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Article

Gender differences in mathematics anxiety among elementary school students: a rasch model approach

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ABSTRACT

Mathematics anxiety is an important psychological issue that may negatively affect students' experiences during mathematics learning. This study aimed to examine gender differences in mathematics anxiety among elementary school students. A quantitative comparative design was employed involving 101 students from SDN 25 Air Tawar Selatan, Indonesia, using a total sampling technique. Data were collected using the Mathematics Anxiety Scale and analyzed using the Rasch model to obtain interval-level person measures, followed by Welch's *t*-test to compare mathematics anxiety between male and female students. The results indicated a statistically significant gender difference in mathematics anxiety, with male students reporting higher levels of mathematics anxiety than female students ($p < .001$). These findings indicate that gender differences in mathematics anxiety were evident within the study sample. However, because this study employed a cross-sectional comparative design and examined only gender, the findings should be interpreted within the scope of the study and should not be considered evidence of causal relationships. The findings underscore the importance of fostering supportive mathematics learning environments and provide a basis for future studies involving more diverse educational settings and additional psychological and contextual factors.

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Introduction

Mathematics learning involves not only cognitive processes but also psychological factors that shape students' ability to engage with mathematical tasks effectively. Among these factors, emotions play a central role because they influence how students perceive, process, and respond to instructional information, ultimately affecting their academic performance (Sun & Zhang, 2026; Tan et al., 2021). Anxiety is one of the most prevalent emotional responses experienced in educational settings, and persistent learning-related anxiety can disrupt students' concentration, reduce their engagement in classroom activities, and interfere with the learning process (Córdova et al., 2023; Leigh et al., 2021). Consequently, anxiety represents an important psychological challenge in education because prolonged anxiety can hinder students' academic development as well as their overall learning experiences. Within this broader context, education plays a fundamental role not only in promoting

knowledge acquisition but also in supporting students' cognitive, affective, and psychological development (Evitarini et al., 2025).

However, anxiety is not experienced uniformly across all academic disciplines. It is particularly prevalent in subjects that require intensive cognitive processing, with mathematics representing one of the most demanding learning domains (Szczygieł et al., 2024). Mathematics is frequently perceived as an abstract and complex subject that requires logical reasoning, precision, and continuous problem-solving. These characteristics place substantial demands on students' working memory, attentional control, and information-processing capacity, thereby increasing their vulnerability to psychological distress (Cohen et al., 2021; Ma & Sun, 2025). Under such cognitively demanding conditions, students may develop mathematics anxiety, which is defined as a negative emotional response characterized by feelings of tension, fear, and apprehension when engaging in mathematics-related tasks or activities (Cipora et al., 2022).

Mathematics anxiety extends beyond formal examinations and may emerge whenever individuals interact with numbers, solve mathematical problems, or participate in everyday mathematics learning activities (Annisa et al., 2024). From a cognitive perspective, mathematics anxiety interferes with concentration, information processing, working memory, and attentional control, thereby reducing the efficiency of cognitive processing during mathematical problem solving (Pellizzoni et al., 2022). From an affective perspective, students experiencing mathematics anxiety generally report lower levels of self-efficacy and develop more negative attitudes toward mathematics, which further weakens their confidence in dealing with mathematical tasks (Octaviani & Sundari, 2024). These findings indicate that mathematics anxiety is not merely an emotional reaction to mathematics but a psychological condition capable of influencing multiple dimensions of students' learning.

The consequences of mathematics anxiety also extend to students' learning behaviours. Students with higher levels of mathematics anxiety are more likely to avoid mathematics-related activities and demonstrate avoidance behaviours during classroom learning (Song et al., 2023). They are also more likely to procrastinate on mathematics-related academic tasks (Maghfiroh & Pradipta, 2023) and generally exhibit lower motivation to learn mathematics (Li et al., 2021). When these behavioural patterns persist, they may create a self-reinforcing cycle in which anxiety contributes to poorer academic performance, while repeated academic difficulties further intensify mathematics anxiety (Ching et al., 2020). Therefore, mathematics anxiety should be understood as a multidimensional psychological construct that influences students' cognitive functioning, emotional responses, and learning behaviours, making it an important factor in understanding students' mathematics learning experiences and academic development.

