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Unraveling the link: math anxiety's role in the relationship between math self-efficacy and math achievement

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ABSTRACT

Teachers and parents closely monitor students' progress in mathematics, recognizing its pivotal role in shaping their perspectives and unlocking diverse career opportunities. Despite extensive research aimed at enhancing mathematical achievement, certain factors remain crucial, notably mathematics anxiety and self-efficacy. This study investigates the interplay among these constructs, particularly focusing on the role of mathematics anxiety in mediating the relationship between math self-efficacy and overall mathematical achievement among senior high school students. Involving 471 participants, this research employed a survey-based approach utilizing an adapted questionnaire. Correlation analysis revealed a significant association between math self-efficacy and academic achievement. Regression analysis further elucidated that mathematics anxiety serves as a partial mediator in this relationship. Notably, the findings suggest that reducing levels of math anxiety strengthens the positive influence of math self-efficacy on students' mathematical performance. These insights offer valuable implications for educational interventions aimed at fostering a supportive environment conducive to mathematical learning and achievement.

RESUMO

Professores e pais monitoram de perto o progresso dos alunos em matemática, reconhecendo seu papel fundamental na formação de suas perspectivas e no desbloqueio de diversas oportunidades de carreira. Apesar da extensa pesquisa voltada para o aprimoramento do desempenho matemático, certos fatores permanecem cruciais, notadamente a ansiedade matemática e a autoeficácia. Este estudo investiga a interação entre esses construtos, focando particularmente no papel da ansiedade matemática na mediação da relação entre a autoeficácia matemática e o desempenho matemático geral entre alunos do ensino médio. Envolvendo 471 participantes, esta pesquisa empregou uma abordagem baseada em pesquisa utilizando um questionário adaptado. A análise de correlação revelou uma associação significativa entre a autoeficácia matemática e o desempenho acadêmico. A análise de regressão elucidou ainda mais que a ansiedade matemática serve como um mediador parcial nesse relacionamento. Notavelmente, as descobertas sugerem que a redução dos níveis de ansiedade matemática fortalece a influência positiva da autoeficácia matemática no desempenho matemático dos alunos. Esses insights oferecem implicações valiosas para intervenções educacionais destinadas a promover um ambiente de apoio propício ao aprendizado e ao desempenho matemático.

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Introduction

Mathematics education is crucial for students' overall success, impacting their trajectories in higher education and future careers (Wilkins & Ma, 2002). Beyond technical skills, learning mathematics fosters critical thinking, logical reasoning, and problem-solving abilities that are essential in today's complex and rapidly changing world (National Council of Teachers of Mathematics [NCTM], 2020; Royal Society, 2024). In response to the increasing need for mathematically literate citizens capable of navigating technological advancements and data-driven environments, modern mathematics education aims to develop students' capacities for inquiry, analysis, and application in real-world contexts (Organisation for Economic Co-operation and Development [OECD], 2019; Royal Society, 2024).

Recent curricular changes reflect an understanding that effective mathematics education goes beyond rote memorization, advocating instead for a pedagogical shift toward fostering conceptual understanding and problem-solving skills (Biesta, 2015; Smith, 2017). These shifts are essential for equipping students with the mathematical competence needed to fully participate in society and constructively critique and engage with cultural and economic issues (Royal Society, 2024). However, a fundamental challenge remains: how can students develop these skills if their foundational mathematical knowledge is weak? The need for deep, meaningful engagement with mathematical concepts is increasingly recognized as a necessary condition for individual empowerment and societal advancement (Biesta, 2015; Royal Society, 2024).

The Philippines, like many countries, faces significant challenges in mathematics education. In the Trends in International Mathematics and Science Study (TIMSS), the country ranked 39th out of 41 participating nations, underscoring the urgency for multi-pronged educational interventions (Mullis et al., as cited in Villaver, 2014). Improving the quality of mathematics education requires understanding the complex interplay of cognitive and affective factors, including mathematics self-efficacy and anxiety, which significantly influence student performance (Pekrun et al., 2020; Beswick, 2012).

Mathematics anxiety is defined as a feeling of apprehension, tension, or fear when engaging with mathematical tasks, which often results in negative experiences and avoidance behaviors (Ashcraft & Moore, 2009). High levels of math anxiety have been linked to impaired cognitive processing, particularly the depletion of working memory, which is essential for solving complex problems (Ashcraft & Krause, 2007; Pletzer et al., 2023). Students with math anxiety frequently associate mathematics with negative emotions, such as inadequacy and fear, which limits their engagement and motivation (Gresham, 2007; Beilock & Gunderson, 2016). The detrimental impact of math anxiety on performance is well-documented, with students

experiencing higher levels of anxiety tending to perform more slowly and inaccurately compared to their less anxious peers (Wu et al., 2012; Frenzel et al., 2017).

