increase anxiety at later stages. The flow of relationships among influencing factors, cognitive mechanisms, and mathematical problem-solving outcomes is presented in Figure 3.

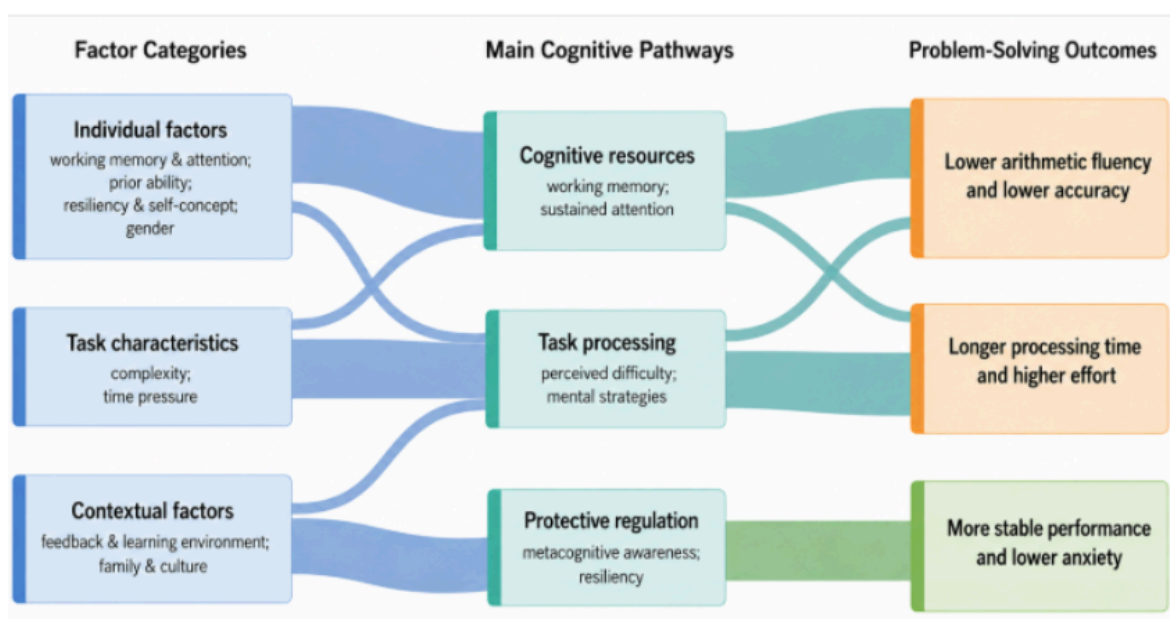


Figure 3. Flow of Factors, Cognitive Mechanisms, and Problem-Solving Outcomes

Figure 3 shows that mathematics anxiety influences problem solving indirectly, through several cognitive pathways. Individual factors primarily influence cognitive resources such as working memory and attention. Task characteristics, such as complexity and time pressure, increase processing demands and influence perceived difficulty and strategy

use. Contextual factors, including learning environment, family, and culture, are more related to protective regulations such as metacognitive awareness and resilience. These three paths then relate to problem-solving outcomes as changes in accuracy, arithmetic fluency, processing time, cognitive effort, and performance stability.

Working memory, attention, and resilience determine students' resilience when demands increase. Students with high cognitive resources are not always protected, especially on fast-paced tasks that require automation (Cuder et al., 2023; Ven & Prast, 2023). Continuous attention reduces distractions during work (Orbach & Fritz, 2022), whereas resilience is associated with lower anxiety and better working memory function (Doz et al., 2024). Task characteristics explain variation in relationships across studies. The learning context can either exacerbate or alleviate anxiety. Negative feedback improves performance temporarily but exacerbates anxiety, enjoyment, and expectations in some students (Ven & Prast, 2023). Culture and family influence anxiety levels and learning experiences. Vanbinst et al. (2020) found that children's anxiety was related to maternal anxiety and the education of both parents.

A synthesis of the articles suggests that the relationship between math anxiety and problem-solving is not simply explained by a direct link between negative emotions and low scores. Anxiety affects how students focus attention, use working memory, select strategies, and assess task difficulty. Its impact varies depending on student ability, problem format, time pressure, and learning environment. These findings position math anxiety as part of the cognitive-affective process that shapes problem-solving quality, rather than simply as a predictor of outcomes.

Working memory is the most prominent mechanism. Problem solving requires students to store information, update calculations, and coordinate multiple steps simultaneously. Anxiety consumes some of this capacity as attention shifts to the possibility of failure or error. Cuder et al. (2023), Doz et al. (2024), and Ven & Prast (2023) showed that this relationship depends on the task type. High working memory capacity does not always protect students when tasks demand speed or the integration of complex information.

Attention, strategy, and perception of difficulty clarify the path. Balt et al. (2022) showed that sustained attention helped students maintain focus when anxiety interfered with the work process. Möhring et al. (2024) found that more anxious students used higher-order mental strategies less frequently. In contrast, Doz et al. (2023) showed that anxiety increased the perception that word problems were too difficult. This pattern is consistent with Attentional Control Theory, which explains that anxiety reduces the efficiency of attentional control and increases distraction from irrelevant thoughts (Eysenck, Santos, Derakshan, & Calvo, 2007).