Mathematics anxiety does not develop uniformly across individuals but is shaped by the interaction of various internal and external factors. Internal factors include cognitive abilities, emotional regulation, and students' self-confidence, all of which influence how students perceive and respond to mathematical challenges (Cohen et al., 2021). External factors, including learning experiences, classroom environments, instructional practices, and evaluation pressure, also contribute substantially to the development of mathematics anxiety (Demedts et al., 2022). In addition to these factors, mathematics anxiety is influenced by individual characteristics, including gender (Du et al., 2021). Gender has frequently been associated with differences in psychological, social, and cultural characteristics that shape individuals' responses to academic demands (Buser et al., 2021). These differences emerge not only from psychological characteristics but also from sociocultural processes that influence students' learning experiences, self-perceptions, and emotional responses toward mathematics (Matud et al., 2024). Consequently, examining mathematics anxiety from a gender perspective provides an important opportunity to understand why students respond differently to similar mathematical learning experiences.

Previous studies have proposed several explanations for gender differences in mathematics anxiety. Psychologically, females generally demonstrate greater emotional sensitivity and a higher prevalence of anxiety than males (Xu et al., 2024). In contrast, males tend to report higher mathematics self-concept and greater confidence in their mathematical abilities, although these

advantages are not consistently reflected in superior academic performance (Arias et al., 2018). Such differences cannot be attributed solely to biological characteristics but are also shaped by social expectations and cultural stereotypes. The persistent perception that mathematics is a domain more suitable for males may influence how students evaluate their own mathematical competence, thereby affecting self-concept, mathematics anxiety, and subsequent academic performance (Justicia-Galiano et al., 2023; Rossi et al., 2022).

The social environment further reinforces these differences. Parenting practices, teacher expectations, and interactions within the learning environment influence how students perceive mathematics and evaluate their own capabilities (Beteno et al., 2025). Likewise, stereotypes portraying mathematics as a male-oriented discipline may strengthen gender disparities in mathematics anxiety. Female students who are repeatedly exposed to such stereotypes tend to develop lower mathematics self-concept and higher levels of mathematics anxiety (Iraola-Real & Carvalho, 2025). Conversely, male students often receive stronger social encouragement to demonstrate confidence when facing academic challenges, which may contribute to lower anxiety levels.

Despite extensive research, empirical evidence regarding gender differences in mathematics anxiety remains inconsistent. Xie et al., (2024), in a study involving 91 students in China, reported that female students experienced significantly higher mathematics anxiety than male students. Similar findings were reported by Ulfah et al. (2023), who found that female students participating in online learning during the COVID-19 pandemic demonstrated higher mathematics anxiety than males, suggesting that differences in learning motivation may partially explain this pattern. However, contrasting evidence has also been documented. Nabilah & Sutini (2026) in a study involving senior high school students at the Indonesian School of Kuala Lumpur (SIKL), reported that male students exhibited higher mathematics anxiety than their female counterparts. Likewise, a study involving 245 university students in the United States found no statistically significant gender differences, although male students demonstrated slightly higher anxiety in certain mathematical domains (Jameson et al., 2024). These findings suggest that mathematics anxiety cannot be attributed exclusively to one gender because its development is likely influenced by learning experiences, coping strategies, and educational contexts.

Similar inconsistencies are also evident within Indonesian educational settings. Dzulfikar et al., (2025), in a study involving 96 senior high school students from several Indonesian cities, reported no significant differences in mathematics anxiety between male and female students. Likewise, a study conducted in Pamekasan Regency, East Java, found no significant differences in mathematics anxiety between male and female students (Yuliati & Zahrah, 2023). Collectively, these findings indicate that gender alone cannot adequately explain variations in mathematics anxiety, suggesting that students' emotional responses toward mathematics are influenced by a more complex interaction of psychological and contextual factors.

Taken together, previous studies consistently acknowledge gender as an important variable associated with mathematics anxiety; however, empirical findings remain inconclusive (Dzulfikar et al., 2025; Jameson et al., 2024; Ulfah et al., 2023; Xie et al., 2024; Yuliati & Zahrah, 2023). Some studies report higher mathematics anxiety among females, whereas others report higher anxiety among males or no statistically significant differences between the two groups. These inconsistencies indicate that evidence regarding gender differences in mathematics anxiety remains far from conclusive and warrants further investigation across different educational contexts and student populations.

