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Research Paper

Attitude towards mathematics as mediator on the relationship between motivated strategies for learning and mathematical anxiety for students

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ABSTRACT

Objective: To look at how students feel about mathematics as a go-between, in the way motivated learning strategies and mathematics anxiety are connected among senior high school students, and to see the level of each one, plus any significant ties among the three variables .
Design: A quantitative non-experimental correlational study, using mediation analysis.
Setting and Participants: There were 340 senior high school students from Panabo City, Davao del Norte, Philippines. They were chosen through stratified random sampling, with the final sample size figured out using Slovin's formula.
Methods: Three modified instruments were used to measure motivated strategies for learning, mathematics anxiety, and attitude toward mathematics. The data were treated using mean scores, Pearson r correlation, regression analysis, and Medgraph, plus the Sobel z-test for checking whether the mediating effect is really significant.
Results: Overall, students showed a high level of motivated strategies for learning. For mathematics anxiety and attitude toward mathematics, the levels were described as moderate. Significant positive relationships were seen between motivated strategies for learning and mathematics anxiety , also between motivated strategies for learning and attitude toward mathematics, and likewise between mathematics anxiety and attitude toward mathematics. Finally, attitude toward mathematics was confirmed as a significant mediator, linking motivated learning strategies with anxiety.
Conclusion: The outlook on mathematics seems to strongly mediate the connection between motivated strategies for learning and anxiety among senior high school students in Panabo City, Davao del Norte, Philippines. Educators might be encouraged to blend stress- reduction methods and also to use a more balanced teaching style, one that highlights effort and improvement instead of demanding perfection. By bringing in practical learning strategies like setting goals, self-regulation, and self monitoring

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during mathematics instruction, plus offering stress-management assistance, students may slowly develop better attitudes and a more genuine drive toward mathematics.

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1. INTRODUCTION

In our technologically advanced and mathematically dependent world, not doing well in math because of anxiety is a problem. The manner in which math is presented makes people's mental and physical work less effective. This anxiety falsely measures the individual's mathematical ability [1]. Additionally, math anxiety is a big problem all over the world that affects people of all ages. Math anxiety can make it hard for students to do well in school. Studies have shown that math anxiety affects people of any age in school, affecting their wellness and capacity to do well in school [2].

Moreover, measuring anxiety over math is essential since it affects many different areas of life and can significantly impede academic achievement and limit opportunities for educational and professional advancement [3]. The 2022 report from the Program for International Student Assessment (PISA) sheds light on the mental effects of math anxiety. It shows that 58% of 15–16-year-olds in the United States have worries about how others think about their failures, compared to a global average of 56% [4].

Furthermore, there exists a correlation between motivational strategies for learning, math anxiety, and attitudes toward mathematics. [5] asserts that students can utilize motivated strategies for learning to overcome their fears and ease math anxiety. In addition, [5] argued that the need for more motivated strategies for learning compels students to engage in rote memorization rather than comprehending and analysing what is being learned. It has the potential to result in boredom and a complacent attitude towards mathematics. Last but not least, [6] stated that students' positive attitudes towards mathematics will reduce mathematics anxiety. Students' positive emotions and attitudes towards mathematics can positively impact mathematics achievement by reducing mathematics anxiety.

Many studies concerning mathematics anxiety have been published in many countries by different researchers but lack emphasis on the attitude towards mathematics as a mediator in the relationship between strategies for learning and anxiety. The researcher chose to undertake the study to assess the potential effect or influence of the abovementioned factors on mathematics anxiety. Moreover, the researcher wants to dig deeper into each variable's indicators and examine how these characteristics affect math anxiety. Lastly, the researcher opted to conduct this study as part of the research agenda framework of the University of Mindanao to sustain gains in the university through the enhancement of programs, mechanisms, and services.

