

The mediating role of motivation between study habits and mathematics achievement of students



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Abstract This study examined the mediating role of motivation in the relationship between study habits and mathematics achievement among Grade 10 students in five selected secondary schools in Lapu-Lapu City, Cebu, Philippines. The main purpose of this research was to determine whether motivation serves as a significant mechanism that influences how study habits translate into mathematics achievement. A descriptive correlational research design was employed during the process, involving 1,042 Grade 10 students who completed surveys assessing their study habits, motivation levels, and mathematics achievement. Data were analyzed using frequency counts, percentages, weighted means, standard deviations, Pearson's r , and multiple regression analysis. Findings revealed that students generally possessed good study habits in mathematics, particularly when engaging in collaborative learning with peers, which enhanced their enjoyment of problem-solving activities. In regard to motivation, students demonstrated high levels across most components, except for self-efficacy, which was rated as moderate. Moreover, students' mathematics achievement level reveals a very satisfactory performance. Statistical analysis indicated a significant but negligible positive correlation between study habits and mathematics achievement. Importantly, motivation was found to partially mediate the relationship of the two variables, suggesting that while strong study habits contribute to mathematics achievement, motivation enhances this overall effect. The results underscore the importance of integrating motivation-enhancing strategies in mathematics education. Schools and teachers are encouraged to foster a supportive, inclusive, and engaging learning environment that not only promotes effective study habits but also strengthens students' confidence and self-belief. By doing so, educational institutions can maximize the positive influence of study habits on mathematics achievement, ultimately contributing to improved academic outcomes.

Keywords: mathematics education, mediation analysis, descriptive correlational design

1. Introduction

Mathematics is considered one of the main subjects across all parts of the world (Kunwar, 2021). In addition to being the basis of education, mathematics is important for future work activities and multifaceted professions (Priestley et al., 1982). It is helpful in everyday tasks such as budgeting, problem-solving, cooking and shopping, highlighting its importance in multiple fields of life (Kunwar, 2021). Nonetheless, many students consider mathematics to be difficult and do not perceive it in high regard, often thinking it brings frustration and hardship (Capuno et al., 2019). This negative viewpoint has resulted in low achievement and difficulty in learning mathematics in several educational systems (Mazana et al., 2020; Fritz et al., 2019). The reason why mathematics is, for the most part, considered difficult is the strong beliefs held by parents and teachers from society, which emphasize achievement rather than the process of learning. This approach diminishes motivation, self-confidence, and resilience, especially after failure (Purbaningrum et al., 2023).

At the global level, the Philippines has consistently faced challenges in mathematics education. In the 2019 Trends in International Mathematics and Science Study (TIMSS), the Philippines scored 297, placing it as the second-lowest among participating countries (Mullis et al., 2020; San Juan, 2019). Likewise, performance data of Filipino students in mathematics from the Programme for International Student Assessment (PISA) in both 2018 and 2022 demonstrate that students are still far from the Organization for Economic Cooperation and Development (OECD) average of 489. From 353 in 2018, there was only a slight increase to 355 in 2022 (OECD, 2023). These statistics highlight a persistent national concern, further exacerbated by regional and local observations of students' struggles in understanding mathematical concepts.

Several studies have pointed out the possible reasons for this phenomenon, most notably teaching- and school-related issues as well as student factors such as motivation and study habits (Langoban 2020; Capuno et al., 2019; Tran & Nguyen, 2021). Study habits, which are the processes and behaviors through which individuals collect and utilize information, are instrumental in achieving academic success (Lone, 2021). Improved mathematics achievement strongly correlates with study habits because of the impact they have on the ways in which students prepare, review, and store information (Abdulkareem,



2024). As students' performance and achievement level in mathematics are considerably influenced by their study practices, good study habits are expected to result in better academic performance (Yadav, 2024). To resolve enduring problems in the teaching of mathematics, focusing on study techniques that emphasize understanding, setting time tables, and integrating orderly note taking is vital (Yadav, 2024). Just as motivation comprising intrinsic value, self-regulation, and self-efficacy has great effects on learning outcomes (Fiorella et al., 2021; Asanre, 2024), motivation functions as a pillar of engagement and is also attributed to academic success (Bryant, 2017). Moreover, it is also important in the achievement of mathematics because it enhances confidence, enjoyment, and positive attitudes toward learning (Herges et al., 2017). Parents' and teachers' support, high motivation, expectations, and favorable learning environments also aid students' motivation and achievement in mathematics (Herges et al., 2017).

