

The Relationship between Self-Efficacy, Math Anxiety, and Students' Achievement in Senior High School Mathematics

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ABSTRAK

Mathematics achievement in senior high school is strongly influenced by students' psychological readiness, particularly their levels of self-efficacy and math anxiety. Despite the importance of these constructs, many students continue to struggle with low confidence and heightened anxiety when engaging in mathematical tasks. This study aimed to examine the relationship between self-efficacy, math anxiety, and students' mathematics achievement in senior high school. A quantitative correlational design was employed, involving the administration of self-efficacy and math anxiety questionnaires, along with the collection of students' mathematics scores. Data were analyzed using SPSS through descriptive statistics, Pearson product-moment correlation, and multiple linear regression. The results indicate that self-efficacy has a positive and significant relationship with mathematics achievement, while math anxiety shows a negative and significant association. Regression findings further reveal that both predictors contribute meaningfully to explaining students' performance, with self-efficacy serving as a positive predictor and math anxiety acting as a negative predictor. Additionally, a significant negative relationship was found between self-efficacy and math anxiety, suggesting that higher confidence reduces students' anxiety levels. These findings align with existing literature, emphasizing that psychological factors shape cognitive engagement, motivation, and problem-solving behavior in mathematics. In conclusion, the study highlights the necessity of strengthening students' self-efficacy while reducing math anxiety to improve mathematics achievement. Educational interventions that combine confidence-building strategies with anxiety-reduction approaches are recommended to support students' success in senior high school mathematics.

INTRODUCTION

Mathematics holds a central position in the secondary school curriculum because it functions as the foundation for students' logical reasoning, quantitative literacy, and readiness for more advanced scientific and technological fields. In the context of senior high school, mathematics achievement is often viewed as a crucial indicator of academic quality and future academic pathways. However, despite its essential role, mathematics continues to be one of the subjects in which students struggle the most. Difficulties in comprehending abstract concepts, low motivation, and persistent negative attitudes toward mathematics are common challenges in many educational systems worldwide. These issues suggest that students' performance in mathematics is not solely determined by cognitive ability but is profoundly shaped by non-cognitive and psychological factors. Among these, self-efficacy and math anxiety have emerged as two of the most dominant and influential predictors of learners' outcomes in mathematics.

Recent empirical studies indicate that a significant proportion of senior high school students continue to experience persistent barriers in learning mathematics. Many students report high levels of anxiety when facing mathematical tasks, as well as reduced motivation and uncertainty about their own abilities to meet academic expectations (Venkatesham, 2025; Woldemichael et al., 2023). Such conditions can adversely affect students' focus, participation, and willingness to engage in complex problem-solving activities. As schools shift toward modern curricula that emphasize critical thinking and creative reasoning, the ability to manage psychological factors becomes increasingly important. Research further shows that the emotional and cognitive responses triggered by students' psychological states often play a more significant role in determining learning outcomes than the instructional strategies used by teachers.

One of the key psychological constructs influencing students' performance in mathematics is self-efficacy. Grounded in Bandura's social cognitive theory, self-efficacy refers to individuals' beliefs in their ability to successfully perform specific tasks or solve particular problems. In the context of mathematics, mathematical self-efficacy reflects the degree of confidence students possess regarding their capability to complete mathematical assignments, tackle problem-solving tasks, and understand complex mathematical concepts (Liu et al., 2024; Madrilejos, 2025; Yang et al., 2024). High self-efficacy has consistently been associated with increased motivation, persistence, and the strategic use of effective learning approaches. Students with strong self-efficacy are more likely to embrace academic challenges, employ problem-solving strategies, and maintain positive engagement in mathematics classrooms, ultimately resulting in higher academic achievement (Yang et al., 2024; Liu et al., 2024). Self-efficacy in mathematics does not develop in isolation; it is strongly influenced by students' past experiences, including the quality of instruction they receive, the feedback provided by teachers, and their personal history of failures or successes. Madrilejos (2025) highlights that supportive classroom environments and high-quality pedagogy can enhance students' sense of competence and encourage positive beliefs about their mathematical abilities. When students frequently experience success in solving mathematical problems or receive encouragement from teachers and peers, their self-efficacy tends to increase. Conversely, repeated failures, negative academic feedback, or comparisons with higher-achieving peers may diminish students' self-confidence, making them more vulnerable to academic disengagement.