2. RELATED WORK

Described math anxiety long ago, as cited by [7]. Math anxiety is the experience of stress and worry that hinders the ability to work with numbers and solve arithmetic issues in various every day and academic contexts. Ashcraft (2002) provided a more current definition of math anxiety as the experience of tension, worry, or fear that hinders one's ability to perform well in mathematics. Math anxiety is

characterized by a detrimental psychological response characterized by worry, nervousness, lack of trust in yourself, and pressure when engaging in activities that require numerical calculations. The research conducted by [8] posited that mathematical anxiety is a psychological phenomenon experienced by individuals when confronted with mathematical problems. A positive attitude towards mathematics develops a favourable perspective of the subject, and conversely. Emotions are of utmost importance in this situation.

Motivated strategies for learning encompass the methods, practices, or methodologies employed to stimulate learners or students to engage in the process of teaching and learning actively. In addition, motivated strategies for learning stimulate the individual's behaviour that is directed towards achieving their goals. Motivated methods are purposeful efforts made to produce a lasting beneficial impact (Cambridge English Language Assessment, 2015). Attitude refers to an individual's cognitive and affective evaluation of something. Moreover, attitudes towards mathematics have the potential to impact the overall academic performance in the subject among pupils [9].

Furthermore, a strong inclination towards mathematics is predominantly seen in students during their early years of education, as they acquire extensive and thorough skills throughout elementary, middle, and high school. The study conducted by [6] found that middle school eighth-grade students exhibited significant levels of math anxiety and motivated strategies for learning mathematics. Furthermore, the study revealed a positive and moderate correlation between math anxiety and the use of motivated strategies for learning arithmetic [5] research indicates that math anxiety influences motivated learning practices. The perception of one's ability plays a vital part in the development of math anxiety, potentially affecting its intensity. It is a component of the motivated strategies for learning that assesses motivation and is one of the six subscales.

Moreover, [10] study revealed that students' attitudes toward mathematics have a stronger relationship with math anxiety. [6] Research findings indicate that students' positive attitudes toward mathematics can mitigate mathematics anxiety. Students' favourable feelings and positive attitudes toward mathematics will positively affect mathematics achievement by reducing mathematics anxiety. Therefore, these factors lead the researcher to create a problem description and determine the indicators. Furthermore, these insights are valuable in reinforcing the assertions or insights of the study.

3. METHODOLOY

3.1. Research Objectives

This study aims to assess the significance of attitude towards mathematics as a mediator in the relationship between motivated strategies for learning and anxiety among senior high school students. More specifically, it seeks to determine the level of motivated strategies for learning in senior high school students in terms of motivation and learning strategies to assess the level of math anxiety among senior high school students in terms of learning mathematics anxiety, perception of difficulty, and motivation; and to determine the level of student attitude towards mathematics among senior high school students in terms of perceptions of mathematical incompetence, enjoyment of mathematics, perceptions of utility, and mathematical self-concept. Furthermore, this study will assess the significant relationship between motivated strategies for learning and attitude towards mathematics, motivated strategies for learning and math anxiety, and math anxiety and attitude towards mathematics to determine the significant mediating effect of attitude towards mathematics in the relationship between motivated strategies for learning and anxiety. Lastly, the hypotheses that there is no significant relationship between motivated strategies for learning, math anxiety, and attitude towards mathematics and that attitude towards mathematics has no significant mediating effect on the relationship between motivated strategies for learning and anxiety will be tested at the 0.05 significance level.

3.2. Research Respondent

The research was undertaken within Panabo City, located in the province of Davao del Norte. The study comprised participants who met the following requirements: Must be at least 18 years of age and

actively enrolled in Grade 12 of a senior high school program. Moreover, they must express their voluntary willingness to participate in the study. Other inclusion criteria will be that these students can provide insights and perceptions regarding how they quantify characteristics associated with their cognitive growth in the acquisition of mathematical knowledge. Further, this study includes 340 senior high school students in grade 12 from a population of 2,266 students from four large educational institutions in Panabo City. The researcher employed stratified random sampling to choose specific groups using Slovin's formula. Stratified random sampling is a way to choose a sample from a population by breaking it up into smaller, more specific groups. The researcher then chooses a specific subset for the study sample size. The target sample size was obtained using Slovin's formula, which calculates the maximum sample size required to obtain a particular sample size (n) based on the population size (N) and margin of error (e). This sampling technique employs a mathematical formula to approximate the sample size, resulting in the population's optimal sample size. Lastly, using the data provided by the selected schools, the researcher distributed 47% to School A (160 participants), 7% to School B (24 participants), 35% to School C (119 participants), and the remaining 11% to School D (37 participants).

