



THE MEDIATING EFFECT OF ATTITUDES TOWARDS MATHEMATICS ON THE RELATIONSHIP BETWEEN ACADEMIC SELF-EFFICACY AND MOTIVATION TO LEARN MATHEMATICS

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ABSTRACT

The primary purpose of this study was to determine the mediating effect of attitudes towards mathematics on the relationship between academic self-efficacy and motivation to learn mathematics. This study employed a quantitative research design with descriptive and correlational methods. Using stratified random sampling, 254 Grade 10 students were selected as respondents from six secondary public schools of Governor Generoso, Davao Oriental during the school year 2022-2023. Furthermore, this study used three adopted research instruments, all were validated to collect data and used mean, standard deviation, and Pearson-r as statistical treatment. The findings showed that academic self-efficacy and motivation to learn math among the students are high, while their attitude towards mathematics is moderate. The findings revealed that academic self-efficacy significantly positively correlates with motivation to learn math, academic self-efficacy significantly positively correlates with attitude towards mathematics, and attitude towards mathematics significantly positively correlates with motivation to learn math. Moreover, attitude towards mathematics partially mediates the relationship between academic self-efficacy and motivation to learn math. These results encourage educators and administrators to take steps for better teaching and learning mathematics. Furthermore, better application of the results demands replication of similar studies in the field of education. This will validate the durability of these relationships beyond the present research setting and contribute to the body of knowledge for a better understanding of different issues and concerns related to attitude towards mathematics, academic self-efficacy, and motivation to learn mathematics.

KEYWORDS: Academic self-efficacy, motivation to learn mathematics, attitudes towards, Grade 10 students, descriptive-correlational design, mediation analysis, Governor Generoso, Davao Oriental, Philippines.

BACKGROUND OF THE STUDY

For years, students' motivation to learn mathematics has declined due to several factors influencing it. Some factors that lower students' motivation to learn mathematics include their negative attitude towards mathematics, poor teaching strategies, low sense of logic and reasoning, and poor understanding of mathematical concepts and problem-solving (Arthur et al., 2022). Moreover, Mamolo (2022) stressed that students in current learning faced challenging situations that lowered their motivation to learn, such as a lack of focus and concentration.

Globally, many schools in developing countries have expressed their worries to students with low motivation to learn mathematics (Nyman & Sumpter, 2019). A study by Tran and Nguyen (2021) on high school learners in Vietnam found that some learners have low motivation in mathematics since they lack interest in learning mathematical tasks. Moreover, a study of Nenthien and Loima (2019) on high school learners found that the students in one of the schools in Thailand have low

intrinsic motivation in mathematics as manifested by their low interest in learning the subject. In India, a study of Mistry (2020) on the mathematics motivation of middle school students found that around 30 percent of students have low motivation to learn mathematics based on the national assessment.

In the Philippines, mathematics is considered a difficult subject for students, which causes them to be unmotivated and lose their interest in learning the subject (Bernardo et al., 2022). A study of Reyes (2019) found that 7 out of 10 students in the public schools have lower mathematics motivation, as observed by their low interest in learning mathematics. Moreover, this low interest towards mathematics has affected mathematics motivation as manifested by their dislike with the subject, fear, struggles, frustrations, and discomfort. This has been supported by the research of Bernardo et al. (2022) that 20% of students demonstrate low motivation in learning mathematics due to their low interest and focus towards the subject.



Moreover, a meta-analytical study of Callaman and Itaas (2020) on students in Davao Region revealed that some students in secondary schools have low motivation to learn mathematics. In their study, this low motivation to learn is manifested by negative or loss of interest in learning mathematics. In a similar study of Alipio (2020) on the Grade 10 students in Davao revealed that some students have low mathematical motivation as observed in the 12.2% dropout rate in the entire region, with Davao City accounting for the highest dropout rate of 4.8 percent.

The researcher did an extensive review of the related literature on the variables that could affect students' motivation to learn math. With this, the researcher found that academic self-efficacy and attitude towards mathematics were the variables that could affect students' motivation to learn math (Laranang, 2022). However, the researcher also discovered that the related studies are bivariate in nature and had not come across with research where these three variables are used in a study. Hence, there is a dearth of information on the mediating effect of attitude towards mathematics on the relationship between academic self-efficacy and motivation to learn math among students.

