Mathematics Anxiety and Types and Frequency of Errors in Algebraic Problem-solving among Grade 12 STEM Students

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ABSTRACT

This study investigated the relationship between mathematics anxiety and the types and frequency of errors in algebraic problem-solving among Grade 12 STEM students in a public school in Himamaylan City during School Year 2025–2026. Using a quantitative descriptive-correlational design, the researchers assessed mathematics anxiety levels via a validated Likert-scale questionnaire and identified error patterns through an eight-item algebraic problem-solving test. Errors were classified as conceptual, procedural, or computational. Descriptive statistics summarized anxiety levels and error frequencies, while Spearman's rho determined the relationship between anxiety and problem-solving performance. The instruments underwent expert validation and were pilot-tested with non-respondents. The reliability test yielded a Cronbach's alpha of 0.978, indicating excellent internal consistency. The study involved 30 students from Grade 12 STEM 1, selected through cluster sampling. While this provided valuable insights, the small and single-class sample limits generalizability, which is acknowledged as a study limitation. Results revealed that students generally exhibited moderate to high mathematics anxiety, with female students showing higher anxiety than males. Conceptual errors were most frequent (Occasional), followed by procedural errors (Rare) and computational errors (Never). Students committing conceptual errors reported higher anxiety levels than those with procedural errors, suggesting that deep conceptual misunderstandings may intensify emotional distress. Correlation analysis indicated a weak, non-significant negative relationship between mathematics anxiety and algebraic problem-solving performance ($\rho = -0.227$, $p > 0.05$), implying that anxiety alone may not strongly predict performance outcomes. Other factors, such as instructional quality, prior knowledge, and coping strategies, may moderate this relationship. The study recommends enhancing conceptual instruction, integrating anxiety-reduction strategies, and providing targeted support—particularly for female students. Balanced teaching approaches that foster both conceptual understanding and procedural fluency are encouraged. Findings contribute to STEM education research by highlighting the nuanced interplay between affective and cognitive factors in algebra learning and informing interventions aimed at reducing errors and improving performance.

Keywords: Mathematics Anxiety, Algebraic Problem-Solving, Conceptual Errors, Procedural Errors, Computational Errors, Error Analysis, STEM Education

INTRODUCTION

In today's globalized and knowledge-driven society, mathematics stands as a fundamental pillar of 21st-century education. It is essential not only for individual academic success but also for national development, particularly in Science, Technology, Engineering, and Mathematics (STEM) fields. Recognizing this, the Philippine Department of Education (DepEd), in alignment with the Department of Science and Technology (DOST), has emphasized the need to strengthen math instruction under the K to 12 Basic Education Curriculum, especially among students in the STEM strand. DOST's push for scientific and technological advancement requires a workforce well-versed in analytical and quantitative reasoning—competencies that are rooted in mathematics proficiency.

At the global level, this initiative supports United Nations (2015) Sustainable Development Goal (SDG) 4: Quality Education, which calls for inclusive and equitable quality education and the promotion of lifelong

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learning opportunities for all. Improving mathematics outcomes, particularly among senior high school students, is crucial to achieving this goal and preparing learners to contribute meaningfully to a knowledge-based economy.

However, persistent challenges remain. One such challenge is mathematics anxiety, which research consistently links to poorer mathematical performance through mechanisms such as avoidance and cognitive interference (Zhang, Zhao, & Kong, 2019). This form of anxiety is especially prevalent during algebraic problem-solving, which often demands abstract reasoning, manipulation of variables, and multi-step logical thinking. When students experience high levels of anxiety, their cognitive resources are compromised, leading to increased errors and reduced performance (Ashcraft & Faust, 1994).

Errors in mathematics problem-solving are commonly classified into three types: conceptual errors (misunderstanding principles or definitions), procedural errors (incorrect execution of steps), and computational errors (mistakes in basic arithmetic). While studies have explored the nature of math anxiety and its effect on general performance, limited research has investigated the specific link between the types and frequency of errors committed and students' anxiety levels—particularly in the context of senior high school STEM learners in the Philippines.