3.3. Materials and Instrument

Data from the respondents were collected using three sets of survey questionnaires that were modified from earlier studies. The motivated strategies for learning were derived from the research conducted by. This instrument consists of 91 items designed to assess the learner's motivation and strategies in mathematics learning. The questionnaire on student attitudes towards mathematics is taken from a study conducted by. The questionnaire consists of 32 items designed to evaluate the perception of mathematical incompetence, enjoyment of mathematics, perception of utility, and mathematical self-concept. The math anxiety scale, developed according to [7] research, consists of 21 items that assess the levels of anxiety, perception of difficulty, and motivation associated with learning mathematics. The survey questions have been subjected to content validity and reliability analysis to ensure the precision of measures. In addition, the survey instruments have been validated by both internal and external validators who possess experience in social research and statistics. Furthermore, this questionnaire had a pilot test with a sample of 30 people who were not included in the study. The computed Cronbach's alpha is 0.995, indicating great internal consistency.

3.4. Design and Procedure

A quantitative, non-experimental correlational design was used for this investigation. Researchers use correlational statistics to find out how closely two or more factors or sets of scores are linked. The study also used mediation methods to look into how the mediator variable affected the results. In collecting data, researchers did the following: Before writing the survey items, the researcher communicated his idea to his mentor. Second, prominent research enthusiasts from different universities validated the survey instruments. On the designated date, the researcher tested the survey instruments after validating them. Fourth, the University of Mindanao statistician tested the survey tools for reliability. Fifth, after survey instrument validation and reliability testing, the researcher submitted his article to UMERC for approval. The Department granted written permission and recommendation after UMERC approval. In the sixth step, the four schools received a letter with the endorsements. A schedule has been set to distribute and retrieve survey questionnaires after permission. Seventh, survey instruments should be distributed without the researcher. Participants will receive explicit guidance. Eighth, the researcher collected questionnaires. After retrieval, data was filtered, encoded, tabulated, and analysed.

Further, multiple statistical instruments were used to make sure that the data was interpreted and analysed accurately. The Mean serves as a measure to assess the levels of motivated strategies for learning, math anxiety, and attitude toward mathematics. The Pearson Product Moment Correlation has been utilized to ascertain the relationships between motivated strategies for learning, math anxiety, and attitude toward mathematics. Additionally, the methodology involves applying multiple regression analysis, which enables the measurement of the influence of math anxiety on motivated learning strategies among senior high school students. Lastly, to assess the mediating effect of math anxiety on the relationship between

motivated strategies for learning and attitude toward mathematics, the Medgraph technique incorporating the Sobel z-test has been employed.

4. RESULTS AND DISCUSSION

Table 1. Level of Motivated Strategies for Learning

Indicators	Mean	Standard Deviation	Descriptive Equivalent
Motivation	3.45	1.13	High
Learning Strategies	3.36	1.12	High
Overall Result	3.39	1.12	High

Table 1 presents the findings of the descriptive statistics that evaluate the extent of motivated techniques for learning among senior high school students in Panabo City. The average value of 3.39 (with a standard deviation of 1.12) suggests a significant degree of motivation. The high level is also indicative of the elevated level of its markers, which encompass motivation (! = 3.45, SD = 1.13) and learning techniques (! = 3.36, SD = 1.12).