Although previous studies have substantially advanced understanding of mathematics anxiety, several important issues remain unresolved. First, empirical findings regarding gender differences continue to be inconsistent. While some studies have reported higher mathematics anxiety among female students, others have found higher anxiety among males or no statistically significant differences between genders (Dzulfikar et al., 2025; Jameson et al., 2024; Ulfah et al., 2023; Xie et al., 2024; Yuliati & Zahrah, 2023). These inconsistencies suggest that gender-related differences in

mathematics anxiety cannot yet be considered conclusive and may vary across educational settings, learning experiences, and student characteristics.

Second, most existing studies have been conducted in international settings or under specific learning conditions, such as online learning during the COVID-19 pandemic (Ulfah et al., 2023; Xie et al., 2024). Consequently, the generalizability of these findings to different educational environments remains uncertain. Although several studies have investigated mathematics anxiety in Indonesia, empirical evidence obtained from local educational contexts remains relatively limited (Dzulfikar et al., 2025; Yuliati & Zahrah, 2023). Considering that educational environments, classroom experiences, and sociocultural characteristics differ across contexts, further investigation is required to provide a more comprehensive understanding of gender differences in mathematics anxiety among Indonesian students.

In addition, previous studies have primarily focused on identifying whether mathematics anxiety differs between male and female students. In the present study, gender differences are examined using Rasch-based person measures, which provide interval-level estimates of students' mathematics anxiety prior to statistical comparison. This measurement approach enables gender comparisons to be conducted using psychometrically calibrated estimates rather than relying solely on raw questionnaire scores, thereby providing a more robust basis for interpreting differences in mathematics anxiety between male and female students.

The present study is therefore important because mathematics anxiety has substantial implications for students' cognitive, affective, and behavioural development during mathematics learning (Lau et al., 2024; Li et al., 2021). Persistent mathematics anxiety not only interferes with students' academic development but may also reduce their interest in mathematics-related fields and future academic opportunities (Ferdinand et al., 2024; Octaviani & Sundari, 2024). A clearer understanding of gender differences in mathematics anxiety is expected to support the development of learning strategies that are more adaptive, inclusive, and responsive to students' psychological needs.

Based on these considerations, this study aims to examine gender differences in mathematics anxiety among students. Specifically, the study seeks to estimate students' mathematics anxiety using Rasch measurement, compare mathematics anxiety between male and female students using Rasch-based person measures, and discuss the implications of the findings for mathematics learning. By integrating Rasch measurement with gender comparison, this study is expected to provide empirical evidence that contributes to a more robust understanding of mathematics anxiety in educational settings.

Methods

This study used a quantitative approach with a comparative design to determine differences in math anxiety levels based on gender among students at SDN 25 Air Tawar Selatan, West Sumatra. The quantitative approach was used to objectively measure variables using numerical data, while the comparative design was used to compare anxiety levels between groups of male and female students (Sugiyono, 2023).

This study was conducted on students of SDN 25 Air Tawar Selatan, West Sumatra Province. The sampling technique in this study used non-probability sampling with the total sampling method, namely a sampling technique that involves all members of the population who meet the research criteria as respondents (Sugiyono, 2023). This technique was chosen because the population size is relatively limited and all students who meet the criteria can be reached by the researcher. The respondent criteria in this study are active students of SDN 25 Air Tawar Selatan who are willing to participate in the study. The number of samples in this study was 101 students, consisting of 61 male students (60.4%) and 40 female students (39.6%).

The instrument used in this study is a scale developed by researchers based on the theory of Richardson & Suinn (1972) which states that feelings of tension and anxiety that interfere when seeing numbers and solving mathematical problems in everyday and academic situations, which consist of several aspects including evaluation of mathematical anxiety and numerical anxiety. This instrument is in the form of a Likert scale of 36 statement items with alternative answer choices strongly agree, agree, disagree, and strongly disagree. One of the statement items is "I am worried about not being able to count change when shopping".