The interplay of math anxiety with other variables and constructs was explored by Camarista (2015), whose study is particularly relevant. Camarista investigated the relationship among creativity, self-efficacy, and anxiety in relation to mathematical problem-solving performance among mathematically gifted Grade 6 pupils. His findings highlighted the significant mediating role of anxiety, which negatively influenced students' mathematical creativity and self-efficacy, ultimately affecting their performance. This supports the notion that affective factors like anxiety can act as a barrier to optimal cognitive functioning, even among high-ability learners. By considering both emotional and cognitive dimensions, Camarista's study underscores the importance of addressing anxiety to enhance students' mathematical performance—a perspective extended in the present study to include specific algebraic error patterns.

Moreover, 21st-century educational thrusts highlight the development of critical thinking, problem-solving, and resilience, especially in high-pressure academic domains like mathematics. Understanding how affective factors like anxiety influence students' approach to problem-solving—and the kinds of errors they make—can inform more effective teaching strategies that address both emotional and cognitive learning needs.

This study seeks to address these gaps by analyzing the relationship between mathematics anxiety and the types and frequency of errors in algebraic problem-solving among Grade 12 STEM students. By identifying which errors are most commonly associated with high levels of anxiety, educators can better design responsive, differentiated instruction and intervention programs. The findings of this study can also inform policy-making and curriculum enhancement initiatives led by agencies such as DOST-SEI, CHED, and DepEd, particularly in improving STEM education quality in line with national and global development goals.

Research Questions

This study aims to explore the relationship between math anxiety and algebraic problem-solving errors among high school students by analyzing how different levels of math anxiety influence the types and frequencies of errors they make.

Specifically, this study aimed to determine the:

What is the level of mathematics anxiety among Grade 12 STEM students towards algebraic problem-solving as an entire group and when categorized in terms of sex, and dominant type of error?

How frequent do Grade 12 STEM students commit each type of errors in algebraic problem solving?

Is there a significant relationship between the level mathematics anxiety and the Algebraic Problem-Solving Performance among Grade 12 STEM Students?

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Theoretical Framework

This study is anchored on two major theoretical underpinnings: Cognitive Load Theory (Sweller, Ayres, & Kalyuga, 1988) and Ashcraft's Disruption Theory of Mathematics Anxiety (Ashcraft & Faust, 1994). According to Cognitive Load Theory, learners have a limited working memory capacity, which can be overwhelmed when tasks require intense cognitive processing. Algebraic problem-solving, especially in the STEM strand, demands abstract reasoning and multi-step operations that can impose a high cognitive load. When students experience mathematics anxiety, this load is further increased as anxiety consumes part of the working memory that would otherwise be allocated for solving the problem. This often results in diminished problem-solving performance and an increase in errors—particularly conceptual and procedural ones.

Ashcraft and Faust (1994) support this notion through their cognitive interference framework, which suggests that math anxiety disrupts the brain's ability to process mathematical tasks by reducing working memory efficiency. Anxiety acts as a cognitive distraction, impairing both the storage and processing functions of working memory. This disruption leads students to commit more errors, particularly in problems that require sustained attention, multi-step logic, and abstract reasoning. Their findings highlight the powerful role of affective factors in undermining cognitive performance during math tasks. Furthermore, Bandura's Social Cognitive Theory (1997) emphasizes the role of self-efficacy and emotional regulation in performance. Students who believe they are incapable of handling algebraic problems may experience increased anxiety and consequently perform poorly, which creates a negative feedback loop of low confidence, high anxiety, and more frequent errors.

Collectively, these theories explain how mathematics anxiety not only influences students' emotional states but also directly impacts the frequency and type of errors they commit. Conceptual errors may occur more frequently among students with high anxiety due to the lack of deep understanding and difficulty in abstract reasoning, while procedural or computational errors may arise from disrupted cognitive processes or inattentiveness. This theoretical grounding provides a comprehensive lens for understanding the complex interplay between affective and cognitive factors in algebraic problem-solving among senior high school students.

METHODOLOGY

Research Design

This study utilized a quantitative descriptive-correlational research design to examine the relationship between mathematics anxiety and algebraic problem-solving errors among Grade 12 STEM students. Quantitative Research encompasses a range of methods concerned with the systematic investigation of social phenomena, using statistical or numerical data. Therefore, quantitative research involves measurement and assumes that the phenomena under study can be measured (Watson, R. 2015). The descriptive component of the study assessed students' levels of mathematics anxiety and identified the types and frequencies of algebraic errors they committed, providing a clear picture of their problem-solving difficulties. The correlational component investigated the natural association between mathematics anxiety and students' problem-solving performance without manipulating any variables, aiming to determine whether higher anxiety levels were linked to increased or specific types of algebraic errors.