Table 2. Level of Anxiety

Indicators	Mean	Standard Deviation	Descriptive Equivalent
Learning Mathematics Anxiety	3.13	1.14	Moderate
Perception of Difficulty and Motivation	2.91	1.14	Moderate
Overall Result	3.03	1.15	Moderate

Table 2 presents the findings of the descriptive statistics that assess the extent of mathematics anxiety among senior high school students in Panabo City. The average value of 3.03 (with a standard deviation of 1.15) suggests a moderate degree of anxiety. The indicators also demonstrate moderate levels, including arithmetic anxiety (! = 1.14, SD = 1.13) and a sense of difficulty and motivation (! = 2.91, SD = 1.14).

Table 3. Level of Attitude Towards Mathematics

Indicators	Mean	Standard Deviation	Descriptive Equivalent
Perception of Mathematical Incompetence	2.93	1.11	Moderate
Enjoyment of Mathematics	2.98	1.15	Moderate
Perception of Utility	3.45	1.27	High
Math Self-concept	3.29	1.16	Moderate
Overall Result	3.34	1.12	Moderate

Table 3 presents the findings of the descriptive statistics that evaluate the extent of attitude towards mathematics among senior high school students in Panabo City. The average value of 3.39 (with a standard deviation of 1.12) is classified as moderate. Specifically, the highest mean indicator is the perception of utility (! = 3.45, SD = 1.27), indicating a high assessment. The remaining indicators are the perception of mathematical incompetence (! = 2.93, SD = 1.11), enjoyment of mathematics (! = 2.98, SD = 1.15), and math self-concept (! = 2.98, SD = 1.15), all at moderate levels.

Table 4. Significant Relationship between Motivated Strategies for Learning, Anxiety and Attitude towards Mathematics

Pair	Variables	Correlation Coefficient	P-Value	Decision
IV and DV	Motivated Strategies for Learning and Anxiety	.740**	.000	Reject

IV and MV	Motivated Strategies for Learning and Attitude towards Mathematics	.750**	.000	Reject
MV and DV	Attitude towards Mathematics and Anxiety	.874**	.000	Reject

Table 4 shows the association between motivated learning strategies, anxiety, and math attitude. The initial analysis on motivated learning strategies and anxiety showed a significant link ($r=0.740$, $p<0.000$) at the 0.05 level. The second analysis found a significant association between motivated learning strategies and math attitude, with an R-value of 0.750 and a probability value of $p<0.000$ (0.05 level). The third zero-order association investigation found a significant link between motivated learning strategies and anxiety ($r=0.874$, $p<0.000$).

Table 5. Regression Results of the Variables in the Four Criteria of the Presence of Mediating Effect

Step	Path	Beta (Unstandardized)	Standard Error	Beta (Standardized)
Step 1	c	1.166	0.058	0.740
Step 2	a	1.078	0.052	0.750
Step 3	b	.802	0.042	0.731
Step 4	c'	.302	0.061	0.192

Table 6 shows the regression results and steps for the variables in the four criteria for the presence of a mediating effect. In step 1, motivated strategies for learning (IV) significantly predict anxiety (DV). In step 2, motivated learning strategies predict the mediator's attitude toward mathematics (MV). In step 3, the attitude toward mathematics significantly predicts senior high school students' anxiety. In step 4 (denoted as c'), the effect of motivated strategies for learning on anxiety quality was even found to increase after being mediated by attitude towards mathematics. As a result, partial mediation took place, as the effect was found to be significant at the $p<0.05$ level.