The causes of math anxiety are multifaceted, involving individual emotional predispositions as well as contextual factors, such as negative feedback from teachers or peers (Usher & Pajares, 2009). Research suggests that interventions focused on reducing anxiety, such as emotional regulation training, mindfulness practices, and supportive learning environments, can significantly mitigate the negative impact of math anxiety and enhance students' performance (Turner et al., 2019; Supekar et al., 2015).

In contrast to anxiety, math self-efficacy, or an individual's belief in their ability to succeed in mathematical tasks, has consistently been linked to higher achievement (Negara et al., 2021; Gu & Qiu, 2016). According to Bandura's social cognitive theory (1997), self-efficacy influences how individuals think, feel, and behave, making it a critical factor in motivation and persistence in mathematics (Pajares, 1996; Schunk & Pintrich, 2014). Students with high math self-efficacy are more likely to engage in effective problem-solving strategies, take on challenging tasks, and demonstrate perseverance even when faced with difficulties (Wigfield & Eccles, 2000; Borgonovi & Pokropek, 2019).

Moreover, recent studies emphasize that self-efficacy should be nurtured through mastery experiences, social persuasion, and fostering a positive emotional state during learning (Usher & Pajares, 2009; Zientek et al., 2019). These sources of self-efficacy are particularly important in mathematical contexts, as they empower students to approach problems with confidence and view mathematics as attainable and meaningful. Effective instructional strategies, such as providing timely, constructive feedback and creating opportunities for success, can play a significant role in enhancing students' math self-efficacy (Pekrun et al., 2020).

While the positive link between math self-efficacy and achievement is well-established, the potential mediating effect of math anxiety on this relationship is less explored. Findings from the present study suggest that math anxiety may mediate the relationship between self-efficacy and performance, such that high levels of anxiety weaken the positive effects of self-efficacy. This is consistent with prior research indicating that anxiety can interfere with performance by occupying cognitive resources needed for effective problem-solving (Ramirez et al., 2016; Carey et al., 2017). Future research should further investigate this mediating role, particularly through longitudinal studies that can provide insights into the dynamic interactions between these variables over time (Ching, 2020).

Methods

Research Design

The study adopted the correlation research design to capture the relationship between the dependent and independent variables. The survey method was employed using a validated questionnaire adapted from the two authors.

Participants

The respondents of this study are senior high school students (Grade 11) from three secondary schools in Romblon District. A complete enumeration of the population was used, but only 80% of the questionnaires were retrieved. A total of 471 students participated in the study, of whom the majority (54.8%) were females while males were only 45.2%. In terms of *Mathematics achievement*, many (35.2%) of them have outstanding average grades ranging from 90-100 percent, followed by those who have very satisfactory and satisfactory with an average grades ranging from 85-89 and 80-84 receiving a percentage of 27.6 and 25.1 respectively. Those with a fairly satisfactory grade with an average grade ranging from 75 to 79 are 11.9%. Only 0.2% was given an average grade of 75 and below, indicating that only a small portion did not meet expectations.

Data Collection

The questionnaire was used to gather the needed information from the respondents. This information includes the math achievement or average grade in their junior high school, math self-efficacy level, and math anxiety. The researchers coordinated with school heads of the secondary schools for data gathering upon the superintendent's approval. The senior high school grade 11 students were the primary source of data. To measure the respondents' level of math self-efficacy, the questionnaire developed by May (2009) was used, while the mathematics anxiety was adapted from an instrument developed by Alexander and Martray (1989). Each of the responses for every item under the mathematics anxiety and self-efficacy variables was rated using Likert's 4-point scale. The questionnaire for Mathematics anxiety generated a Cronbach's Alpha value of 0.71, which still meets the standard value. At the same time, the items for self-efficacy yielded an alpha score of 0.93, which is way beyond the acceptable value. Given that the validity and reliability of this instrument had already been established previously, no further action was necessary for the instrument.