Participants of the Study

The respondents of this study were the Grade 12 - STEM 1 students from one of the public schools in Himamaylan City during the School Year 2025–2026. The selection of respondents followed a cluster sampling technique, in which an entire pre-existing group (STEM 1) was chosen as a representative sample for the study.

Cluster sampling is a probability sampling method wherein the population is divided into groups or "clusters," and a whole cluster is selected either randomly or purposively for data collection (Alvi, 2016). This method is

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commonly used in educational research due to its cost-effectiveness, time efficiency, and practicality in studying naturally occurring groups, such as a class of students (Saunders, Lewis, & Thornhill, 2019).

The total Grade 12 STEM population in the school consisted of three intact classes. STEM 1 was selected randomly through a cluster draw, making its 30 enrolled students the study's respondents. While the sample size provided meaningful insights, the relatively small number and single-class sample limit the generalizability of the findings. This limitation is acknowledged in the conclusion and recommendations.

Data Gathering Procedure

The data collection process followed a systematic approach to ensure validity, reliability, and accuracy. Initially, the research instruments were developed based on relevant learning competencies, with a Table of Specifications (TOS) created to ensure content alignment. These instruments underwent expert validation, during which Mathematics educators reviewed them for clarity, relevance, and appropriateness. Their feedback guided necessary revisions to improve the instruments' effectiveness.

Following validation, a pilot test was conducted with a group of non-respondents to assess the instruments' clarity and reliability. Statistical measures, such as Cronbach's Alpha for internal consistency and item analysis for difficulty and discrimination indices, were applied. Based on the pilot test results, modifications were made to enhance the accuracy and quality of the instruments.

Once finalized, the researchers sought formal approval from the School Principal, Senior High School Department Head, and Class Adviser to conduct the study. Permission letters were submitted to secure proper authorization. Prior to the administration of the instruments, the respondents and their parents or guardians were informed about the study's purpose, the voluntary nature of participation, and the confidentiality of their responses. Written consent was obtained to ensure ethical compliance.

The administration of the research instruments took place in a controlled classroom setting to minimize external influences. Clear instructions were given, and students were allotted sufficient time to complete the assessments. After data collection, all responses were checked for completeness and consistency. Incomplete or invalid entries were excluded from further analysis.

Finally, the gathered data were encoded and analyzed using statistical software. Descriptive statistics were used to summarize the findings, while correlational analysis was conducted to determine the relationship between mathematics anxiety and algebraic problem-solving errors. The results were reviewed by the research adviser and a statistician to ensure accuracy and proper interpretation.

Research Instrument

The research instrument used in this study consisted of two main parts: a Likert scale questionnaire to assess students' mathematics anxiety levels and a set of algebraic problem-solving questions to identify and categorize errors and evaluate problem-solving performance.

The first part was a validated researcher-made Likert scale designed to measure students' levels of mathematics anxiety specifically in algebra. It included statements related to students' feelings and reactions toward algebra and algebraic problem-solving, rated on a five-point scale: Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1). This section provided a quantifiable measure of anxiety that could be analyzed in relation to performance.

The second part consisted of eight (8) algebraic problem-solving questions that required students to show complete solutions. The students' responses were analyzed to identify the types and frequencies of errors. Based on the frameworks of Hudson and Miller (2006) and Ginsburg (1987, as cited in the University of Kansas, n.d.), the errors were categorized into three types: conceptual errors, which involved incorrect understanding of algebraic principles (e.g., operations on variables or properties like the distributive law); procedural errors, which resulted from incorrect application or sequencing of steps; and computational errors, which involved basic arithmetic mistakes such as incorrect operations or decimal misplacement.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VIII August 2025

To ensure the content validity of the test items, the researchers developed a Table of Specification (TOS) aligning each problem with the General Mathematics Learning Competencies. The items were based on the following competencies: (1) operations on functions, (2) solving rational equations and inequalities, (3) inverse of one-to-one functions, and (4) solving exponential equations and inequalities.

To assess the quality and accuracy of the students' responses, the researchers used a standardized scoring rubric based on Polya's problem-solving strategy.