The instrument analysis results showed a person reliability value of 0.78 and an item reliability of 0.94. These findings indicate that the consistency of student responses is quite good, and the level of difficulty of the items in the instrument has very high stability. Furthermore, the Cronbach's Alpha (KR-20) value of 0.87 indicates that the internal consistency between individuals and items is in the very good category. Furthermore, the raw variance explained by measures value of 60% indicates that the instrument has met the assumption of unidimensionality, as it has exceeded the minimum limit of 40% (Linacre, 2017)

Instrument validity was tested using the Rasch Model approach through the Winsteps application version 5.6. Construct validity was evaluated based on item fit by observing the Outfit Mean Square (MNSQ), Infit Mean Square (MNSQ), Outfit Z-Standard (ZSTD), and Point Measure Correlation (Pt Measure Corr) values. An item is declared valid if it meets the criteria of Outfit and Infit MNSQ in the range of 0.50–1.50, Outfit ZSTD in the range of -2.00 to +2.00, and Point Measure Correlation in the range of 0.40–0.85 (Linacre, 2024; Syahputra et al., 2025)

Results and Discussion

The results of the analysis conducted using Winsteps software present a descriptive overview of mathematics anxiety based on gender, as shown in Table 1.

Table 1. Descriptive Statistics of Mathematics Anxiety by Gender

Gender	N	Mean Score	Mean Measure (Logit)	SD
Male	61	94.8	-0.81	0.33
Female	40	88.7	-1.06	0.33
Total	101*	92.4	-0.91	0.35

Based on Table 1, male students (n = 61) obtained a higher mean score than female students (n = 40), with mean scores of 94.8 and 88.7, respectively. Overall, the average score for the total sample of 101 students was 92.4. These descriptive findings suggest that male students tended to exhibit a higher level of mathematics anxiety than female students. In terms of the Rasch mean measure (logit), male students recorded a value of –0.81, whereas female students obtained a value of –1.06. Within the Rasch measurement framework, a higher logit value (i.e., one that is closer to zero) indicates a higher level of the measured construct. Accordingly, these results are consistent with the mean score findings, indicating that male students demonstrated relatively higher levels of mathematics anxiety than their female counterparts. Furthermore, both groups exhibited the same standard deviation (SD = 0.33), suggesting a comparable degree of variability and a relatively homogeneous distribution of mathematics anxiety scores across genders. This indicates that the dispersion of mathematics anxiety levels was similar for both male and female students. Nevertheless, these findings are based solely on descriptive statistics and, therefore, should not be interpreted as evidence of statistically significant gender differences. Further inferential statistical analyses are required to determine whether the observed differences are statistically significant.

Figure 1 presents the person distribution plot illustrating the differences in mathematics anxiety between male and female students, as generated by the Rasch analysis. The plot is presented as follows.

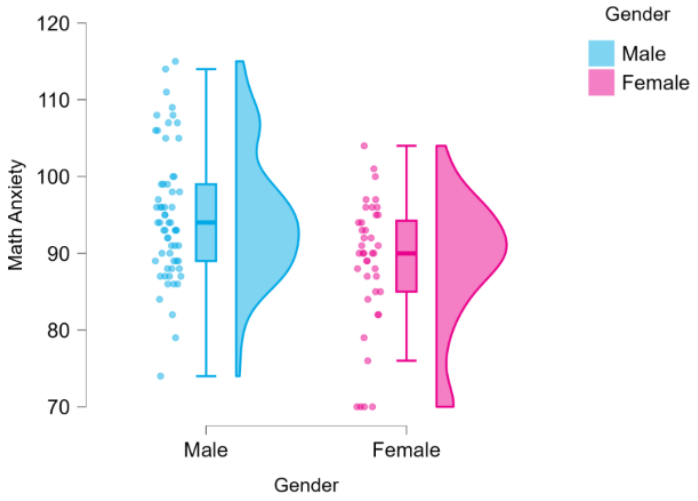

Figure 1. Mathematics Anxiety Plot

Figure 1 illustrates the distribution of mathematics anxiety scores by gender. The plot shows that male students (displayed in blue) tend to have relatively higher mathematics anxiety scores than female students (displayed in pink). This visual difference suggests a tendency for male students to exhibit higher levels of mathematics anxiety compared to their female counterparts. More specifically, the distribution of scores for male students is concentrated at higher logit values than that of female students, reinforcing the findings obtained from the descriptive statistics presented earlier. The plot also indicates that the higher levels of mathematics anxiety are predominantly represented by male students. Overall, this visualization provides preliminary evidence of gender-related differences in mathematics anxiety patterns. However, it is important to note that the interpretation of the plot remains descriptive and does not provide statistical evidence of a significant gender difference. Consequently, further inferential statistical analysis is required to determine whether the observed differences are statistically significant or merely reflect random variation within the study sample.