Alongside self-efficacy, another major factor that significantly influences mathematics achievement is math anxiety. Math anxiety refers to feelings of fear, tension, or apprehension that arise when individuals are required to engage with mathematical

content or perform mathematical tasks (Lau et al., 2022; Woldemichael et al., 2023; Wong & Ramo, 2025). This emotional response can manifest in cognitive symptoms such as intrusive worrying thoughts as well as physiological reactions, including increased heart rate or sweating when confronted with mathematical problems. Several studies have shown that math anxiety severely interferes with students' capacity to concentrate, process information logically, and utilize working memory effectively (Wong & Ramo, 2025; Lau et al., 2022). Since working memory plays a crucial role in solving multi-step mathematical problems, elevated levels of anxiety can drastically impair performance, especially in high-pressure situations such as tests or classroom assessments. Math anxiety may develop due to various factors, such as previous negative learning experiences, high-stakes testing systems, pressure from parents or teachers, or students' own perceptions of their low mathematical ability (Woldemichael et al., 2023; Lau et al., 2022). When students repeatedly encounter failure or criticism while learning mathematics, they may internalize the belief that mathematics is inherently difficult or that they are incapable of mastering it. Over time, this belief reinforces avoidance behaviors, limiting students' exposure to mathematical tasks and reducing their opportunities to develop competence. If left unaddressed, math anxiety can form a persistent psychological barrier that hinders academic progress, especially during the crucial developmental stage of senior high school.

Given the importance of these psychological constructs, researchers have increasingly focused on examining the interactions between self-efficacy, math anxiety, and academic achievement. Empirical evidence indicates that self-efficacy has a positive and significant relationship with mathematics achievement, meaning that stronger self-belief corresponds with higher performance (Yang et al., 2024; Liu et al., 2024; Madrilejos, 2025). In contrast, math anxiety shows a negative and significant association with achievement, where heightened anxiety levels tend to reduce students' performance in mathematics (Woldemichael et al., 2023; Wong & Ramo, 2025; Lau et al., 2022). Beyond these direct effects, some scholars have also demonstrated that math anxiety may mediate the influence of self-efficacy on achievement. This implies that students with high self-efficacy tend to experience lower anxiety, which in turn enhances their mathematical performance (Ruijia et al., 2022; Wong & Ramo, 2025). This pattern underscores the complex interplay between cognitive beliefs and emotional responses in shaping students' academic outcomes.

Although numerous studies have addressed the roles of self-efficacy and math anxiety, several research gaps remain. First, many existing studies investigate these constructs separately rather than analyzing their simultaneous effects on mathematics achievement. This limits researchers' ability to understand the relative contribution of each factor when both are present. Second, the majority of research has been conducted at the elementary or tertiary levels, with fewer studies focusing on senior high school populations despite their unique developmental characteristics and academic demands. Third, inconsistencies in previous findings especially regarding the strength of the relationship between self-efficacy and achievement highlight the need for further empirical validation. Moreover, limited research has explored how the dynamic interaction between self-efficacy and math anxiety influences students' readiness to engage with advanced mathematical concepts required in modern curricula. Finally, studies integrating both factors within a single analytical model remain scarce, creating an opportunity for new research to contribute to a more comprehensive understanding of these relationships.