In addition, the instruments underwent expert validation by mathematics educators to confirm clarity, appropriateness, and alignment with the intended learning competencies. A pilot test was then conducted with non-respondents. Statistical reliability analysis using Cronbach's alpha yielded 0.978, indicating excellent internal consistency. Item analysis was also performed, examining difficulty and discrimination indices to further improve the quality of the test items. Necessary revisions were made prior to the final administration.

Data Analysis Method

The collected data were analyzed using appropriate descriptive and inferential statistical tools to ensure accurate interpretation of the findings. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were used to determine the overall level of mathematics anxiety among Grade 12 STEM students and to summarize the types and frequencies of errors—conceptual, procedural, and computational—committed in algebraic problem-solving.

To examine the relationship between students' mathematics anxiety levels and their problem-solving performance, Spearman's rank-order correlation coefficient (Spearman's rho) was computed. This non-parametric test was appropriate because mathematics anxiety was measured on an ordinal scale using a Likert-type questionnaire.

To assess significant differences in mathematics anxiety levels based on sex and other categorical variables, the Mann-Whitney U test was used for two-group comparisons (e.g., male vs. female), while the Kruskal-Wallis H test was applied for comparisons involving more than two groups (e.g., performance levels or error-type categories). These non-parametric tests were selected due to the ordinal nature of the anxiety data and the small sample size.

All statistical analyses were conducted using SPSS (Statistical Package for the Social Sciences) and Microsoft Excel to ensure the accuracy and reliability of the data interpretation.

RESULTS AND DISCUSSION

Table 1 Level of Mathematics Anxiety of Grade 12 STEM Students towards Algebraic Problem Solving as an Entire Group and When Categorized as to Sex and Type of Error

Variable	Category	n	Mean	SD	Description
Sex	Male	9	3.44	.85	Moderate
	Female	21	3.78	.62	High
Type of Error	Conceptual	25	3.82	.65	High
	Procedural	5	2.95	.53	Moderate

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VIII August 2025

	Total	30	3.67	.71	High

Note: 4.51-5.00 Very High; 3.51-4.50 High; 2.51-3.50 Moderate; 1.51-2.50 Low;

1.00-1.50 Very Low

The study aimed to determine the level of mathematics anxiety experienced by Grade 12 STEM students toward algebraic problem solving, both as an entire group and when categorized by sex and type of error. The findings indicate that, on average, students exhibit a moderate to high level of anxiety.

As an entire group, students demonstrated a high level of mathematics anxiety, particularly in algebraic problem solving—a common area where students often experience conceptual and procedural difficulties. This moderate to high anxiety could negatively influence students' confidence, problem-solving ability, and overall academic performance in mathematics (Xie, 2024).

When analyzed by sex, the data revealed that, male students had a mean score of 3.44 (SD = 0.85), categorized as moderate anxiety. On the other hand, female students had a higher mean score of 3.78 (SD = 0.62), falling within the high anxiety category.

These findings are consistent with previous research, as a recent meta-analysis confirmed that gender differences in math anxiety remain robust across settings, with females consistently scoring higher (Xie, 2024). Similarly, a study conducted in Ghana reported that while both genders generally exhibited moderate levels of mathematics anxiety, female students' achievement was more negatively impacted, underscoring the persistent link between anxiety and performance (Asomah et al., 2025).

While the current discussion focuses on sex-based comparisons, categorizing anxiety levels by the type of error—conceptual, procedural, careless—may further illuminate how particular kinds of mathematical mistakes trigger different emotional responses. Research on algebraic error types supports this distinction, identifying conceptual errors (stemming from misunderstanding principles) versus procedural errors (slips in method) as meaningful error categories (Vicinanza, 2024; Yudhanegara et al., 2023).

The data revealed notable differences in anxiety levels based on the type of error committed. Students who committed conceptual errors exhibited a high level of mathematics anxiety, with a mean score of 3.82 (SD = 0.65). In contrast, those who struggled primarily with procedural errors showed a moderate level of anxiety, with a mean score of 2.95 (SD = 0.53). This difference suggests that conceptual misunderstandings evoke more anxiety in students than procedural lapses.

Conceptual errors refer to misunderstandings of fundamental mathematical principles, such as the properties of algebraic expressions, equations, or functions. Students making these errors likely lack a clear mental model of algebraic concepts, leading to uncertainty, confusion, and frustration, which may increase anxiety.