Although prior research has analyzed the role of motivation and study habits in mathematics achievement, these factors are frequently considered in isolation. This study attempts to fill that gap by analyzing motivation as a mediating variable in the relationship between study habits and mathematics achievement, which comprises intrinsic value, self-regulation, self-efficacy, utility value, and test anxiety. The objective here is to help understand how motivation operates to support the positive effect of study habits on academic achievement with a focus on mathematics.

This stage is critical, as Grade 10 students are beginning to build skills that will serve them in the long run. The effective use of this research will help educators devise proper plans that can help motivate students to improve their study skills and, ultimately, their grades in mathematics. This research aims to help students achieve their personal educational goals as well as work toward solving the bigger picture problem of the lack of education in mathematics in the area, country, and even in the world. This study presents a framework for comprehensive educational practices that empowers students to overcome hurdles and flourish in mathematics by examining the relationship between study habits and mathematics achievement, with motivation as the mediator. Importantly, motivation affects the relationship between study habits and mathematics achievement. Specifically, this study sought to answer the following questions:

1. What is the level of study habits among the respondents?
2. What is the level of motivation of the respondents in terms of
 - 2.1. Intrinsic value
 - 2.2. Self-regulation
 - 2.3. Self-efficacy
 - 2.4. Utility value and
 - 2.5. Test anxiety?
3. What is the level of mathematics achievement of the respondents?
4. Is there a significant relationship between the following:
 - 4.1 Respondents' study habits and mathematics achievements
 - 4.2 Respondents' motivation and mathematics achievements
 - 4.3 Respondents' study habits and their motivation?
5. Does motivation significantly mediate the relationship between the study habits and mathematics achievement of the respondents?

2. Conceptual Framework

As shown in figure 1, mathematics is known as a complicated subject, and this subject requires not only problem-solving skills but also logical reasoning and analytical thinking. Students usually face challenges in achieving good grades, especially in mathematics. Understanding the factors that influence mathematical achievement is very important for developing effective strategies. Among the numerous variables that impact student success are study habits. Study habits help the student in critical reflection on skills outcomes such as selecting, analyzing, critiquing, and synthesizing (Fielden, 2004).

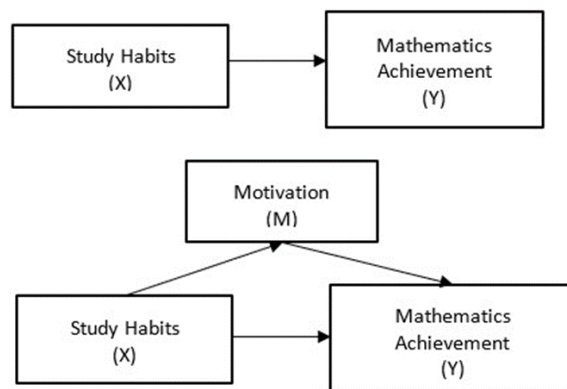


Figure 1 Mediation model.

2.1. Study habits and mathematics achievement

Study habits constitute the backbone of a student's academic success. They encompass actions such as reading, taking notes, conducting study groups that students perform frequently, and regularly accomplishing learning goals. Study habits can be defined as effective or counterproductive on the basis of whether they serve students well (Tus et al., 2020). Furthermore, Castillo et al., (2023) reported that study habits are never absent in the day-to-day activities of a student while studying. They are routines that would enable a student to somehow be interested while studying without being harassed or disturbed. Yadav (2024) studied the correlation between mathematics study habits and academic performance among higher secondary students. The research concluded that students' study habits and performance in mathematics were positively correlated. In addition, this research is anchored with self-regulated learning theory, which was conceived by Zimmerman and Schunk in 1989. This theory influences study habits because of its involvement of learners taking responsibility in organizing their own way to study, doing time management, and choosing their learning strategy. Effective study habits, such as time management and organizational skills, are critical components of self-regulation and directly impact academic achievement. Students who use self-regulated learning strategies are likely to perform better academically, including in mathematics, because they can adapt their learning strategies to overcome challenges.