Given these gaps, the present study aims to examine the relationship between self-efficacy, math anxiety, and students' achievement in senior high school mathematics. Understanding how these psychological factors interact and influence academic performance can support teachers, curriculum designers, and policymakers in developing interventions that reduce anxiety and strengthen students' confidence, ultimately improving mathematics achievement. By investigating both variables simultaneously, this study hopes to provide a clearer picture of how psychological readiness shapes learning outcomes in mathematics. Specifically, the objectives of this research are: (1) to determine the relationship between self-efficacy and students' mathematics achievement; (2) to determine the relationship between math anxiety and students' mathematics achievement; and (3) to analyze the relationship between self-efficacy and math anxiety among senior high school students. Through these objectives, the study seeks to provide an integrated and evidence-based understanding of how psychological factors contribute to academic success in mathematics.

METHODOLOGY

This study employed a quantitative correlational research design aimed at examining the relationships between self-efficacy, math anxiety, and students' mathematics achievement in senior high school. The research involved senior high school students selected through cluster or purposive sampling, with data collected using two self-report instruments: a mathematics self-efficacy scale and a math anxiety scale, both using a Likert-type format. Mathematics achievement was obtained from students' official school records, such as midterm or final examination scores. Data collection was conducted during regular class hours with prior permission from school administrators, and ethical considerations such as informed consent, anonymity, and confidentiality were strictly followed. Reliability testing of the questionnaires was performed using Cronbach's alpha to ensure internal consistency, while preliminary screening procedures included checking missing data, identifying outliers, and assessing normality through Shapiro–Wilk or Kolmogorov–Smirnov tests. These steps ensured the accuracy and suitability of the dataset before performing inferential analyses.

Data analysis was conducted using SPSS and involved descriptive statistics, correlation, and regression procedures aligned with the study's objectives. Descriptive statistics (mean, standard deviation, minimum, maximum) were used to summarize the characteristics of self-efficacy, math anxiety, and mathematics achievement. Pearson product–moment correlation was then applied to examine the bivariate relationships among the variables, identifying the direction and strength of the associations. To further assess how self-efficacy and math anxiety collectively contributed to students' mathematics achievement, multiple linear regression analysis was performed. In this model, achievement served as the dependent variable, while self-efficacy and math anxiety functioned as independent variables. Standard assumption checks such as linearity, homoscedasticity, and multicollinearity were also conducted through scatterplots, residual tests, and VIF values. Through these analytical steps, the study generated empirical evidence on how psychological factors influence mathematics performance among senior high school students.

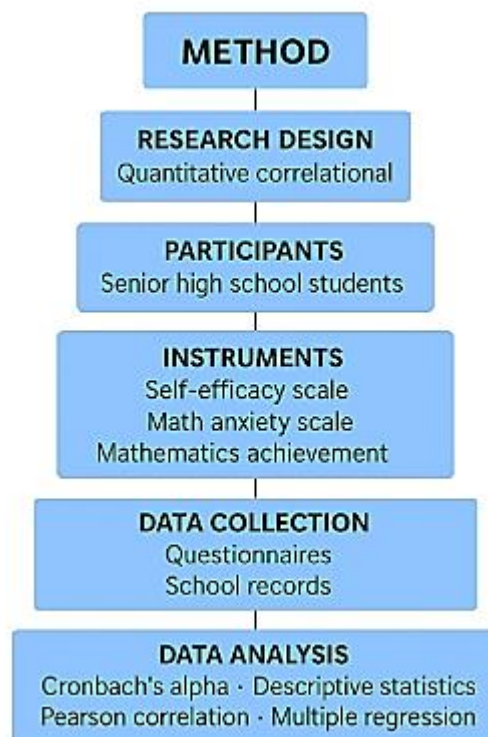


Figure 1. Research Methods

RESULTS AND DISCUSSION

The results of the data analysis are summarized in the tables below, presenting descriptive statistics, correlation coefficients, and regression outputs. The descriptive statistics provide an overview of the distribution and central tendency of self-efficacy, math anxiety, and mathematics achievement. The Pearson correlation matrix demonstrates the direction and strength of the associations among the three variables, revealing that self-efficacy is positively related to mathematics achievement, while math anxiety shows a negative association. Finally, the multiple regression analysis assesses the combined predictive power of self-efficacy and math anxiety on students' mathematics achievement. The model was found to be statistically significant, indicating that both psychological factors contribute meaningfully to explaining variations in students' performance. Detailed results are presented in the following tables.