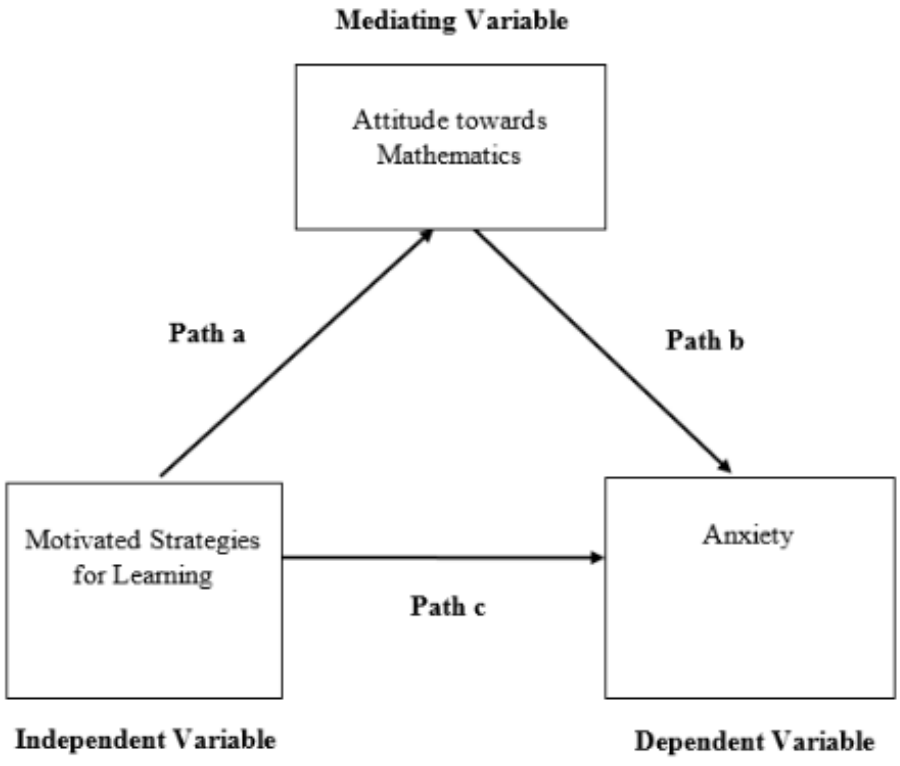

Figure 1. Conceptual Framework Showing the Variables of the Study

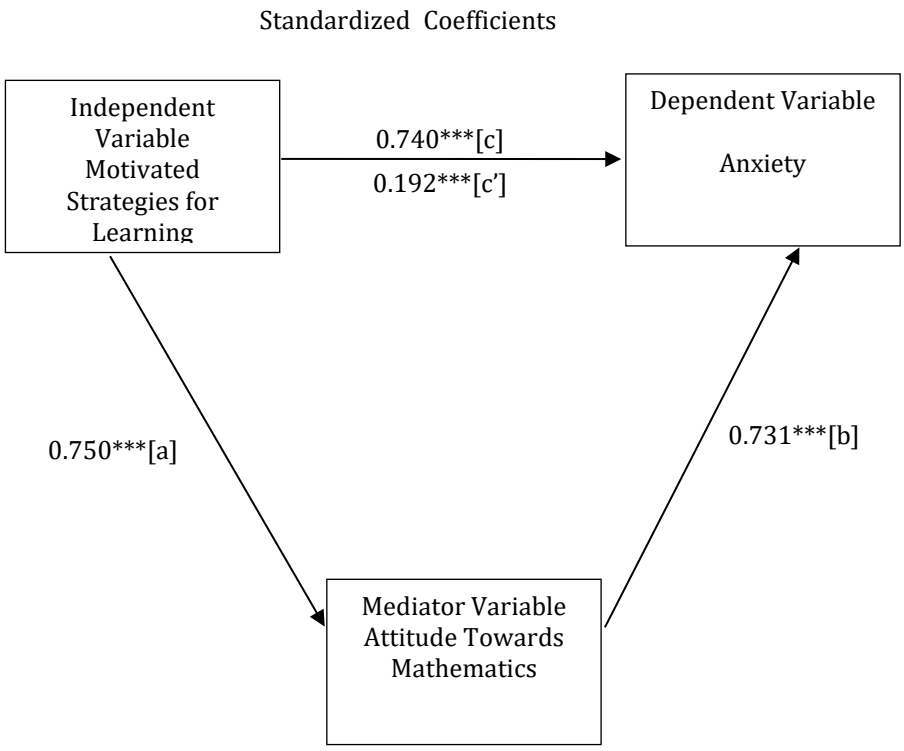

Figure 2. Medgraph Showing the Variables of the Study

Table 6. Sobel Test Results for Mediation Effect

Mediation Analysis	
Sobel z-value	14.045 p-value (0.0000) < 0.05
Percentage of the total effect that is mediated	74.1471698
Ratio of the indirect to the direct effect	286.2768212
Effect Size Measures	
Unstandardized Coefficients	
Total:	1.166
Direct:	0.302
Indirect:	0.865
Ratio Index:	0.741

4.1. Discussion

Table 1 shows a high level of motivated strategies for learning among senior high schools in Panabo City. This result indicates their general drive and strong academic desire for academic success. Studies show that motivated students are more likely to set goals, make efforts, and persist in facing challenges. Supportive learning environments and effective teaching practices in their schools could be the reasons for these students' high motivation levels [11]. Table 2 displays a moderate level of anxiety-related explicitly to learning mathematics, indicating some stress and apprehension, but it is not excessively high. Ashcraft and Moore (2009) suggest that while some levels of anxiety can be motivating, excessive anxiety can lead to avoidance behaviours and negatively impact academic performance [2]. Table 3 displays a moderate level of attitude towards mathematics. Students have a moderate perception of their incompetence in mathematics. This result indicates a balanced view where students recognize their struggles but still have confidence in their skills. According to, perceived mathematical incompetence can negatively impact students' motivation and performance, as noted by [12].

Table 4 illustrates that there is a strong positive link between motivated strategies for learning and anxiety, motivated strategies for learning and attitude towards mathematics, as well as students' attitudes towards mathematics and their anxiety levels. According to, anxiety can sometimes accompany high motivation, significantly when students are deeply invested in their academic success. It is essential to balance high motivation with strategies to manage stress and anxiety to ensure students can perform optimally without detrimental emotional effects. Recent research has supported this idea. Research investigating the connection between academic stress and test anxiety in college students has demonstrated a noteworthy association. The study indicates that students with high academic motivation can experience heightened anxiety levels because of the intense pressure to achieve success. This result highlights the critical role of emotional self-regulation and supportive environments in managing these effects.