2.2. Motivation and mathematics achievement

Motivation is one of several mental mechanisms underlying human action, and it is the force that drives a person and propels them to achieve their goals and behave in a certain way in a given situation (Davidovitch & Dorot, 2023). Several studies have also shown that motivation not only drives the development of effective study habits but also influences mathematics achievement. Fiorella et al., (2021) explored 2551 secondary students in Grades 7--9 from seven states in the United States via the Mathematics Motivation Questionnaire (MMQ). The results revealed that intrinsic value, self-regulation, and self-efficacy were positively correlated with mathematics achievement, whereas test anxiety was negatively correlated with achievement. In addition, Awoniyi (2022) reported that intrinsically motivated students are likely to dedicate themselves to the subject, and as a result, they do better. Self-determination theory supports this study, which is an approach to human motivation and personality that uses traditional empirical methods while also employing an organismic metatheory that highlights the importance of humans' evolved inner resources for personality development and behavioral self-regulation (Ryan et al., 1997). This highlights that intrinsic motivation can lead to greater engagement of students, particularly in subjects that students see as challenging, such as the subject mathematics. In addition, Howard et al., (2021) explained how other types of motivation, such as introjected motivation, particularly ego-involved motives, can drive persistence and performance and cause stress and negative emotions. Extrinsic motivation driven by rewards or punishment fails to enhance performance and is linked to decreased well-being.

2.3. Study habits and motivation

Two of the most important variables in educational research are study habits and motivation, as both affect what students do and how they learn (Cottrell, 2024). Study habits include well-established learning strategies such as self-directed activities, a focus on time management, involvement in class discussions and activities involving self-reflection (Cottrell, 2024). On the other hand, motivation reflects the internal and external drive that propels students to achieve their academic goals (Bontempi, 2023). This finding is supported by Jolly and Sethi (2024), who reported that there is a relationship between academic motivation and overall study habits. Students with better study habits, such as a balanced approach and better time management skills, are likely to have higher motivation levels that influence them to develop effective learning strategies and habits. Motivation drives the development of effective study habits, where study habits also reinforce and sustain motivation that enhances self-regulation and determination (Mallillin et al., 2020; Fiorella et al., 2021).

2.4. Study habits, motivation, and mathematics achievement

Several studies indicate that study habits and motivation are the variables most related to academic performance. This finding is supported by Jolly and Sethi (2024), who reported that there is a relationship between academic motivation and overall study habits. Motivation drives the development of effective study habits, where study habits also reinforce and sustain motivation that enhances self-regulation and determination (Mallillin et al., 2020; Fiorella et al., 2021). If students see the result of their effective study practices, such as increased ability to understand, better performance, and good grades, they will be motivated to continue and improve their study habits. However, students who tend to rely more on extrinsic learning styles are likely to have lower motivation levels, which negatively affects academic motivation (Jolly & Sethi, 2024). This highlights the importance of maintaining and developing students' study habits and the various strategies adopted for better results influenced by motivation, which will benefit better academic achievement (Almoslamani, 2022). Villa and Sebastian (2021) stated that desirable study habits mean that a student fully knows the importance of study habits in his or her mathematics achievement. In terms of mathematics achievement, most students are average achievers, whereas only a few students are high and low achievers. However, motivation was the sole predictor of mathematics achievement. It was concluded that high

achievement motivation can predict high mathematics achievement. Thus, Kaur (2017) highlighted that proper motivation and good study habits can positively influence the academic achievement of students.

This research holds enormous value in the new context since the demand for academic performance is also increasing, and mathematics has an essential role in many sectors. Understanding the factors that can contribute to a student's success is important. The existing related literature, studies, and legal bases provide a comprehensive framework for understanding the relationships among the variables of interest in this study, which are motivation, study habits, and mathematics achievement. Studies frequently prove that those who are intrinsically motivated by the use of effective study strategies can achieve greater academic performance or mathematics results.

3. Materials and Methods

3.1. Research design

This research utilized a descriptive correlational design that seeks to describe and measure relationships among variables without attempting to infer causal relationships (Devi et al., 2022). A descriptive research design aims to accurately and comprehensively depict the population, situation, or phenomenon under investigation and describe the patterns, trends and relationships that occur within the data (Sirisilla, 2023). This helps researchers determine the level or extent of these variables within the population. Moreover, correlational research is nonexperimental in nature and investigates the relationship between two or more variables without researchers controlling or manipulating any of them (Devi et al., 2022). Thus, researchers have investigated the relationship between study habits and mathematics achievement and the role of motivation in mediating this relationship. Data were obtained from survey questionnaires and respondents' grades. The data were then analyzed by applying statistical measures, such as correlations between study habits, motivation, and mathematics achievement. Correlation coefficients and regression analysis, for instance, were employed.

3.2. Respondents

The respondents of this study were Grade 10 students from 5 identified public high schools in Lapu-Lapu City, Cebu, Philippines. The distribution of the respondents is shown in Table 1.

Table 1 Distribution of the respondentes.