This finding aligns with earlier study showing that weak conceptual understanding is a strong predictor of mathematics anxiety. El Houari et al. (2020) confirmed that strengthening conceptual understanding is more effective in reducing math anxiety than focusing solely on procedural fluency.

By contrast, procedural errors occur when students understand the concept but misapply a rule, perform steps incorrectly, or make arithmetic slips. The lower anxiety levels observed among these students may reflect a perception that such mistakes are more easily corrected and less indicative of deep misunderstanding. Dowker, Sarkar, and Looi (2016) noted that procedural errors elicit less emotional strain because students retain confidence in their basic understanding, while Vicinanza (2024) added that the correctable nature of these errors reduces their impact on anxiety. Taken together, these findings suggest that the type of error students commit has distinct implications for their experience of mathematics anxiety, with conceptual misunderstandings posing the greater emotional burden.

Table 2 Frequency of Each Type of Error Grade 12 STEM Students Commit in Algebraic Problem Solving

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VIII August 2025

Type of Error	n	Mean	SD	Description
Conceptual	30	4.71	1.59	Occasional
Procedural	30	3.10	1.68	Rare
Computational	30	1.19	.86	Never

Note: 6.41-8.00 Very Frequent; 4.81-6.40 Frequent; 3.21-4.80 Occasional;

1.61-3.20 Rare; 1.00-1.60 Never

The analysis of students' responses to the eight-item algebraic problem-solving test revealed varying frequencies of error types—conceptual, procedural, and computational—among Grade 12 STEM students.

Conceptual Errors: Mean = 4.71, SD = 1.59 (Occasional)

The most frequently committed errors were conceptual in nature. With a mean of 4.71, categorized as Occasional, it suggests that students made an average of nearly five conceptual errors across the eight problems. Conceptual errors typically stem from misunderstandings of the underlying principles or relationships in algebra—such as failing to grasp variable manipulation, the distributive property, or the meaning of equations and expressions.

This result aligns with both recent and earlier findings of Kenney (2024) confirmed that conceptual misunderstandings remain the most prevalent type of algebraic error, while Delastri and Lolang (2023) found that students who depend primarily on rote rules are less able to transfer or adapt their knowledge to novel problem-solving contexts.

Procedural Errors: Mean = 3.10, SD = 1.68 (Rare)

Procedural errors were less frequent, with a mean of 3.10, interpreted as Rare. These errors involve incorrect steps in problem-solving, such as misapplying rules or incorrectly following algorithms. The relatively low occurrence may indicate that students have acquired procedural fluency—possibly through repetition and practice—but may not fully understand when and why specific procedures apply.

Rittle-Johnson and Schneider (2015) emphasize the distinction between procedural and conceptual knowledge, noting that students can often execute steps correctly without understanding their purpose. This study's result supports this, showing that while students may follow correct procedures, they may falter when required to apply deeper reasoning.

Computational Errors: Mean = 1.19, SD = 0.86 (Never)

Computational errors were the least common, with a mean of 1.19, falling within the Never category. These errors involve basic arithmetic operations such as addition, subtraction, multiplication, or division mistakes. The rarity of such errors suggests that students have achieved automaticity in arithmetic operations, enabling them to perform calculations accurately.

This finding is consistent with Dowker et al. (2016), who observed that computational proficiency tends to stabilize earlier in education, especially for students in advanced tracks like STEM. As students mature academically, computational skills become more reliable, allowing cognitive resources to shift toward higher-level problem-solving.

Table 3 Significant Relationship Between the Level Mathematics Anxiety and the Algebraic Problem-Solving Performance among Grade 12 STEM Students

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VIII August 2025

		Math Anxiety	Problem-Solving Performance
Math Anxiety	Spearman's rho	1.000	-.227
	p-value	-	.227
	n	30	30
Problem-Solving Performance	Spearman's rho	-.227	1.000
	p-value	.227	-
	n	30	30

Note: $p < .01$ – Significant at .01 level

Spearman's rho: ±0.1 to ±0.3 – Small/Weak, ±0.3 to ±0.5 – Medium/Moderate,

±0.5 to ±1.0 – Large/Strong

The results indicate a non-significant negative correlation between the level of mathematics anxiety and algebraic problem-solving performance among Grade 12 STEM students, as reflected by Spearman's rho of -0.227 and a p-value of 0.227 ($p > 0.05$). This suggests that although there is a weak inverse relationship—whereby higher mathematics anxiety tends to associate with lower problem-solving performance—the relationship is not statistically significant in this sample.