To further examine whether mathematics anxiety differs significantly by gender, the results of Welch's t-test are presented in Table 2 below.

Table 2. Welch's t-Test Results

Comparison	Mean Difference	S.E.	t	d.f.	Sig.
Male – Female	0.26	0.07	3.79	82	0.000

Based on Table 2, the results of Welch's *t*-test revealed a statistically significant difference in mathematics anxiety between male and female students. This finding is supported by the significance value ($p < .001$), indicating that the mean mathematics anxiety scores differed significantly between the two gender groups. The mean difference of 0.26 indicates that male students reported higher levels of mathematics anxiety than female students. Furthermore, the obtained test statistic, $t(82) = 3.79$, provides strong evidence that the observed difference between the two groups is statistically significant. Therefore, it can be concluded that mathematics anxiety varies significantly by gender, with male students exhibiting significantly higher levels of mathematics anxiety than their female counterparts.

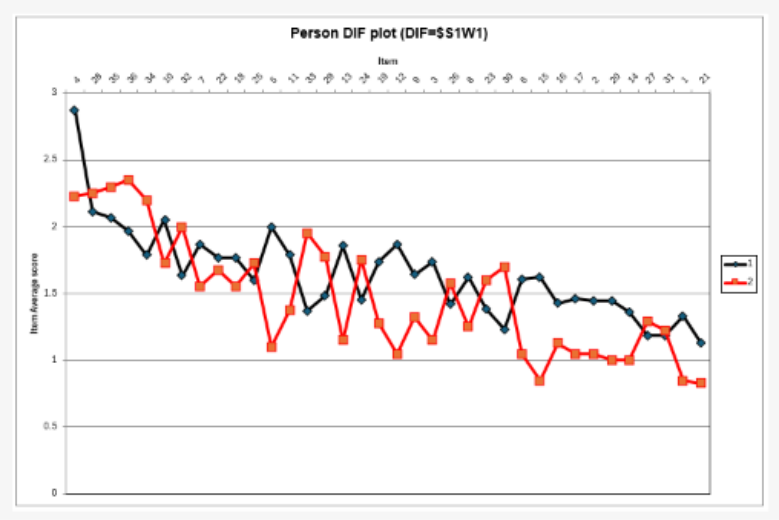

Figure 2. Comparison of Mean Mathematics Anxiety Scores by Gender (Blue = Male; Red = Female)

Based on Figure 2, noticeable differences in response patterns can be observed between male and female students across several mathematics anxiety items. Overall, male students tended to report higher scores than female students on most of the questionnaire items. Although some variations were evident for specific items, the overall pattern consistently indicates that male students experienced higher levels of mathematics anxiety than their female counterparts. The visual findings are consistent with the previous statistical analyses, which demonstrated a significant gender difference in mathematics anxiety. Taken together, these results suggest that gender is associated with students' levels of mathematics anxiety, with male students exhibiting significantly higher anxiety levels than female students. This finding implies that gender-related psychological characteristics may influence how students perceive and respond to mathematics-related situations.

Overall, the findings of this study demonstrate a statistically significant gender difference in mathematics anxiety. Male students reported higher levels of mathematics anxiety than female students. This conclusion is supported by the descriptive statistics, the visual inspection of the data, and the inferential analysis using Welch's *t*-test, all of which consistently indicate a statistically significant difference between the two groups. These findings further suggest that gender is associated with individuals' emotional experiences when engaging in mathematics-related activities. The higher levels of mathematics anxiety observed among male students indicate that they are more likely to experience feelings of anxiety, discomfort, and worry when confronted with mathematical tasks than their female counterparts.