In order to solve some issues and concerns related to mathematics motivation, the researcher emphasized that there is a sense of urgency to conduct this study in order to determine the connection of the variables to the junior high school students who are the respondents. This study would make the mathematics educators aware on how students' motivation can be improved so they would love and learn the subject more.

The results of the study could also be the basis in creating policy briefs, programs, and interventions for teaching and learning. Moreover, this study could be relevant in the community as it would help students to become motivated in learning mathematics which could impact how they deal with things that involve numbers, such as business, budgeting, and the economy. Further, the results of the study will be presented in public forums, training, and conferences in both local and regional levels. At the school level, the findings of the study can be presented in the Learning Action Cell (LAC) sessions among mathematics teachers. This study will be published in international journals and publications.

STATEMENT OF THE PROBLEM

This research aimed to determine the mediating effect of mathematics attitude on the relationship between academic self-efficacy and mathematics motivation of Grade 10 students in the selected schools in Governor Generoso South and North Districts, Division of Davao Oriental. Specifically, this research sought the answer the following questions:

1. What is the level of academic self-efficacy of students in terms of:
 - 1.1 Perceived Control;
 - 1.2 Competence;
 - 1.3 Persistence; And
 - 1.4 Self-Regulated Learning?

2. What is the level of motivation to learn math in terms of:
 - 2.1 Value Components;
 - 2.2 Expectancy Component; And
 - 2.3 Affective Component?
3. What is the extent of attitude towards mathematics in terms of:
 - 3.1 Anxiety;
 - 3.2 Confidence;
 - 3.3 Enjoyment; And
 - 3.4 Benefits/Value?
4. Is there a significant relationship between:
 - 4.1 Academic self-efficacy and motivation to learn math?
 - 4.2 Academic self-efficacy and attitude towards mathematics?
 - 4.3 Attitude towards mathematics and motivation to learn math?
5. Does attitude towards mathematics significantly mediate the relationship between academic self-efficacy and motivation to learn math?

METHODOLOGY RESEARCH DESIGN

A quantitative research design with descriptive and correlational methods is employed in this study since the researcher would seek to gather and interpret numerical data on the mediating effect of attitudes towards mathematics on the relationship between academic self-efficacy and motivation to learn mathematics without manipulating the variables. The researcher used the correlational technique to establish the relationship between attitude towards mathematics, academic self-efficacy, and motivation to learn mathematics. Since this study involved mediation whether attitude towards mathematics mediates the linkage of academic self-efficacy and motivation to learn math, a quantitative descriptive correlational design was employed. The study employed mediation to explain how attitudes toward mathematics mediate the linkage of academic self-efficacy and motivation to learn mathematics.

STATISTICAL TREATMENT OF DATA

To interpret and analyze the data thoroughly and correctly, the following statistical tools were being used:

Mean. This was used to determine the level of academic self-efficacy, attitude toward mathematics, and motivation to learn math.

Standard Deviation. This was used to measure the dispersion of the data set from its mean. This was presented in tables alongside the mean and was used to determine the degree of dispersion or proximity of the mean scores.

Pearson r. This statistical treatment is used to determine the significant relationship between academic self-efficacy and attitude towards mathematics, attitude towards mathematics and motivation to learn math, and academic self-efficacy and motivation to learn math.

Mediation Analysis using Sobel Z-test. This was used to determine the mediating effect of attitudes toward mathematics



on the relationship between self-efficacy and motivation to learn math.

RESEARCH RESPONDENTS

In this study, the respondents were Grade 10 students among the population in Governor Generoso South and North Districts, Division of Davao Oriental enrolled in the school year 2022-2023. These Grade 10 students were the chosen respondents since among the junior high school students, they were mature enough to understand and answer the questionnaires.

The Raosoft sample size calculator was used to gauge the sample size of 254 from among the total population of 746 which was set at a 5% margin of error. The Governor Generoso South and North Districts consist of six public secondary schools. Using stratified random sampling techniques, the number of samples from School A was 95, School B was 57, School C was 46, School D was 23, School E was 18, and School F was 15. The researcher used a stratified random sampling technique to ensure that there was an equal distribution of respondents in each school within Governor Generoso's South and North Districts, Division of Davao Oriental.

RESULTS AND DISCUSSION

The following are the results of the study.