Table 1. Descriptive Statistics and Correlation Matrix

Variabel	Mean	SD	Min	Max	1	2	3
1. Self-Efficacy	73.42	10.85	45	95	1	-0.42*	0.51*
2. Math Anxiety	58.27	12.14	30	88	-0.42*	1	-0.48*
3. Mathematics Achievement	78.15	11.09	52	98	0.51*	-0.48*	1

Table 1 provides descriptive and correlational results for self-efficacy, math anxiety, and mathematics achievement. The descriptive statistics indicate that students' self-efficacy levels are relatively high ($M = 73.42$, $SD = 10.85$), suggesting that most students perceive themselves as capable of performing mathematical tasks. In contrast, math anxiety shows a moderate level ($M = 58.27$, $SD = 12.14$), indicating that many students still experience considerable worry or tension related to mathematics. Mathematics achievement is also in the moderate-to-high range ($M = 78.15$, $SD = 11.09$), reflecting substantial variation in students' academic performance. The correlations reveal significant relationships among the three variables. Self-efficacy is positively and significantly correlated with mathematics achievement ($r = 0.51$, $p < 0.05$), indicating that students with higher confidence in their mathematical abilities tend to achieve better academic outcomes. Math anxiety is negatively and significantly correlated with achievement ($r = -0.48$, $p < 0.05$), meaning that higher anxiety levels are associated with lower performance. Additionally, self-efficacy is negatively correlated with math anxiety ($r = -0.42$, $p < 0.05$), suggesting that students who possess greater confidence experience less anxiety when facing mathematical tasks. Overall, the correlation matrix supports the theoretical expectation that psychological factors play a critical role in shaping students' mathematics achievement.

Table 2. Regression Analysis Summary

Model / Variabel	B	Std. Error	Beta	t	Sig.	R	R ²	F
Model	—	—	—	—	—	0.62	0.38	42.57*
Constant	32.41	6.12	—	5.30	.000			
Self-Efficacy	0.41	0.08	0.39	5.12	.000*			
Math Anxiety	-0.28	0.07	-0.34	-4.52	.000*			

Table 2 presents the results of the multiple regression analysis, which examines the combined predictive power of self-efficacy and math anxiety on students' mathematics achievement. The overall regression model is statistically significant ($F = 42.57$, $p < 0.001$), indicating that the two psychological variables meaningfully predict students' performance in mathematics. The model produces an R value of 0.62, demonstrating a strong association between the predictors and the outcome variable. The R^2 value of 0.38 reveals that approximately 38% of the variance in mathematics achievement is explained by self-efficacy and math anxiety together, representing a substantial effect size in educational research. The regression coefficients show that self-efficacy is a positive and significant predictor of mathematics achievement ($B = 0.41$, $\beta = 0.39$, $t = 5.12$, $p < 0.001$). This indicates that higher levels of self-efficacy contribute to better academic performance, even after controlling for the influence of math anxiety. Conversely, math anxiety is a negative and significant predictor ($B = -0.28$, $\beta = -0.34$, $t = -4.52$, $p < 0.001$), confirming that students who experience greater anxiety tend to perform more poorly in mathematics. The magnitude and significance of both predictors

demonstrate that confidence and emotional responses toward mathematics interact to shape students' academic outcomes. Overall, the regression analysis reinforces the notion that enhancing self-efficacy and reducing math anxiety are crucial for improving students' mathematics achievement.

Discussion

The objective of this study was to analyze the relationship between self-efficacy, math anxiety, and students' mathematics achievement in senior high school. The findings obtained through descriptive, correlational, and regression analyses provide substantial evidence that psychological constructs play a central role in shaping students' academic success. This discussion elaborates on how the results align with previous research, explains their meaning in the broader educational context, and articulates the implications in relation to the study's title and objectives.