The findings of the present study are consistent with the theoretical framework proposed by Richardson & Suinn (1972) who defined mathematics anxiety as feelings of tension and apprehension that interfere with an individual's ability to manipulate numbers and solve mathematical problems in both academic and everyday contexts. This definition suggests that mathematics anxiety extends beyond a simple dislike of mathematics; rather, it represents an emotional response that can adversely affect an individual's capacity to perform numerical tasks. Similarly, Ashcraft (2002) described mathematics anxiety as a state of fear, tension, and worry experienced when individuals engage in mathematics-related activities, which may impair cognitive performance, particularly in problem-solving and numerical information processing. Within this theoretical framework, the findings of the present study indicate that male students exhibited significantly higher levels of mathematics anxiety than female students. This suggests that male students tend to experience greater emotional barriers when confronted with mathematical activities, whether in classroom learning, academic assessments, or everyday situations involving numerical reasoning.

The findings of this study are consistent with those reported by Jameson et al. (2024) who found that male students exhibited higher levels of mathematics anxiety than female students. Although

the overall gender differences were not statistically significant in their study, male students demonstrated higher levels of mathematics anxiety on specific dimensions than their female counterparts. These findings suggest that male students may also experience elevated mathematics anxiety under certain circumstances. Collectively, the evidence supports the view that mathematics anxiety is influenced by a complex interplay of factors and cannot be attributed solely to biological sex. Instead, psychological, educational, and contextual factors are likely to contribute to the development and manifestation of mathematics anxiety. Similar gender-based differences have also been reported in other forms of academic anxiety. Alizamar et al. (2019) found that male and female students differed in statistical anxiety, indicating that gender may influence students' emotional responses across different academic domains, including mathematics.

The findings of the present study indicate that male students exhibited higher levels of mathematics anxiety than female students. However, this finding contrasts with those reported in several previous studies that identified the opposite pattern. For example, Xie et al. (2024) reported that female students tended to experience higher levels of mathematics anxiety than their male counterparts. Similarly, Nugroho et al. (2025) found that female students demonstrated significantly higher mathematics anxiety than male students. These inconsistencies across studies suggest that the relationship between gender and mathematics anxiety is not universal. Rather, it appears to be shaped by a complex interaction of contextual factors, including sociocultural influences, learning experiences, sample characteristics, and educational environments. Consequently, gender alone may not adequately explain variations in mathematics anxiety, and its influence should be interpreted within the broader educational and social contexts in which students develop and learn.

The findings of the present study are further supported by Mier et al. (2019) who reported that gender differences in mathematics anxiety are not consistently observed across all populations, suggesting that gender alone is insufficient to explain variations in mathematics anxiety. This evidence highlights the multifaceted nature of mathematics anxiety, indicating that it arises from the interaction of multiple psychological, educational, and contextual factors rather than from gender alone. In addition to gender, previous learning experiences, mathematics self-efficacy, instructional approaches employed by teachers, family support, and students' prior experiences with mathematics assessments have all been identified as important contributors to the development of mathematics anxiety. This explanation is also supported by previous studies demonstrating that students' psychological responses to academic demands, including academic stress, differ across individuals and may contribute to variations in academic anxiety (Ifdil et al., 2022). These findings underscore the importance of considering mathematics anxiety as a multidimensional construct influenced by the interplay of individual and environmental factors.

The findings of the present study, which was conducted among elementary school students, indicate that male students exhibited higher levels of mathematics anxiety than female students. This finding suggests that gender differences in mathematics anxiety are not universal and may vary across different populations and educational contexts. Szczygieł (2020) argued that gender differences in mathematics anxiety among school-aged children depend on the specific dimension or type of mathematics anxiety being assessed, which may account for the variability in findings across studies. Furthermore, Möhring et al. (2024) reported that mathematics anxiety among elementary school students is closely associated with their learning experiences and the instructional contexts in which mathematics is taught. Taken together, these findings suggest that mathematics anxiety is shaped not only by gender but also by developmental, educational, and contextual factors that influence children's emotional responses to mathematics.