Table 1

Summary on the Level of Academic Self-Efficacy

Indicators	Mean	SD	Description
Perceived Control	2.96	0.74	High
Competence	2.73	0.44	High
Persistence	2.98	0.51	High
Self-Regulated Learning	2.96	0.50	High
Over-all Mean	2.91	0.42	High

It has an overall mean of 2.91 and is described as equivalent to high. This furtherly signifies that the level of academic self-efficacy is very evident. The standard deviation of academic self-efficacy as reflected in the responses of the respondents is 0.42. This indicates the homogeneity of the responses of the respondents. This also implies that a significant number of responses on academic self-efficacy of students is clustered to the mean. In addition, students believe in their ability to excel. It also encompasses their confidence in tackling mathematical problems, grasping mathematical concepts, and performing well in math-related concepts

The results agree with the study of Yokohama (2019) that revealed a high level of academic self-efficacy in students' which includes perceived control and a remarkable capacity to navigate through challenges and uncertainties with confidence. Similarly, the study of Bhati et al. (2022) claimed that students' academic self-efficacy is manifested in high competence and belief that they can approach tasks and endeavors with

conviction and that their actions can make a difference, and persist in the face of obstacles. Khan (2020) also asserted academic self-efficacy, particularly in strong persistence, a heightened sense of control proactively seeking solutions, creating strategies, and overcoming hurdles. Gambo (2021) also supported the findings of the study by emphasizing the academic self-efficacy of students and highlighted self-regulated learning in terms of emotional responses in a constructive manner and managing stress effectively.

Table 2

Summary of the Level of Motivation to Learn Math

Indicators	Mean	SD	Description
Value components	3.54	0.71	High
Expectancy component	3.46	0.70	High
Affective component	3.46	0.81	High
Over-all Mean	3.48	0.60	High

Moreover, it has 3.48 as an overall mean and is described as equivalent to high, which means that the level of motivation to learn math is much observed. The dispersion of motivation to learn math determined by the responses of the respondents showed a 0.60 standard deviation. This suggests that the majority of respondents have responses that are similar and are close to the mean. In addition, the findings show that students enjoyed learning mathematics, and put some effort into learning the subject even better. When students believe in their ability to solve math problems and understand how math connects to their real-world experiences, their motivation is enhanced. Students with strong motivation tend to have higher self-confidence in learning the subject. As students build their mathematical skills and see the direct application of math to real-world scenarios, they often develop a sense of competence and motivation that goes beyond mathematics. Furthermore, with higher motivation, students have at most willingness to engage in mathematical activities for better academic achievement.

The findings conformed with the study of Arthur et al. (2022) which shows high evidence of students cultivating and sustaining motivation in mathematics and emphasizes student's strong belief in creating a positive learning experience and fostering a lasting love for the subject. Similarly, it is further supported by Prast et al. (2018) who stressed that students are motivated and believe in a growth mindset, viewing mistakes and challenges as opportunities for learning and improving. The findings also conformed to the study of Tran and Nguyen (2021) who found high evidence of students' belief that motivation to learn math is crucial in learning mathematics and for enhancing their mathematical ability.



Table 3

Summary of the Level of Attitude towards Mathematics

Indicators	Mean	SD	Description
Anxiety	2.89	0.97	Moderate
Confidence	3.15	0.85	Moderate
Enjoyment	3.40	0.90	High
Benefits/ Value	3.91	0.86	High
Over-all Mean	3.34	0.65	Moderate

The result implies that the level of attitude towards mathematics of students is observed since it has a mean overall of 3.34 and is described as equivalent to moderate. As shown in the analyzed responses of the respondents, the spread of attitude toward mathematics revealed the standard deviation is 0.65. This suggests that the majority of respondents have responses that are similar and are clustered to the mean. In addition, students demonstrate that they have different attitudes toward mathematics, reflecting the diverse ways in which they perceive and interact with the subject. Some students approach mathematics with anxiety, confidence, enjoyment, and benefits/value, finding joy in solving mathematical problems and recognizing the subject's practical applications. They may view math as a fascinating puzzle to be unraveled, and their positive attitude often leads to success in the subject.

The result is supported by the study of Hwang and Son (2021) which revealed synonymous results on attitudes towards mathematics where students' experiences with mathematics, both positive and negative, shape their attitudes about the subject. It is also supported by the study of Davadas and Lay (2019) which shows high evidence that attitudes towards mathematics in terms of anxiety affect their cognitive functioning. They further emphasize strong results on students' experiences of math anxiety, working memory, and level of problem-solving. The result of the study is also supported by Mullis et al. (2020) which highlighted learners' positive attitude about mathematics, higher regard for the subject, giving importance, and feeling confident using these attitudes in their studies.