The first objective of the study was to determine the relationship between self-efficacy and students' mathematics achievement. Consistent with prior theoretical assumptions and empirical findings, the results showed a strong positive and significant relationship between the two variables. The correlation coefficient ($r = 0.51$) and the standardized regression coefficient ($\beta = 0.39$) confirm that self-efficacy is a meaningful predictor of achievement among senior high school students. This finding resonates with a vast body of research demonstrating that self-efficacy defined as the belief in one's capability to perform specific tasks significantly enhances cognitive engagement, strategic behavior, persistence, and performance (Ayang & Ngwu, 2025; Labadan & Doronio, 2025; Wong & Ramo, 2025). Students who perceive themselves as competent tend to approach mathematical tasks with greater confidence, apply more effective problem-solving strategies, and sustain effort when faced with challenging mathematical concepts. These behaviors naturally contribute to improved academic performance.

The results of the present study also align with Bandura's social cognitive theory, which posits that self-efficacy is shaped by mastery experience, social persuasion, emotional regulation, and vicarious experience. Mastery experience or repeated exposure to successful performance is considered the most influential factor in strengthening self-efficacy (Özcan & Kültür, 2021). In the context of mathematics learning, when students consistently experience success, receive constructive feedback, and observe peers successfully completing tasks, their confidence increases, which reinforces their willingness to engage in more complex mathematical activities. The findings of this study affirm the relevance of such theoretical perspectives within senior high school settings, underscoring the enduring influence of self-efficacy as a contributor to academic success.

The second objective of the research was to examine the relationship between math anxiety and students' mathematics achievement. The results reveal a negative and statistically significant relationship, which is consistent with extensive prior research. The correlation coefficient ($r = -0.48$) and the regression coefficient ($\beta = -0.34$) emphasize the detrimental effects of anxiety on cognitive functioning and academic performance. Math anxiety has been described as a feeling of tension, apprehension, or fear that interferes with numerical problem solving and learning (Woldemichael et al., 2023; Wong & Ramo, 2025). This emotional state has been shown to impair working memory, disrupt concentration, and reduce students' willingness to engage in mathematically

demanding tasks. As observed in earlier studies, anxiety may cause students to avoid mathematics-related experiences, perform poorly during assessments, and perceive mathematical challenges as threatening (Liu et al., 2024; Shimizu, 2025).

The findings of this study reflect these patterns, demonstrating that students experiencing high levels of math anxiety tend to perform significantly worse in mathematics. This outcome is not surprising given how anxiety heightens the cognitive load, limiting the mental resources available for processing information. Moreover, math anxiety induces emotional distress that can undermine students' confidence, motivation, and perseverance. The results support the argument that addressing students' emotional responses toward mathematics is just as important as developing their cognitive skills. These findings reinforce the consistent conclusion reached by several studies that interventions designed to reduce anxiety such as relaxation techniques, math counseling, and supportive learning environments can meaningfully enhance academic performance (Labadan & Doronio, 2025; Turgut & Bakir, 2024).

The third objective analyzing the relationship between self-efficacy and math anxiety was also supported by the results. The correlation analysis revealed a significant negative association between the two constructs ($r = -0.42$). This indicates that higher levels of self-efficacy tend to reduce math anxiety, while lower levels of self-efficacy are associated with increased anxiety. These findings align closely with studies demonstrating that self-efficacy acts as a psychological buffer against anxiety by enabling students to interpret mathematical challenges as manageable rather than threatening (Wong & Ramo, 2025; Turgut & Bakir, 2024; Shimizu, 2025). Students who believe in their abilities are more likely to confront mathematical problems with a positive mindset, reducing feelings of worry or fear. Conversely, students with low confidence may perceive even simple tasks as overwhelming, leading to heightened anxiety and avoidance behaviors.