Data Analysis

The Pearson Product Moment Correlation Coefficient was utilized in determining the relationship between Math self-efficacy and Math achievement. On the other hand, regression analysis explains the mediating role of math anxiety on the relationship between self-efficacy and math performance. Baron and Kenny's (1986) technique was used for testing the predicted

mediation of math anxiety between math self-efficacy and math performance. This mediation test provides mediation support if the model-1: independent variable relates to the dependent variable. Model 2: The independent variable relates to the middle variable. Model 3: The mediation variable relates to the dependent variable. Model 4: The relation between the independent and dependent variables is significantly reduced (partial mediation) or no longer significant (full mediation) when controlled by a mediator.

Ethical Consideration

Ethical considerations were central to this study. All 471 participants were fully informed about the study's objectives, methods, risks, and benefits, and their rights as participants. Emphasis was placed on voluntary participation, ensuring individuals could freely choose to take part without coercion. Special attention was given to protecting vulnerable populations, such as minors in senior high school, with parental consent required for those under 18. Measures were in place to maintain confidentiality and anonymity of responses. Steps were taken to minimize harm or discomfort, including support for students with math anxiety. Transparency, integrity, and disclosure of conflicts of interest were prioritized throughout the research process. By adhering to these ethical considerations, the study aimed to provide valuable insights into mathematics education while upholding ethical standards.

Results

Level of students' mathematics anxiety

Mathematics Anxiety refers to the students' feelings of pressure when frightened by mathematics that impedes their competence to apply math in an educational or everyday situation (Richardson & Suinn, 1972). In this study, math anxiety has three subscales Test Anxiety which refers to the degree of stress/worry experienced by a student in taking a Mathematics exam; Task Anxiety which refers to the degree of stress/worry experienced by a student in carrying out a task; and Course Anxiety refers to the degree of worry experienced by a student towards Mathematics course such as buying a Mathematics book and going into a Mathematics course.

Table 1 presents the level of Mathematics anxiety among student respondents, categorized into Test Anxiety, Task Anxiety, and Course Anxiety. Each type of anxiety is associated with a specific mean score, with Test Anxiety being labeled as "High" and Task Anxiety and Course Anxiety having mean scores of 2.68 and 2.16, respectively. It quantifies the level of anxiety for each category, allowing for a comparison of the intensity of anxiety across different aspects of Mathematics. Test Anxiety appears to be the highest among the three categories, as it is labeled as "High" in the table. Task Anxiety and Course Anxiety have similar mean scores, both falling under the category of "Average." The Overall Grand Mean of 2.40

suggests that, on average, students experience a moderate level of Mathematics anxiety across all categories.

Table 1.
Student respondents' level of Mathematics anxiety

Mathematics Anxiety	WM	DI
A. Test Anxiety	2.68	High
B. Task Anxiety	2.16	Average
C. Course Anxiety	2.40	Average
Overall Grand Mean	2.41	Average

Level of students' mathematics self-efficacy

The level of mathematics self-efficacy of the students was measured in this study. Self-efficacy refers to a person's belief in successfully completing the task(s) required to achieve a given result (Bandura, 1977). Table 2 explores how confident the student respondents felt in various aspects of their math abilities. The table uses a scale to rank their self-efficacy from low to high. It examines different parameters like confidence in asking questions, passing exams, completing homework, and applying math in future careers. Interestingly, students reported the highest self-efficacy in believing they could use math in their future jobs and felt confident during exams. This suggests they understand the value of math and can perform well in test situations. However, their confidence in completing homework and asking questions in class fell within an average range. While they can generally manage homework, there might be some hesitation to seek clarification when needed. Overall, the average score, called the Overall Weighted Mean, indicates a high level of general math self-efficacy among the students. However, the breakdown by specific areas highlights potential areas for improvement, such as building confidence in seeking help or applying math outside of exams.

Table 2.
Student respondents' level of Mathematics self-efficacy

	Parameters	**WM**	**DI**
1.	I feel pretty confident about asking questions in mathematics.	2.56	Ave
2.	I think I can pass a mathematics examination.	2.59	Ave
3.	I believe I can complete any homework in a mathematics class.	2.51	Ave
4.	I think I'm the type of person that's good at mathematics.	2.32	High
5.	I think I can use math in my future career if necessary.	2.90	High
6.	I think I can figure out the content of a mathematics class.	2.53	Ave
7.	I think I might get a passing grade when I'm in a math class.	2.58	Ave
8.	I think I can learn math just fine.	2.73	Ave
9.	I feel confident while taking a math test.	2.38	High
10.	I think I'm one of those people who can do the math.	2.42	High
11.	I sense that I will be able to do well in future math lessons.	2.45	High
12.	I think I might be able to take math classes.	2.45	High
13.	I have faith in myself when I use mathematics outside of school.	2.61	Ave
	Overall Weighted Mean	2.54	High

Relationship between the student respondents' Mathematics self-efficacy, Math anxiety, and Mathematics achievement

In the present study, the relationship between student respondents' mathematics self-efficacy, math anxiety, and mathematics achievement was examined (see Table 3). The results revealed a significant positive correlation between mathematics self-efficacy and mathematics achievement ($p < .001$). This suggests that students with higher levels of mathematics self-efficacy tend to perform better in mathematics. Conversely, the analysis showed a significant negative correlation between mathematics anxiety and mathematics achievement ($p = .006$), indicating that students with lower levels of mathematics anxiety tend to achieve higher in mathematics.