Furthermore, one possible explanation for the findings of the present study is the performance pressure arising from gender-based social expectations regarding mathematical ability. Justicia-Galiano et al. (2023) demonstrated that gender stereotypes related to mathematics competence can influence students' emotional responses, including mathematics anxiety. In many educational and sociocultural contexts, the expectation that boys should naturally excel in mathematics may create additional internal pressure to perform well. Consequently, when confronted with challenging

mathematical tasks or when their performance falls short of expectations, male students may experience heightened levels of anxiety due to the perceived need to meet these societal expectations. This perspective suggests that mathematics anxiety is shaped not only by students' academic competence but also by psychological pressures rooted in gender-related social norms and expectations. This finding reinforces the importance of students' psychological beliefs about themselves. Stronger self-efficacy may help students cope more effectively with performance expectations and reduce anxiety when facing challenging academic situations (Sari et al., 2025).

In addition to gender-related factors, psychological characteristics such as mathematics self-efficacy have consistently been identified as important predictors of mathematics anxiety. Previous studies by Octaviani & Sundari (2024) ; Vos et al. (2023) demonstrated that mathematics anxiety is closely associated with students' confidence in their ability to successfully perform mathematical tasks. Students with lower or unstable levels of self-efficacy are more likely to experience heightened mathematics anxiety, as they tend to doubt their ability to cope with mathematical challenges. Furthermore, recent evidence suggests that mathematics anxiety serves as a significant mediator in the relationship between gender and mathematics achievement, implying that gender differences in mathematics anxiety may partially explain variations in students' academic performance.

Learning experiences also represent a crucial factor in the development of mathematics anxiety. Study by Dowker & Sheridan (2022) reported that students' attitudes toward mathematics, prior learning experiences, and test anxiety all contribute to the emergence of mathematics anxiety. Negative learning experiences–such as repeated academic failure, persistent difficulties in understanding mathematical concepts, or receiving discouraging feedback from teachers–may increase students' fear and apprehension toward mathematics. Likewise, learning environments characterized by excessive performance pressure, limited emotional support, or an overemphasis on academic outcomes may further exacerbate mathematics anxiety. Conversely, positive learning experiences and supportive classroom environments can foster students' confidence, promote positive attitudes toward mathematics, and ultimately reduce the likelihood of developing mathematics anxiety. This explanation is further supported by Nurfadillah et al. (2024), who demonstrated that students' learning anxiety is influenced by their psychological capacity to cope with academic challenges. These findings indicate that anxiety in learning contexts is not merely determined by cognitive ability but is also shaped by students' internal psychological resources and adaptive responses toward academic demands. The influence of psychological conditions on mathematics anxiety has also been demonstrated by Salendu et al. (2025), who found that students' stress significantly contributes to mathematics anxiety. This finding suggests that mathematics anxiety develops through interactions between academic demands and students' psychological responses, reinforcing the argument that emotional factors should be considered alongside cognitive aspects in mathematics learning.

Furthermore, the relationship between gender and mathematics anxiety has not been consistently observed across different educational and cultural contexts. While some studies have reported that female students experience higher levels of mathematics anxiety, others have found contrasting patterns depending on the characteristics of the study population, learning environment, and psychological factors involved (Megreya et al., 2023). These inconsistent findings suggest that the influence of gender on mathematics anxiety cannot be generalized across all student populations. Rather, mathematics anxiety should be understood as a multifaceted construct shaped by the dynamic interaction of individual, educational, and contextual factors. Variables such as prior learning experiences, self-confidence in mathematics, environmental support, and academic demands may jointly influence the development and expression of mathematics anxiety. Therefore, gender differences in mathematics anxiety should be interpreted within the specific context of each study rather than being regarded as universally applicable.

Overall, the findings of the present study suggest that the higher levels of mathematics anxiety observed among male students may be understood as the result of a complex interaction between social expectations, psychological characteristics, and learning experiences. These findings reinforce

the view that gender should not be considered the sole determinant of mathematics anxiety but rather one component within a broader network of individual and contextual influences that shape students' emotional responses to mathematics. Accordingly, efforts to reduce mathematics anxiety should adopt a comprehensive approach that extends beyond improving mathematical competence alone. Educational interventions should focus on fostering supportive and inclusive learning environments, strengthening students' psychological well-being and self-confidence, and implementing instructional strategies that encourage positive engagement with mathematics. In addition, emotional regulation should also be considered an important psychological resource that enables students to respond more adaptively to stressful academic situations (Haryono et al., 2026). Students who are able to regulate their emotions effectively are more likely to manage feelings of anxiety when confronted with challenging mathematical tasks. Therefore, interventions designed to strengthen emotional regulation, alongside students' confidence and psychological well-being, may contribute to reducing mathematics anxiety and fostering more adaptive responses toward mathematics learning. Such efforts may help alleviate mathematics anxiety and promote more positive attitudes toward mathematics, thereby enabling both male and female students to achieve their full academic potential.