Spatial abilities, metacognitive awareness, and resilience complement these mechanisms. Spatial activities can help students construct problem representations and reduce anxiety, although affective changes do not necessarily directly improve overall math outcomes (Lennon-Maslin & Quaiser-Pohl, 2024; Ridgley et al., 2025; Y. Zhang et al., 2025; Halme et al., 2024). Low anxiety does not always indicate high competence because students may be unaware of their misconceptions. Resilience acts as a protective factor because it helps students maintain emotional regulation and working memory function when facing difficulties (Doz et al., 2024).

At the process level, anxiety primarily reduces efficiency. Students can retain correct answers, but it takes longer, requires more effort, and uses less efficient strategies. Ridgley et al. (2025) found that more anxious students could still achieve good scores with longer processing times. This finding distinguishes effectiveness, the accuracy of results, from efficiency, the resources required to achieve those results. The impact of anxiety on performance was most consistently seen in arithmetic fluency and word problems. Fluency requires stable attention and rapid fact retrieval, while word problems require language integration, situation representation, and multiple solution steps. As a result, both task types are more sensitive to attentional and working memory disruptions (Cuder et al., 2023; Doz et al., 2023; Orbach & Fritz, 2022; Ven & Prast, 2023). Halme et al. (2024) found that students can exhibit low anxiety but perform poorly on fractions when unaware of their errors.

Longitudinal evidence suggests that the direction of the relationship can also move from performance to anxiety. Maulyda et al. (2025) found that initial arithmetic fluency predicted anxiety at subsequent measurements, whereas initial anxiety did not always predict changes in performance. These findings support a reciprocal relationship. Math difficulties can elicit anxiety, which then impairs learning and performance efficiency at later stages.

Individual factors determine a student's level of vulnerability to anxiety. Working memory, attention, prior ability, resilience, self-concept, and learning difficulties influence a student's ability to sustain the problem-solving process. Gender differences are more consistently observed in anxiety levels, task time, or self-perceptions than in actual math ability (Doz, Pellizzoni, et al., 2023; Vanbinst et al., 2020; Zhang et al., 2024). These findings do not support the notion that one gender is inherently weaker in mathematics. Task characteristics determine the type of impairment that emerges. Word problems are more sensitive

to working memory limitations because they require language comprehension and multi-step coordination. Time-limited arithmetic demands more attention and automation. Fractions and spatial tasks require strong conceptual representations. Therefore, a single measure of general anxiety may not always adequately explain performance across all domains of mathematics. The learning context can amplify or diminish anxiety. Negative feedback can temporarily improve performance, but lower expectations can exacerbate emotional responses (Ven & Prast, 2023). Game-based learning and spatial activities can increase engagement and reduce anxiety, but their effects on math outcomes are not always immediate (Bouزيد et al., 2021; Ridgley et al., 2025). Family and cultural factors are also associated with anxiety and performance, although available evidence does not yet support causal conclusions (Vanbinst et al., 2020).

■ CONCLUSION

Research shows that math anxiety affects problem-solving by disrupting attention, working memory, strategy selection, perceived difficulty, spatial ability, and resilience. These mechanisms do not operate in isolation; they interact based on student characteristics and task demands. The impact of anxiety is most evident in decreased processing efficiency, when students take longer, expend more effort, use less appropriate strategies, or judge problems as too difficult. The strength of the relationship between math anxiety and problem-solving is determined by individual factors, task characteristics, and the learning context. Working memory, attention, prior ability, resilience, and learning difficulties influence students' level of vulnerability. Complex and time-limited tasks tend to amplify the impact of anxiety, while the learning environment and family support shape how students interpret mathematical experiences. Reducing the impact of anxiety requires combining cognitive and affective support. Instruction should help students understand problems, choose appropriate strategies, recognize misconceptions, and build confidence that they can overcome difficulties. This integrated approach is more appropriate than simply reducing anxiety or improving scores because problem-solving depends on the close relationship among thinking processes, emotional responses, and learning experiences. Thus, mathematics anxiety influences problem-solving through interactions among various cognitive and emotional processes. Its impact varies among students, shaped by individual characteristics, task demands, and the learning environment; consequently, addressing it

requires strengthening both cognitive processes and emotional regulation.

Teachers need to provide enough time, guide students through clear problem-solving steps, and offer feedback that helps them understand their errors. Mathematics curricula should also structure tasks with graduated levels of difficulty while creating opportunities for students to practice their thinking skills, reflection, and resilience when facing challenging problems.

■ DECLARATION OF GENERATIVE AI USAGE IN THE WRITING PROCESS

During the preparation of this manuscript, the author used ChatGPT (OpenAI) to help improve sentence structure, enhance the clarity of academic language, and support the translation process. All output has been reviewed and revised by the author. The author is fully responsible for the accuracy, integrity, and final content of this article.

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