Profile	f	%
Age		
> 16	68	6.52
16	340	32.63
15	633	60.75
14	1	0.10
Total	1042	100.00
Gender		
Female	636	61.04
Male	406	38.96
Total	1042	100.00

Grade 10 students were chosen as respondents, with the majority of the students being 15 and 16 years old because they are in their final year of junior high school, a critical stage where time management and academic achievement, particularly in mathematics, are essential. The total number of students is 1,042. This study included both male and female students. The respondents were selected through a random sampling technique to ensure that they were proportionally distributed among secondary schools. Cochran's formula was used to guarantee that the sample size was sufficient to gather accurate and dependable data. This approach ensured the number of respondents required to provide a representative figure of the large population. It also balances the requirement of having a sufficient number of respondents against the need to obtain significant results. The method provides an even representation of each school within the sample, thereby increasing the validity and dependability of the findings.

3.3. Data collection tools

This research utilized a two-part survey questionnaire to assess the variables investigated in this study. The survey questionnaire adopted from Charles-Ogan and Alamina's (2014) modified Students' Study Habits Assessment Scale (SSHAS) was used to assess the students' study habits. The questionnaire consisted of 9 closed-ended items to describe their study habits in mathematics with a 5-point Likert scale, with responses ranging from 5 - strongly agree, 4 - agree, 3 - undecided, 2 - disagree, and 1 - strongly disagree. The instrument's reliability was determined to be 0.86 by the use of the Kuder-Richardson 21 for assessing the items' internal consistency and validity. Moreover, this study adopted a questionnaire from Fiorella et al., (2021),

which is the Mathematics Motivation Questionnaire (MMQ) for secondary students. It consists of 19 questions, and it is a 5-point Likert-type scale with five factors underlying mathematics motivation. The validity and reliability of the scale were confirmed via Cronbach's α values ranging from 0.71--0.89.

3.4. Data collection process

Before the data were gathered, the researchers sought permission from the Superintendent of the Schools Division and the principals of the chosen public secondary schools in Lapu-Lapu City. Afterward, the researchers secured informed consent from the students and conducted an orientation in the presence of their teacher to ensure transparency and sincere cooperation. The researchers provided instructions to the students, informing them that their participation was entirely voluntary and that they had the right to refuse to participate or withdraw at any time without any negative consequences when they were uncomfortable answering the survey. Additionally, they were instructed on how to complete the survey, gave ample time for completion, and ensured that all completed surveys were collected and handled with utmost confidentiality.

3.5. Data analysis

The data gathered were organized, tallied, summarized, and treated via descriptive and inferential statistics. Frequency counts and percentages were used to treat the respondents' profiles and calculate the distribution of the mathematical achievement of the respondents. The weighted mean and standard deviation were used to determine the level of respondents' study habits and motivation. Pearson's correlation coefficient (r) is the most common way of measuring a linear correlation and measures the strength and direction of a relationship between two variables (Obilor & Amadi, 2018), which is fitted for use in this study's variables. Furthermore, multiple regression analysis was used to investigate whether motivation significantly mediated the relationship between study habits and mathematics achievement. Additionally, the study employed the Preacher and Hayes (2004) approach to test mediation, which focuses on directly estimating the indirect effect of the independent variable (study habits) on the dependent variable (mathematics achievement) through the mediator (motivation).

4. Results

This section presents the results on the basis of the data gathered from the respondents in terms of their study habits, motivation, and mathematics achievement. It also includes a test of the relationships among the three variables. Additionally, it tested the mediating effect of motivation on the relationship between study habits and mathematics achievement.

4.1. Level of study habits of the respondents

Table 2 presents the level of study habits in mathematics of the respondents. The overall weighted mean is 3.32, with a standard deviation of 1.04. Students often practice study habits associated with mathematics; however, their effectiveness and consistency are mixed. The analysis of individual indicators reveals a range of engagement levels, with some habits being more effective than others.

Table 2 Level of study habits of the respondents.

S/N	Indicators	WM	SD	Verbal Description
1	I consider mathematics notwithstanding when I am incredibly drained.	3.15	0.93	Good
2	I examine mathematics first by deciding what topic to contemplate.	3.44	0.9	Very Good
3	I study math for approximately 50 minutes and afterward take around ten minutes break before beginning once more.	2.98	1.11	Good
4	I practice mathematics with a textbook	3.1	1.13	Good
5	I consider mathematics with a friend(s), test one another, share any useful info and foresee test questions.	3.72	1.1	Very Good
6	In taking care of an issue, I give much consideration to subtleties	3.37	0.95	Good
7	I think about mathematics for a long stretch without respect to my timetable.	2.88	1.02	Good
8	I feel good when I solve mathematics problems by myself.	3.91	1.2	Very Good
9	I study mathematics with a high level of concentration.	3.33	1.06	Good
Aggregate Weighted Mean		3.32		Good
Aggregate Standard Deviation			1.04	

Legend: 4.21-5.00-Excellent; 3.41-4.20-Very Good; 2.61-3.40- Good; 1.81-2.60- Poor; 1.00-1.80- Very poor.