The findings of the present study have important practical implications for mathematics education, particularly at the elementary school level. The observation that male students exhibited higher levels of mathematics anxiety highlights the need for teachers to pay greater attention to students' emotional well-being during mathematics instruction. Beyond promoting cognitive achievement, teachers should also foster supportive, inclusive, and psychologically safe learning environments that minimize unnecessary performance pressure. Practical instructional strategies may include providing constructive and encouraging feedback, implementing diverse and engaging teaching approaches, and creating opportunities for students to view mistakes as a natural and valuable part of the learning process rather than as indicators of failure. In addition, teachers should actively support the development of students' mathematics self-efficacy and confidence in their mathematical abilities, as strengthening these psychological resources may help reduce mathematics anxiety and encourage more positive engagement with mathematics learning.

From a theoretical perspective, the present study contributes to the growing body of literature by reinforcing the view that mathematics anxiety is a multidimensional construct shaped by the interaction of psychological, social, and educational factors. The finding that male students exhibited higher levels of mathematics anxiety further supports the argument that gender differences in mathematics anxiety are context-dependent rather than universal. Consequently, these findings underscore the importance of considering the broader contextual and individual factors that influence students' emotional responses to mathematics rather than attributing mathematics anxiety solely to gender. Future research is therefore encouraged to examine more specific determinants of mathematics anxiety, such as mathematics self-efficacy, social support, and students' coping strategies when dealing with mathematics-related challenges. A deeper understanding of these factors may facilitate the development of more targeted and evidence-based interventions to reduce mathematics anxiety across diverse student populations.

Despite its contributions, this study has several limitations. The study included participants from only one elementary school, SDN 25 Air Tawar Selatan, using a total sampling technique; therefore, the findings may reflect the characteristics of this particular educational and sociocultural context and should be generalized with caution. In addition, this study focused solely on gender differences in mathematics anxiety without examining other influential factors, such as mathematics self-efficacy, prior mathematics achievement, social support, or classroom experiences. Consequently, although significant gender differences were identified, the present study cannot explain the underlying factors contributing to the higher mathematics anxiety observed among male students. Furthermore, the use of a self-report questionnaire may have introduced response bias. Future research is encouraged to involve more diverse educational settings and incorporate additional psychological and contextual variables to provide a more comprehensive understanding of mathematics anxiety among elementary school students.

Conclusions

This study found a statistically significant gender difference in mathematics anxiety among students at SDN 25 Air Tawar Selatan, with male students reporting higher levels of mathematics anxiety than female students. These findings indicate that gender was associated with differences in mathematics anxiety within the study sample. However, because this study employed a cross-sectional comparative design and examined only gender, the findings should not be interpreted as evidence that gender alone explains mathematics anxiety or that the observed differences reflect causal relationships. The findings have practical implications for mathematics education by highlighting the importance of paying attention to students' emotional well-being during mathematics learning. Teachers are encouraged to create supportive and inclusive classroom environments, provide constructive feedback, and strengthen students' confidence in learning mathematics. Although these recommendations are not gender-specific, they may help reduce mathematics anxiety and promote more positive learning experiences for all students. This study was limited to participants from a single elementary school using a total sampling technique and relied on a self-report instrument. Consequently, the findings should be generalized with caution, as they may reflect the characteristics of the particular educational and sociocultural context in which the study was conducted. Furthermore, because other potentially relevant variables, such as mathematics self-efficacy, prior mathematics achievement, social support, and classroom experiences, were not examined, future research should incorporate these factors and involve more diverse educational settings to obtain a more comprehensive understanding of mathematics anxiety among elementary school students.

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