Further, a meta-analysis on mathematics anxiety and motivation found a similar relationship, showing that while motivation can enhance learning outcomes, it can also be linked to higher levels of anxiety, particularly in high-stakes academic settings. The analysis emphasizes the need for interventions that address motivation and anxiety to support student well-being and academic performance [13]. Moreover, the positive relationship between motivated strategies and attitudes toward mathematics suggests that as students employ motivated strategy, they often develop more positive attitudes toward mathematics, reinforcing their motivation and learning efforts. To take advantage of this, teachers can promote successful learning and provide positive feedback on students' progress [14]. Additionally, students with a positive attitude toward mathematics can exhibit perfectionist tendencies. The aspiration for outstanding achievement [15] and the fear of making mistakes [16] can contribute to increased levels of anxiety. Similarly, found that positive attitudes can lead to increased anxiety due to the drive to succeed and the fear of falling short, as [14] noted.

The data presented in Table 5 indicates that the impact of motivated strategies for learning on anxiety was observed to be further amplified after being influenced by one's attitude towards mathematics. Furthermore, figure 3 illustrates the estimate of the mediating impact. The Sobel test yielded a z-value of 14.045 and a p-value of 0.0000, indicating statistical significance at the 0.05 level. This outcome suggests that the mediating effect is only partially present. In addition, the picture illustrates the calculation of the effect size in the mediation test, including the three variables. The effect size measures the degree to which the indirect path contributes to the influence of motivated learning strategies on anxiety. The beta coefficient for motivated techniques in learning about anxiety is 1.166, representing its entire effect value. The regression analysis includes the beta-motivated strategies for learning about anxiety with attitude towards mathematics, with a direct impact value of 0.302. The indirect impact value of 0.865 represents the proportion of the initial beta coefficient that is now transmitted through the relationship between motivated strategies for learning and attitude towards mathematics (denoted as "a * b," where "a" represents the road between motivated strategies for learning and attitude towards mathematics, and "b" represents the path between attitude towards mathematics and anxiety). Finally, the ratio index is calculated by dividing the indirect effect by the total effect. In this instance, it is dividing 0.865 by 1.166 results in a ratio index of 0.74147. Approximately 74.15% of the overall impact of motivated techniques for learning on anxiety is channelled through attitude towards mathematics, while the remaining 25.85% is either a direct effect or influenced by additional variables not accounted for in the model.