4.2. Level of motivation of the respondents

Table 3 presents the results on students' motivation in mathematics, showing variation in the degrees of motivation across components. The intrinsic value (WM=2.25, SD=1.04) reflects students' high level of motivation. Self-regulation (WM=2.60, SD=1.05) was also a high level of motivation. Self-efficacy (WD=2.18, SD=1.08) is at a moderate level. Utility value (WD=2.80, SD=1.04) and test anxiety (WD=2.79, SD=1.22) indicate a high level of motivation. The overall grand mean was 2.58 and a standard deviation of 1.09, is at a high level and indicates that students experience frequent motivation in learning mathematics, but in certain areas, students show variability.

Table 3 Level of motivation of the respondents.

Components	WM	SD	Verbal Description
Intrinsic Value	2.52	1.04	High
Self- Regulation	2.60	1.05	High
Self-Efficacy	2.18	1.08	Moderate
Utility Value	2.80	1.04	High
Test Anxiety	2.79	1.22	High
Grand Mean	2.58	1.09	High
Grand Standard Deviation		1.09	

Legends: 3.21-4.00- Very high; 2.41-3.20- High; 1.61-2.40- Moderate; 0.81-1.60-Low; 0.00-0.80- Very low.

4.3. Level of mathematics achievement

Table 4 shows the distribution of students' mathematics achievement levels, revealing that a significant portion of the students performed well, with 40.79% achieving a very satisfactory rating (85--89) and 29.56% attaining an outstanding rating (90--100). Additionally, 25.14% of the students were categorized as satisfactory (80--84), whereas 4.41% fell into the fairly satisfactory range (75--79). Only 0.10% did not meet expectations (below 75). The mean score was 86.84, with a standard deviation of 4.54, indicating considerable variability in performance.

Table 4 Level of mathematics achievement.

Level	Numerical Range	f	%
Outstanding	90-100	308	29.56
Very Satisfactory	85-89	425	40.79
Satisfactory	80-84	262	25.14
Fairly Satisfactory	75-79	46	4.41
Did not Meet the Expectations	Below 75	1	0.10
Total		1042	100.00
Mean			86.84
St. Dev.			4.54

4.4. Correlation analysis

Table 5 presents the correlation analysis between the respondents' study habits, motivation, and mathematics achievement. The results show that study habits have a significantly weak positive effect on motivation ($r=0.485$, $p<0.001$). Study habits also have a significantly yet negligible positive effect on mathematics achievement ($r=0.247$, $p<0.001$). Finally, motivation has a significantly weak positive effect on mathematics achievement ($r=0.340$, $p<0.001$).

Table 5 Correlation analysis.

Variables	1	2	3
1 Study Habits	1		
2 Motivation	0.485***	1	
3 Mathematics Achievement	0.247***	0.340***	1

Note: ***significant at $p<0.001$.

4.5. Mediation analysis

Table 6 presents the results of the mediation analysis, which reveals the total, direct, and indirect effects of study habits on mathematics achievements. The total effect ($\beta=2.150$, $p<.001$). The strong total effect confirms the important role of study habits in shaping students' academic performance. The direct effect ($\beta=0.938$, $p=.002$) suggests that not only does motivation play a role but also that study habits have a significant direct influence on mathematics achievement. The indirect effect



($\beta=1.212, p < .001$) clearly confirms the mediating role of motivation. The confidence intervals (CIs) for both direct ([0.343--1.52]) and indirect ([0.910--1.53]) effects do not include zero (Preacher & Hayes, 2004). Moreover, study habits account for 56.4% of the total effect on mathematics achievement, whereas the direct effect accounts for 43.6%. As both effects strongly influence mathematics achievement, the mediation effect is considered partial.

Table 6 Mediation analysis.