Collectively, these findings led to the rejection of the null hypotheses, which stated that there was no significant relationship between students' mathematics self-efficacy and mathematics performance, as well as no significant relationship between students' mathematics anxiety and mathematics performance. The results underscore the importance of fostering students' mathematics self-efficacy and reducing their mathematics anxiety to enhance their mathematics achievement.

Table 3.
Relationship between the student respondents' mathematics self-efficacy, math anxiety, and mathematics achievement

Independent Variable	Dependent Variable		
	Mathematics Achievement		
	Pearson r	Sig. (2 tailed)	Result
Mathematics Self-Efficacy	.184**	.000	S
Mathematics Anxiety	-.127**	.006	S

p<0.05
*** Correlation is significant at the 0.01 level (2-tailed).*
S - Significant

Mediation of Math Anxiety between Math Self-efficacy and Math Performance

The mediation analysis in this study examines whether Math Anxiety acts as an intermediary variable between Math Self-efficacy and Math Performance. Specifically, this analysis investigates how Math Self-efficacy, which refers to an individual's confidence in their capability to perform well in mathematics, indirectly influences Math Performance by impacting levels of Math Anxiety.

Two models were constructed to evaluate this mediation effect: Model 1 included only Math Self-efficacy and Math Performance, while Model 2 introduced Math Anxiety as a mediating factor between Math Self-efficacy and Math Performance.

Model 1 analyzed the direct relationship between Math Self-efficacy and Math Performance. The results revealed that Math Self-efficacy was a significant predictor of Math Performance ($\beta = 0.184$, $p < 0.01$), explaining 3.4% of the variance in Math Performance ($R^2 = 0.034$). This positive β value indicates that higher levels of Math Self-efficacy are associated with better Math Performance, supporting previous literature that suggests self-efficacy beliefs are critical determinants of academic success.

Model 2 included Math Anxiety as an additional variable to determine whether it partially or fully mediates the effect of Math Self-efficacy on Math Performance. The addition of Math Anxiety accounted for a slight increase in explained variance ($R^2 = 0.046$), which suggests the potential mediating influence of Math Anxiety. Importantly, the relationship between Math Self-efficacy and Math Performance diminished when Math Anxiety was included (β changed from 0.184** to -0.126**, $p < 0.01$). This change suggests that part of the effect of Math Self-efficacy on Math Performance operates through Math Anxiety.

Mediation Effect

The inclusion of Math Anxiety led to a negative β value (-0.126**) for the pathway from Math Anxiety to Math Performance, indicating that Math Anxiety adversely affects Math Performance. Individuals who reported higher levels of Math Anxiety tended to perform worse in mathematics, consistent with previous findings that anxiety impairs cognitive functioning and problem-solving abilities. In the presence of Math Anxiety, the direct effect of Math Self-efficacy on Math Performance weakened, suggesting that Math Anxiety acts as a suppressor variable in the self-efficacy-performance pathway.

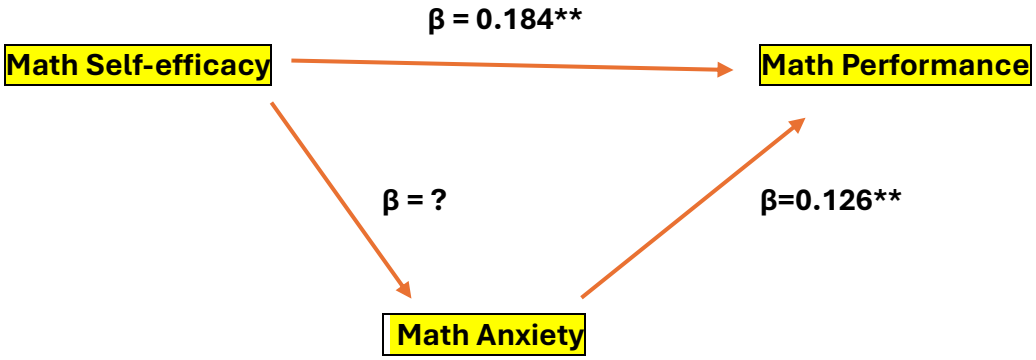
This pattern of results indicates that Math Anxiety partially mediates the relationship between Math Self-efficacy and Math Performance. That is, while Math Self-efficacy exerts a positive influence on performance directly, this positive impact is dampened by anxiety. When students feel confident in their math skills, they are less likely to experience anxiety, which in turn benefits their overall performance. Conversely, even students with high self-efficacy may underperform if they experience significant anxiety, pointing to the critical role that emotional factors play in academic outcomes.