This data suggests that attitude towards mathematics significantly mediates the relationship between motivated strategies for learning and anxiety. Moreover, the mediation analysis demonstrates that attitudes towards mathematics account for a significant portion of the impact of motivated strategies for learning on anxiety. It implies that while motivated strategies for learning have a direct effect on anxiety, a substantial portion of their influence is indirect, as they operate by shaping students' attitudes towards mathematics. This concept aligns with the study by [17], which emphasizes the role of achievement emotions, including anxiety, in educational settings. [14] Pekrun suggest that cognitive appraisals and achievement-related motivations influence emotions. This idea is supported by the systematic review conducted by [18] on the effects of achievement emotions on online learning outcomes. Moreover, according to self-determination theory, the need to fulfill three basic psychological needs autonomy,

competence, and relatedness drives human motivation [19], [20]. Students' positive attitudes towards mathematics likely reflect a high intrinsic motivation to fulfill these needs.

5. CONCLUSION

The result shows that the senior high school students in Panabo City, Davao del Norte, reported high-level motivational strategies for learning, a moderate level of anxiety, and an attitude towards mathematics. The results also confirm a positive significant relationship between motivated strategies for learning and anxiety among senior high school students in Panabo City, Davao del Norte. These findings indicate that motivated learners can experience higher anxiety levels due to the pressure and self-imposed standards associated with intense involvement and achievement. Therefore, the researcher recommends that educators integrate stress-reduction techniques into the curriculum and promote a well-rounded approach to learning that emphasizes effort and progress rather than striving for perfection to reduce student anxiety. Similarly, a significant positive correlation exists between motivated learning strategies and attitudes towards mathematics. To take advantage of this, the researcher recommends that educators incorporate effective learning strategies, such as goal-setting, self-regulation, and self-monitoring, into mathematics instruction to help students develop more positive attitudes towards the subject by enhancing their understanding and mastery.

Moreover, the study's findings reveal a significant relationship between anxiety and attitude towards mathematics. Interestingly, positive attitudes towards mathematics were associated with increased anxiety due to the more substantial investment and higher expectations that students with positive attitudes place on their performance in mathematics. The researcher suggests that educators should provide support that helps students manage their expectations and stress, provide positive reinforcement, and create a balanced learning environment that promotes a balanced perspective on success and failure to help students maintain their enthusiasm for mathematics without experiencing excessive anxiety. As cited by, Walberg's theory supported the above findings. This theory asserts that learners' psychological characteristics and learning situations greatly influence their cognitive, behavioral, and attitudinal outcomes.

Additionally, proposed that mathematics engagement centers on cultivating positive attitudes towards mathematics, which forms the basis for motivated learning strategies and promotes effective learning habits. Lastly, the propositions, as mentioned earlier, analyze the correlation between the variables employed in the investigation. Overall, based on the study's findings, attitudes toward mathematics significantly mediate the relationship between motivated learning strategies and anxiety among senior high school students in Panabo City, Davao del Norte.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E		Vi	Su	P	Fu
Anthony R. Caputol	✓	✓	✓	✓		✓		✓	✓	✓		✓			
Dr. Liezel V. Chan		✓	✓	✓			✓	✓	✓				✓	✓	✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Fo : **Fo**rmal analysis E : Writing - Review & **E**diting

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not Applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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