This pattern aligns with recent studies reporting complex and occasionally non-significant associations between math anxiety and achievement, particularly among secondary students. For instance, a study involving primary and secondary students found only weak negative correlations, sometimes non-significant depending on the grade level and context (Mitchell, 2022). Similarly, research in the Turks and Caicos Islands observed a small, non-significant negative correlation between mathematics anxiety and achievement among secondary students (Anderson-Waugh & George, 2024).

These findings indicate that students may have adopted effective coping mechanisms—such as cognitive reframing or anxiety regulation strategies—that reduce the detrimental effects of mathematics anxiety on performance. Furthermore, variables such as instructional quality, intrinsic motivation, prior mathematical knowledge, and test-taking experience may exert a more substantial influence on students' algebraic problem-solving outcomes than anxiety alone.

Taken together, while mathematics anxiety remains a significant affective construct in educational research, its direct impact on academic performance appears to be complex and context-dependent. Hence, it should be examined in conjunction with cognitive and contextual factors to provide a more comprehensive understanding of its role in mathematics learning (Mitchell & George, 2022).

CONCLUSIONS

The study found that Grade 12 STEM students generally experience moderate to high levels of math anxiety, especially in algebraic problem solving—likely due to its abstract and complex nature. Female students showed higher anxiety than males, probably influenced by social and psychological factors like stereotypes and self-doubt. Students who made conceptual errors reported greater anxiety than those with procedural errors, perhaps because deeper misunderstandings cause more confusion and stress. In contrast, procedural mistakes may feel more manageable, resulting in lower anxiety levels.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VIII August 2025

The findings suggest that students most frequently committed conceptual errors, followed by procedural, with computational errors being the least common. This likely reflects a solid foundation in basic arithmetic but a lack of deep understanding of algebraic concepts. Perhaps instruction has focused more on procedural steps than on the underlying "why," making abstract reasoning more challenging. These results highlight the need for balanced teaching that builds both conceptual understanding and procedural fluency.

The study found a weak, non-significant negative relationship between mathematics anxiety and algebraic problem-solving performance among Grade 12 STEM students. This suggests that while higher anxiety may slightly relate to lower performance, the link is not strong or consistent. Perhaps students have developed coping strategies or other factors—like motivation, teaching quality, or prior knowledge—play a more influential role in their math success. This aligns with previous research highlighting the complex nature of the anxiety-performance connection.

RECOMMENDATIONS

Enhance Conceptual Instruction in Algebra: Teachers should focus more on building deep conceptual understanding rather than relying heavily on procedural instruction. Using visual models, real-life applications, and inquiry-based approaches may help students grasp the "why" behind algebraic processes and reduce conceptual errors.

Integrate Anxiety-Reducing Strategies in Math Lessons: Incorporating mindfulness activities, growth mindset practices, and low-stakes assessments can help manage students' anxiety. Encouraging a supportive classroom climate where mistakes are viewed as learning opportunities may especially benefit students with high math anxiety.

Provide Targeted Support for Female Students: Since female students tend to report higher levels of anxiety, schools may consider gender-responsive strategies such as mentorship programs, positive role models in STEM, and confidence-building activities to address stereotype threats and boost self-efficacy.

Balance Procedural Fluency with Conceptual Depth: While students may be able to follow procedures, they may not fully understand their application. Teachers should ensure a balance by designing activities that require explanation, justification, and exploration of multiple solution paths.

Offer Remedial and Enrichment Programs: Establish programs that focus on conceptual gaps and provide differentiated instruction to meet varying student needs—particularly those who struggle with abstract reasoning in algebra.

Train Teachers in Math Anxiety Awareness: Professional development should include training on identifying signs of math anxiety and implementing instructional practices that reduce student stress, especially in topics known to trigger anxiety like algebra.

Conduct Further Research on Other Influencing Factors: Given that mathematics anxiety was only weakly associated with algebraic problem-solving performance in this study, future research should investigate other potential variables—such as motivation, prior achievement, teaching methods, or peer influence—that may exert a stronger impact. Additionally, future studies could expand the scope by including larger and more diverse samples across different grade levels, schools, or regions to enhance the generalizability of findings and provide a more comprehensive understanding of the factors influencing students' algebraic problem-solving ability.

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