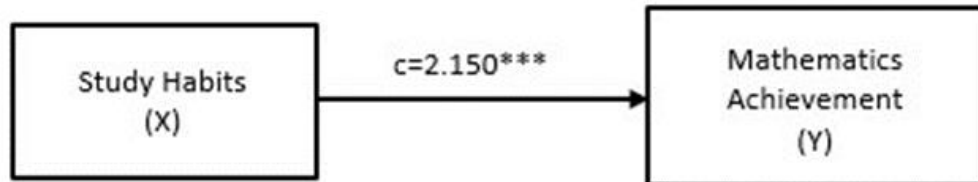
	Total effect	Direct Effect	Indirect effect of Motivation
β	2.150***	0.938	1.212***
t value	7.97	3.15	7.60
p value	<.001	.002	<.001
CI	(1.622-2.68)	(0.343- 1.52)	(0.910-1.53)
%Mediation	100	43.6	56.4

Table 7 presents the path estimates of the relationships among the variables. The relationship between study habits and motivation has an estimated value of 0.477, which is significant at $p<0.001$. The relationship between motivation and mathematics achievement has an estimated value of 2.542, indicating that motivation has a strong significant effect on mathematics achievement. Finally, study habits have a significant negligible positive effect on mathematics achievement, with a p value of 0.002. In addition, Figure 2 presents the two pathways influencing mathematics achievement, the relationships among the three variables and how the mediation takes place. The total effect of study habits on mathematics achievement is ($c = 2.150, p<0.001$) the mixture of both direct and indirect pathways. The direct pathway shows that study habits directly ($c' = 0.938, p = 0.002$) enhance mathematics achievement, independent of motivation. The indirect pathway shows that study habits have a positive effect on motivation ($a = 0.477, p < 0.001$) and that higher motivation leads to better mathematics achievement ($b = 2.542, p < 0.001$). This pathway makes it clear that motivation is a mediator that reinforces the positive impact of study habits on mathematics achievement.

Table 7 Path estimates.

			95% Confidence Interval					
		Label	Estimate	SE	Lower	Upper	p	
habits	→	motivation	a	0.477***	0.0283	0.420	0.532	<.001
motivation	→	mathematics achievement	b	2.542***	0.2923	1.964	3.111	<.001
habits	→	mathematics achievement	c'	0.938**	0.2977	0.343	1.518	0.002

Panel A



Panel B

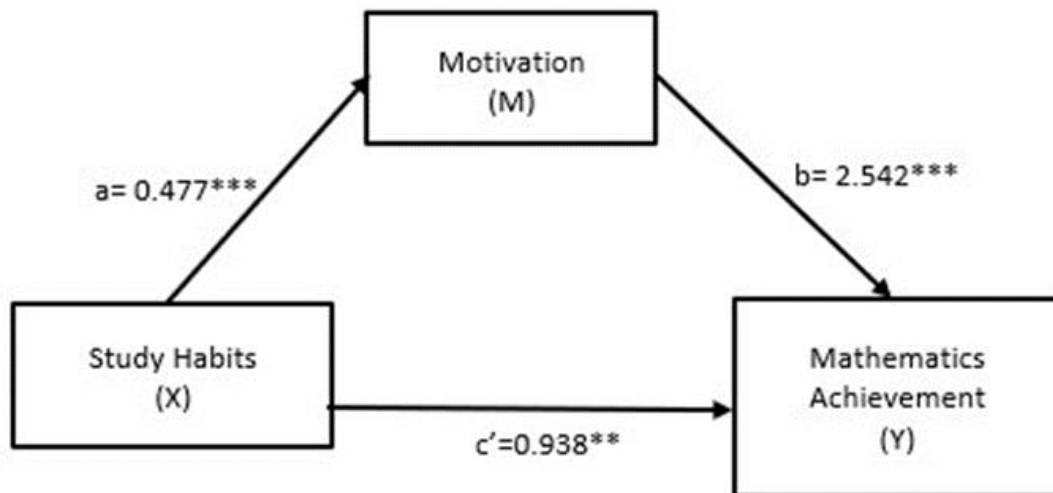


Figure 2 Schematic diagram of the mediation model.



5. Discussion

Table 2 focuses on how study habits affect learning outcomes. This section examines the connection between students' performance in mathematics and their study habits. Study habits are crucial for developing a positive attitude toward learning as well as for grasping mathematical concepts. For example, students can maintain motivation and succeed academically by establishing specific goals during study sessions (Dotson, 2016). Teachers can improve their teaching methods and assist students in improving their learning practices by evaluating these habits.

The results show that although their efficacy and consistency vary, students generally follow mathematical study habits. Solving problems on their own gives many students confidence, illustrating the importance of self-efficacy in learning (Voica et al., 2020). Peer discussions and group problem solving improve comprehension, which is another advantage of collaborative learning. However, better time management strategies are necessary, as some students find it difficult to focus during unstructured study sessions.

Although students show a moderate level of focus and perseverance, they could do better at developing more deliberate study habits. For example, while some students study even when they are exhausted, others struggle to focus, which may not always result in the best learning outcomes. Students also understand the value of picking particular subjects and working through issues on their own, which improves their fundamental abilities.