These findings support the proposed mediational model, where math anxiety acts as a partial mediator in the relationship between math self-efficacy and math performance. The direct and indirect effects of self-efficacy on performance, as well as the significant paths involving math anxiety, provide evidence for the hypothesized model. This mediation analysis provides valuable insights into the complex interplay between cognitive and emotional factors in the context of mathematics achievement. Math Anxiety is a critical mediating variable that

can substantially alter the pathway from Math Self-efficacy to Math Performance, highlighting the importance of considering both personal beliefs and emotional well-being in educational settings.

Figure 1.

Meditation Path Model: Math Anxiety between Math Self-Efficacy and Math Performance



Discussion

The primary objective of this study was to determine the interplay between mathematics anxiety, self-efficacy, and achievement in Grade 11 students from three secondary schools in Romblon District. Although a wealth of research has explored these relationships (e.g., Maloney & Beilock, 2018; Papadopoulos et al., 2020), findings often vary due to contextual differences, such as cultural, educational, and demographic factors (Pekrun et al., 2020). Our investigation contributes to this knowledge base by examining these constructs within the specific context of Filipino Grade 11 students, providing unique insights into their educational experiences and challenges.

Consistent with previous studies, our findings revealed a significant negative correlation between math anxiety and student performance (Beilock, 2008; Harari et al., 2013). Students with higher math anxiety reported lower math achievement, suggesting that anxiety impedes their ability to effectively engage in mathematical problem-solving tasks. The effect of math anxiety on performance can be attributed to its detrimental impact on cognitive resources, particularly working memory (Ashcraft & Krause, 2007). Math anxiety is known to consume valuable cognitive capacity, leading to difficulties in maintaining focus and processing information, ultimately affecting performance (Ashcraft & Moore, 2009; Pletzer et al., 2023). Recent neurocognitive evidence supports this, indicating that math anxiety leads to ineffective deactivation of the default mode network (DMN) in the brain, which results in impaired cognitive functioning during mathematics tasks (Pletzer et al., 2023). Thus, addressing math anxiety is crucial for enhancing academic outcomes, as suggested by

interventions targeting emotional regulation, mindfulness, and self-compassion (Turner et al., 2019; Passolunghi et al., 2020).

Our findings also support a positive correlation between math self-efficacy and student performance, aligning with Bandura's (1997) social cognitive theory. Specifically, students with higher self-efficacy beliefs demonstrated stronger academic performance, consistent with previous research highlighting the importance of self-belief in achieving success (Kabiri & Kiamanesh, 2004; Liu & Koirala, 2009; Negara et al., 2021). The relationship between self-efficacy and performance can be explained by the motivational and cognitive benefits conferred by high self-efficacy, such as persistence in the face of challenges and greater engagement in learning activities (Bandura, 1997; Schunk & Pintrich, 2007). Furthermore, research shows that task-specific measures of self-efficacy are more predictive of performance outcomes, emphasizing the need for context-specific interventions that foster mastery experiences and build students' confidence in specific mathematical domains (Borgonovi & Pokropek, 2019; Zientek et al., 2019).

Interestingly, the present study suggests a potential mediating role of math anxiety in the relationship between self-efficacy and performance. While a positive association between self-efficacy and performance was found, higher levels of math anxiety were observed to weaken this link. This indicates that even students with strong self-beliefs may experience performance setbacks if they suffer from significant anxiety during mathematics tasks. This finding aligns with earlier research suggesting that math anxiety can interfere with performance by occupying cognitive resources and undermining confidence (Carey et al., 2017; Ramirez et al., 2016). Future research could further investigate this mediating effect by employing longitudinal designs to understand how math anxiety evolves over time and influences academic trajectories (Ching, 2020). This finding underscores the importance of a two-pronged approach that simultaneously fosters math self-efficacy while addressing math anxiety to maximize student achievement (Núñez-Peña et al., 2019).