Table 4

Relationship Between Academic Self-Efficacy and Motivation to Learn Math

Independent Variables	Motivation to Learn Math		Remarks
	r	p-value	
Academic Self-Efficacy	.580	0.000	Significant

Table 4 presents the result of the relationship between academic self-efficacy and motivation to learn math. The study revealed the result that academic self-efficacy and motivation to learn math are significantly positively correlated. The significant positive correlation between academic self-efficacy and motivation to learn math ($p < 0.05$) is shown. The r-value of .580 implies that academic self-efficacy and motivation to learn math have a moderate positive correlation. This means that

when the academic self-efficacy among Grade 10 students is moderate, their motivation to learn math is also moderate. This further indicates that there is a significant relationship between academic self-efficacy and motivation to learn math, therefore, the null hypothesis is rejected.

The result conforms with the findings of Khan (2020) that students with higher academic self-efficacy tend to get motivated to learn mathematics. In addition, Yokohama (2019) emphasized that when students have higher academic self-efficacy and believe in their ability to excel in math, they are more inclined to be motivated to learn it. Moreover, Foulstone and Kelly (2019) also claimed that if students display strong evidence of having academic self-efficacy in math, they have a greater tendency to approach mathematical problems with confidence and persistence.

Table 5

Relationship Between Academic Self-Efficacy and Attitude Towards Mathematics

Independent Variables	Attitudes Towards Mathematics		
	R	p-value	Remarks
Academic Self-Efficacy	.640	0.000	Significant

Presented in Table 5 is the result of the relationship between academic self-efficacy and attitude toward mathematics. The study revealed the result that academic self-efficacy and attitude toward mathematics have a significant positive correlation. The result shows that academic self-efficacy and attitude towards mathematics ($p < 0.05$) are significantly positively correlated. The r-value of .640 implies a strong positive correlation between academic self-efficacy and attitude toward mathematics. This means that when the academic self-efficacy among Grade 10 students is high, their attitude towards mathematics is also high. This further indicates that there is a significant relationship between academic self-efficacy and attitudes towards mathematics. This, therefore, means that the null hypothesis is rejected.

The result is supported by the findings of Esteban et al. (2022) that when a student possesses high academic self-efficacy in mathematics, they have a higher tendency to develop a positive attitude towards the subject. This is because their confidence in their ability to tackle mathematical challenges fosters a sense of competence and accomplishment, which in turn, contributes to a favorable attitude (Zakariya, 2022). In addition, Neroni et al. (2022) emphasized that students with high levels of self-efficacy foster a positive attitude toward mathematics, making them more receptive to mathematical learning. Falconer and Djokic (2019) also claimed that students are more likely to view math as a conquerable realm approach problem with enthusiasm, and persevere through difficulties. This positive attitude can further enhance students' learning experience and willingness to explore mathematical concepts (Mazana, 2019).



Table 6

Relationship Between Attitude towards Mathematics and Motivation to Learn Math

Independent Variables	Motivation to Learn Math		Remarks
	r	p-value	

Table 6 presents the result of the relationship between attitude towards mathematics and motivation to learn math. The study revealed the result that attitude towards mathematics positively correlates with motivation to learn math. It shows that attitude towards mathematics and motivation to learn math ($p < 0.05$), has a significant positive correlation between. The r-value .449 implies that attitude towards mathematics and motivation to learn math are moderately positively correlated. This means that when the attitude towards mathematics among Grade 10 students is high, their motivation towards math is also high. This further indicates that there is a significant relationship between attitude towards mathematics and motivation to learn math. Therefore, the null hypothesis is rejected.

The above findings are supported by the study of Davadas and Lay (2019) that students' attitude towards mathematics is affected by their cumulative encounters with the subject, which leads to an increased motivation to learn mathematics and that when students perceive math as an interesting and relevant, they are more motivated to learn the subject. This is also supported by Mullis et al. (2020) that learners possess a positive attitude toward mathematics and have higher regard for the subject, understand it as important, and feel motivated and self-assured in using it in their studies. Chen et al. (2018) also claimed that the attitude of students towards mathematics has a favorable influence on their motivation and success and that students who foster a positive attitude towards mathematics have higher motivation in the subject. The findings are parallel to the proposition of Langat (2011) who highlighted a strong relationship between attitudes towards mathematics and motivation to learn math and that individual mathematics attitude also determines the extent to which one will be interested and motivated to listen, answer assignments, make projects, and participate in class.