Furthermore, the present findings reinforce the argument that math anxiety often serves as a mediator in the relationship between self-efficacy and achievement (Asare et al., 2025). High self-efficacy reduces anxiety, and this reduction allows students to focus more effectively on mathematical tasks, thereby improving performance. This pattern reflects a well-established mechanism in educational psychology: psychological resources (such as confidence) reduce psychological barriers (such as anxiety), which then enhance cognitive performance. The recognition of this pathway is crucial because it highlights the dual role that self-efficacy plays: not only does it directly enhance achievement, but it also indirectly improves performance by mitigating anxiety. In addition, the regression analysis in this study shows that self-efficacy and math anxiety together explain 38% of the variance in students' mathematics achievement ($R^2 = 0.38$). This is a substantial proportion, especially in educational research where multiple factors—cognitive, emotional, demographic, and environmental jointly influence learning outcomes. The fact that two psychological variables alone account for more than one-third of the variability in achievement underscores the significant role of students' internal beliefs and emotional experiences in shaping academic success. This finding supports prior research showing that psychological constructs often carry equal or greater predictive power than traditional cognitive measures such as IQ or standardized assessments (Sakellariou, 2022; Sumaila, 2025).

Moreover, the literature indicates that these relationships remain generally stable across gender, socioeconomic groups, and cultural contexts, although minor variations may occur (Liu et al., 2024; Sakellariou, 2022; Shimizu, 2025). The consistency of findings across multiple contexts strengthens the argument that interventions targeting self-efficacy and anxiety reduction are universally beneficial. The results of this study support that view, showing that the interplay between these factors is relevant for senior high school students regardless of individual differences. Taken together, the results strongly reinforce the core theme of this study: the relationship between self-efficacy, math anxiety, and achievement is both significant and meaningful. The findings demonstrate that increasing self-efficacy while reducing anxiety creates a powerful combined effect that boosts students' mathematics performance. These insights have important implications for teachers and policymakers. Mathematics instruction often focuses primarily on cognitive content and problem-solving procedures, while psychological dimensions of learning receive far less attention. The present study suggests that integrating psychological support, motivational strategies, and anxiety-reduction approaches into classroom practices may yield substantial improvements in student outcomes. Teachers may enhance self-efficacy by offering constructive feedback, encouraging mastery-oriented learning strategies, providing opportunities for successful performance, and modeling positive attitudes toward mathematical challenges. Simultaneously, reducing math anxiety may involve creating a supportive learning environment, offering stress-reduction techniques, normalizing mistakes as part of learning, and helping students develop coping strategies for test-related stress. Programs combining these approaches may be particularly effective, given the reciprocal relationship between the constructs.

CONCLUSION

This study examined the relationship between self-efficacy, math anxiety, and students' mathematics achievement in senior high school, and the findings clearly demonstrate the significant role of psychological factors in academic performance. First, the results show that self-efficacy has a strong and positive influence on mathematics achievement. Students who possess higher confidence in their mathematical abilities tend to perform better, engage more deeply during learning, and persist when confronted with challenging tasks. This confirms the first research objective and aligns with prior studies emphasizing the motivational and cognitive benefits of self-efficacy. Second, the study found that math anxiety negatively affects students' mathematics achievement, fulfilling the second objective. Higher anxiety levels reduce students' working memory capacity, impair concentration, and lead to avoidance behaviors, all of which diminish performance. This finding reinforces the extensive literature documenting the detrimental effects of anxiety on learning.

Third, the results confirmed a significant negative relationship between self-efficacy and math anxiety, thereby addressing the third research objective. Students with higher self-efficacy experience lower levels of anxiety, suggesting that confidence serves as a protective factor against emotional barriers in mathematics learning. Overall, the study concludes that improving students' mathematics achievement requires simultaneously strengthening self-efficacy and reducing math

anxiety. Both factors are essential and should be addressed through instructional strategies, school support systems, and targeted psychological interventions.

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