Implications for Educational Practice

These findings add to the growing body of literature on the interplay between math anxiety, self-efficacy, and achievement, underscoring the importance of targeted educational interventions. To effectively enhance mathematics achievement, educational programs should not only focus on reducing anxiety but also cultivate positive self-beliefs in students' mathematical abilities. For instance, implementing mastery-oriented learning experiences, emphasizing progress and effort, and providing timely social persuasion can significantly boost students' self-efficacy (Usher & Pajares, 2009). Similarly, addressing the emotional component of learning through strategies such as relaxation techniques, resilience training,

and the development of effective coping mechanisms has been shown to mitigate the negative effects of math anxiety (Passolunghi et al., 2020; Supekar et al., 2015).

The findings also point to the critical role of instructional quality in shaping students' learning experiences and emotional responses to mathematics. Providing students with high-quality, structured learning opportunities can enhance their sense of control and alleviate anxiety (Pekrun et al., 2020). Studies show that students who perceive their instructional environment as supportive and well-structured report lower levels of anxiety and greater self-efficacy, contributing to better academic outcomes (Frenzel et al., 2007; Ching, 2020). Thus, teachers play a pivotal role in shaping both the cognitive and emotional aspects of students' learning and their capacity to create a supportive classroom environment is crucial for fostering mathematical resilience.

This study highlights the complex interplay between cognitive and emotional factors in mathematics achievement among Filipino Grade 11 students. Math anxiety emerges as a critical mediating variable that can substantially alter the relationship between math self-efficacy and math performance, underscoring the importance of addressing both personal beliefs and emotional well-being in educational settings. Future research efforts should explore the factors influencing these constructs to inform the development of more comprehensive interventions aimed at enhancing student success in mathematics.

Study Limitations

The study's scope may be constrained by sampling bias, as it solely focuses on senior high school students, limiting the generalizability of its findings to other educational levels or age groups. Additionally, the use of self-report measures like surveys introduces the possibility of response bias and social desirability bias, potentially impacting the accuracy of the collected data. Its cross-sectional design hinders the establishment of causality, necessitating the inclusion of longitudinal or experimental designs to better determine the causal relationships among math self-efficacy, math anxiety, and mathematical achievement. While the questionnaire was adapted, the lack of thorough assessment of its psychometric properties and validity in the Philippine setting may compromise the reliability of the results. The mediation analysis used to explore the role of math anxiety as a mediator may oversimplify the complex relationships among the variables, leaving room for other unexplored variables or alternative mediation models. Moreover, the study lacks control for variables like prior academic achievement, socioeconomic status, or teaching methods, which could influence the relationships under investigation. Its applicability to other subjects or domains of learning beyond mathematics remains uncertain, and the study may not fully account for contextual factors such as cultural differences or school environment. Furthermore, the limited diversity

in participant demographics in terms of gender, ethnicity, or academic ability could restrict the generalizability of the findings. Further, the study is limited to quantitative analysis and did not delve into qualitative aspects such as the reasons for the respondents' high or average level of math anxiety and math self-efficacy. Finally, participants' responses may have been influenced by social desirability bias, particularly regarding sensitive topics like math anxiety, potentially impacting the validity of the results. Researchers who are interested in pursuing studies of a similar nature may consider addressing these limitations to reinforce the study's validity and enhance the reliability of the conclusions.

Conclusion

In summary, our research underscores the significant impact of math self-efficacy and math anxiety on the mathematical achievement of high school students. While high levels of self-efficacy enhance mathematical performance, math anxiety hinders it, serving as a barrier that partially influences this relationship. As Bandura highlighted, self-efficacy plays a critical role in determining success in mathematics, emphasizing the need to boost students' confidence in their math abilities. Therefore, the educational community needs to prioritize strategies that enhance self-efficacy and address math anxiety. Practical steps include incorporating evidence-based interventions like cognitive-behavioral techniques, mindfulness practices, and peer support networks into the curriculum to create a positive and supportive learning environment. Collaboration between educators and parents is also crucial in providing personalized support and resources to students dealing with math anxiety, promoting resilience and effective coping mechanisms. Additionally, ongoing research should assess the effectiveness of these interventions across various student demographics and educational settings to ensure equitable access to support and resources for all learners. By implementing these recommendations, we can establish an inclusive educational environment that empowers students to excel in mathematics and reach their academic potential.

Conflict of interest

The authors declare no conflict of interest.

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