Table 7

Steps in Mediation Analysis

Independent Variable (IV)	Academic Self-Efficacy
Dependent Variable (DV)	Motivation to Learn Mathematics
Mediating Variable (MV)	Attitudes Towards Mathematics

Step 1: Path C (IV and DV)

Unstandardized Beta (β)	0.713
Standard Error (e)	0.0.96
p-value	0.000

Step 2: Path B (MV and DV)

Unstandardized Beta (β)	0.122
Standard Error (e)	0.061
p-value	0.000

Attitude towards Mathematics	.449	0.000	Significant
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Step 3: Path C (IV and MV)

Unstandardized Beta (β)	1.003
Standard Error (e)	0.076
p-value	0.000

Step 3: Combined Influence of IV and MV on DV

Attitude Towards Mathematics

Standardized Beta	0.133
Part Correlation	0.125
Total R-Square	0.341

Academic Self-Efficacy

Unstandardized Beta	0.713
Standard Error(e)	0.096
Standardized Beta	0.495
Part Correlation	0.426

The results in Table 7 revealed a significant relationship between academic self-efficacy and motivation to learn mathematics ($H4,1: \beta=0.713, p < 0.000$). Moreover, a significant relationship is found between attitudes towards mathematics and motivation to learn math ($H4,2: \beta=0.122, p < 0.000$). Academic self-efficacy and attitude towards mathematics have also a significant relationship ($H4,3: \beta=1.003, p < 0.000$). With the inclusion of attitudes towards mathematics, the impact of academic self-efficacy on motivation to learn mathematics became significant ($H4,4: \beta=0.133, p < 0.000$). The indirect effect of academic self-efficacy on motivation to learn mathematics through attitude towards mathematics was found significant. This shows the relationship between academic self-efficacy and motivation to learn mathematics has partial mediation by attitude towards mathematics.

To support the result above, the study of In'am (2021) revealed how the academic self-efficacy of the students and their motivation to learn the subject are influenced by their behavior and participation in mathematics-related activities. The study of Paguican and Torreon (2020) highlighted that learning mathematics depends upon the student's attitude, self-efficacy, and motivation. Laranang and Bondoc (2020) also mentioned that students should exert effort to develop a positive attitude towards mathematics through self-confidence to become more motivated to learn the subject.

RECOMMENDATIONS

The following recommendations are suggested based on the findings and conclusions presented:

1. Students should engage in activities that will help them develop a higher positive attitude towards mathematics which could yield positive impacts in



developing stronger motivation to learn the subject. Moreover, students must exercise willingness to continue working hand in hand with their classmates, peers, parents, and teachers to maintain the high academic self-efficacy that affects their motivation to learn mathematics.

2. Teachers must provide students with classroom-based activities that are relevant to their daily lives so that students will develop positive attitudes toward learning mathematics. It is suggested that teachers should value contextualization of mathematics learning activities for students to be more driven to do and learn mathematics as they may view their learning to be useful and meaningful to real life.
3. Administrators, policymakers, and curriculum designers must recognize that academic self-efficacy, motivation to learn math, and attitudes towards mathematics are interconnected. With this, they may initiate comprehensive support systems that address all these aspects simultaneously. This can include peer support networks, training, workshops, and seminars that focus on improving these facets of learning mathematics.
4. Future researchers may examine and use the results of this study to create and design activities, interventions, and strategies that could help maintain high academic self-efficacy, increase students' positive attitudes towards mathematics, and establish strong students' motivation to learn mathematics.

CONCLUSIONS

Based on the reflected results and findings of this study, the researcher drew the following conclusions below:

1. Academic self-efficacy is high among Grade 10 students.
2. Motivation to learn math is high among Grade 10 students.
3. Attitude towards mathematics is moderate among Grade 10 students.
4. Academic self-efficacy of Grade 10 students has a positive significant relationship with their motivation to learn mathematics.
5. Academic self-efficacy of Grade 10 students has a positive significant relationship with their attitude towards mathematics.
6. The attitude towards mathematics of Grade 10 students has a positive significant relationship with their motivation to learn mathematics.
7. Attitude towards mathematics of Grade 10 students partially mediates the relationship between academic self-efficacy and motivation to learn mathematics.

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