Taken together, the findings imply that well-organized study plans and efficient time management may improve students' memory and problem-solving skills. Because every person learns differently, customized methods might be needed. Research has shown that study habits have a large influence on performance, but other elements, such as academic support, motivation, and teaching strategies, are also very important (Wolters & Brady, 2020; Ryan & Deci, 2020). To help students reach their full academic potential, teachers should support them in developing more structured study habits as well as a deeper understanding of mathematical ideas.

On the other hand, as provided in Table 3, it examines the main motivating factors that affect students' performance in mathematics, offering information on test anxiety, intrinsic value, self-regulation, self-efficacy, and utility value. Since these elements have a large impact on students' performance and engagement, understanding them is crucial to promoting academic success.

The results show that although motivation varies by component, students typically feel motivated in mathematics. The greatest motivator is utility value, suggesting that students usually understand how useful mathematics is for their daily lives and potential careers (Benedick & Caramoan, 2019). The range of answers, however, indicates that some students may still find it difficult to relate math to their individual objectives. Another important factor is self-regulation; students usually try to control their learning, but they might require more structured methods to increase their consistency (Ambaryani & Putranta, 2022).

However, intrinsic value demonstrates moderate engagement, indicating that while students enjoy math to some extent, they might not be particularly inspired by the subject (Schukajlow et al., 2023). Conversely, students who score the lowest on self-efficacy often lack confidence in their mathematical skills, which can impair their perseverance and performance (Basith et al., 2020). Furthermore, test anxiety is still a major problem since many students become stressed during exams, which may impair their capacity to show what they know (Howard, 2020).

These results underscore the necessity of focused interventions to increase intrinsic motivation, lower anxiety, and increase students' self-esteem. A more encouraging learning atmosphere can be produced by employing tactics such as encouraging a growth mindset, giving constructive criticism, and implementing stress-reduction methods (Süren & Kandemir, 2020). In the end, addressing these motivating factors can enhance students' resilience, engagement, and general mathematical success (Elmi, 2020).

Moreover, achievement in mathematics is a key determinant of students' future academic and problem-solving abilities since it reflects how well they understand and apply mathematical ideas. As presented in Table 4, performance in this area is affected by a number of important factors, such as attitudes toward mathematics, teaching methods, student engagement, and self-efficacy. According to research, while negative perceptions may impede learning, positive attitudes can promote motivation and perseverance (Limeri et al., 2020; Saidi et al., 2024). Furthermore, self-efficacy beliefs are important because students who believe in their own abilities more often perform better (Mozahem et al., 2020).

The need for individualized teaching strategies is highlighted by the variation in student performance. Because they encourage greater engagement and conceptual understanding, student-centered and interactive learning approaches have been shown to improve achievement (Wang, 2023). Additionally, logistical factors such as the proximity of the school may also affect the results, indicating that interventions should consider both environmental and academic factors (Peteros et al., 2022).

Teachers should take a comprehensive approach that incorporates engaging pedagogical methods, confidence-building strategies, and self-regulation techniques to support all students. To close achievement gaps and guarantee fair learning opportunities, increasing students' self-efficacy and cultivating positive attitudes toward mathematics can be beneficial. Teachers can better assist students in realizing their mathematical potential by addressing these complex influences.

Although these relationships are not highly predictive on their own, the analysis reveals significant relationships between motivation, study habits, and mathematical achievement. Although study habits and motivation are positively correlated, their weak relationship implies that they function somewhat independently; improving one may not always improve the other. This finding supports previous research showing that organized study practices lower academic stress but necessitate supplementary motivational techniques for optimal efficacy (Almoslamani, 2022).

Similarly, there are weak but significant correlations between math achievement and both motivation and study habits. Previous findings on the significance of self-efficacy in math performance are supported by the marginally stronger role of motivation (Yang et al., 2024). In particular, study habits support conceptual mastery and problem solving, which together lead to better results, whereas motivation seems to support persistence (Castillo et al., 2023).

These findings have significant ramifications for educational practice. First and foremost, interventions should take an integrated approach, fusing structured study skill development (such as time management) with motivational techniques (such as goal setting) (Jolly & Sethi, 2024). Second, since obstacles such as conceptual gaps or test anxiety may call for customized solutions, individualized support is essential (Mefferd & Bernacki, 2023). Third, creating supportive learning environments can improve study habits and motivation at the same time by promoting a growth mindset and reducing stress (Dalimunthe et al., 2024).

These findings are theoretically consistent with existing frameworks. By showing how internal motivation and external structures (study habits) interact to shape achievement, they support self-determination theory (Ryan & Deci, 2020). They also lend credence to the idea that motivation serves as a catalyst, facilitating the efficient application of self-control techniques (Schunk & DiBenedetto, 2021). In the end, maximizing performance in mathematics seems to require a balanced emphasis on both the psychological and the methodological aspects of learning.

Finally, important information regarding the connections among study habits, motivation, and mathematical achievement is revealed via mediation analysis. The results show that study habits have a direct and indirect effect on math achievement, with motivation acting as a significant partial mediator. This implies that while good study habits directly lead to improved performance, they also increase students' motivation, which in turn improves achievement (Jolly & Sethi, 2024).

Conversely, the direct effect emphasizes how crucial structured learning routines are to the teaching of mathematics. Regular study practices, such as time management and active participation, give students the groundwork they need to grasp mathematical ideas (Mwambazi et al., 2024). Moreover, the indirect effect through motivation shows how these study habits can increase academic engagement and perseverance, which in turn increases their beneficial effects on achievement (Aljaffer et al., 2024).

The practice of education is significantly impacted by these findings. First, they propose that to optimize their efficacy, interventions should simultaneously address motivation and study habits. For example, training in self-regulated learning techniques combined with intrinsic motivation-boosting activities may be more beneficial than concentrating on either technique alone (Seli & Dembo, 2019). Second, the results highlight the importance of designing learning spaces that promote learning's behavioral and psychological components (Abramovich et al., 2019).

The partial mediation effect is consistent with previous studies on motivation and self-regulated learning in mathematics education. Research has demonstrated that consistent study habits have a positive effect on achievement (Tus et al., 2020), and intrinsic motivation is a crucial component in maintaining performance and engagement (Abah et al., 2022). By showing how these elements interact during the learning process, the current findings build on this work.

From a theoretical standpoint, the findings confirm how crucial it is to consider both cognitive and affective aspects when analyzing mathematical achievement. The mediation model emphasizes how internal motivation and external learning strategies (study habits) interact to affect academic results (Zimmerman & Schunk, 1989). According to this integrated viewpoint, both facets of learning should be covered in comprehensive approaches to mathematics education.

In summary, the mediation analysis offers insightful information about the intricate connection between motivation, study habits, and mathematical success. As this combined approach may be most effective in supporting student success in mathematics, the findings emphasize the need for educational interventions that simultaneously develop effective learning strategies and foster motivation. How these relationships differ among various student populations and educational contexts could be further investigated in future studies.

6. Final Considerations

In conclusion, the findings of this study are notable in showing the good study habits of the students regarding mathematics, since they are intrinsically motivated and enthusiastic about mathematics. Nevertheless, even though the respondents mentioned liking working with peers and solving problems, good study habits and sustained attention were seen as problematic areas. Despite these obstacles, self-regulation and intrinsic motivation were quite robust; however, at times, there were some gaps in test preparation among the respondents. Additionally, their self-efficacy was moderate, as there was an average feeling of capability without much confidence in their computational thinking ability. Most importantly, motivation, specifically the usefulness of mathematics in the future, significantly influenced attempts to learn.

Alternatively, test anxiety was also found to be a significant obstacle, hindering their overall test performance. In addition, analysis revealed that study habits have a direct effect on mathematics achievement, with motivation being a mediator in this relationship. This finding indicates that encouraging motivation may promote a greater effect of study habits on academic achievement. On the basis of these results, both motivation and test anxiety must be addressed in future instructional interventions to maximize student performance. Generally, the results indicate that it is necessary to find a balance between mathematics achievement and affective variables such as test anxiety, intrinsic motivation, and study habits in increasing mathematics achievement.

7. Recommendation

The results of this study strongly suggest that the proposed mathematics achievement enhancement plan, particularly with respect to the mediating role of motivation between mathematics achievement and study habits, should be adopted. To ensure its effective implementation, administrators and teachers must prioritize giving constant teacher training for motivation and enhancing study habits. Teachers must be provided with techniques to motivate students, foster a good learning environment, and incorporate motivational methods into the course of study. Administrators also need to develop support systems, such as peer tutoring or mentoring, for struggling students. Building a growth mindset in the classroom so that students view challenges as an opportunity to grow can increase motivation and study habits. Monitoring progress and constructive feedback should also be provided to identify which students need special support. By implementing these practices, administrators and teachers are able to address problems and assist students in improving their mathematics achievement by utilizing better motivation and study habits.

Ethical Considerations

The researchers obtained informed consent from all the participants of the study.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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