

Exploring the mediating role of mathematics self-efficacy in students' perceptions and achievement in mathematics

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ABSTRACT

This study examined the mediating effect of mathematics self-efficacy (MSE) on the relationship between students' perception of mathematics (SPM) and mathematics achievement (MA) among 544 Grade 9 students from selected public high schools in Mandaue City, Philippines, using a descriptive correlational research design. Participants were selected through simple random sampling. Data were collected using adopted survey questionnaires to measure SPM and MSE, while MA was obtained from first-quarter grades. The data collected were treated using frequency count, percentage, weighted mean (WM), standard deviation (SD), Pearson's r , and multiple regression. Results indicated that students demonstrated neutral SPM, moderate MSE, and satisfactory MA. Moreover, there was a significant moderate positive relationship between SPM and MSE ($r=0.627$, $p<0.001$), while negligible positive correlations were observed between SPM and MA ($r=0.216$, $p<0.001$) and between MSE and MA ($r=0.205$, $p<0.001$). Furthermore, results also revealed that MSE partially mediated the relationship between SPM and MA, accounting for 33.4% of the total effect (indirect effect $\beta=0.597$, $p=0.037$). These findings suggest that teachers and school administrators should integrate self-efficacy building strategies including supportive feedback, engaging, and inclusive learning environments that enhance students' perception and achievement in mathematics.

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1. INTRODUCTION

Mathematics is not just a subject that has been taught in any educational sector, but it also plays an important role in everyday life, being the key to many branches of science, technology, business, and any other area that requires mathematical abilities [1]–[3]. It shapes skills and abilities, such as problem-solving skills, critical thinking, logical thinking, and the ability to understand any pattern or sequence, which is very important in both academic and real-life situations [4]. Moreover, since it is likely to be taught in schools and colleges globally more often than any other subject, mathematics is commonly considered to be one of the most significant contents and a crucial part of the curriculum in every society [5], [6]. Despite the benefits of learning mathematics, it is well acknowledged that the subject is challenging, complex, and uninteresting to some people [7]. There is no denying the significance of mathematics in life, but most students find it extremely difficult to learn the various mathematical procedures and abilities that they will need in their daily lives. In addition, struggles and hindrances in mathematics are not only personal but may also limit

opportunities and slow down progress within the societies [8], [9]. Furthermore, those factors affecting the achievement of students in mathematics needs to be considered because, it is not just a matter for individual countries but has become an issue globally over the years [10].

Locally, similar math challenges are evident in regions such as Cebu Province. Like one in Division of Mandaue City where various studies indicate that student performance in mathematics varies significantly, and factors such as classroom experiences, perceptions, and attitudes toward mathematics influence the outcomes of the subject [11]–[13]. At the national level, the established nationwide math competition Metrobank–MTAP–DepEd Math Challenge (MMC), once celebrated as a contest for excellence has recently been restructured by its sponsor, Metrobank Foundation, Inc. (MBFI), into a remediation program (Metrobank Foundation SOLUTION) in response to critical math learning gaps among learners [14], [15]. Globally, like many Association of Southeast Asian Nations (ASEAN) countries, the Philippines continues to perform poorly in international assessments such as Programme for International Student Assessment (PISA). In line with that, the country's math score was 210 which is significantly lower than the Organisation for Economic Co-operation and Development (OECD) average of 355, placing the Philippines 77th out of 81 nations which is consistent with the 2018 result [16]. This result shows that mathematics difficulties are still evident and are not limited to underperforming schools or individuals, but reflect a broader educational challenge. These persistent outcomes highlight the difficult state of the Philippine education system and the urgent need for instructional strategies in mathematics [17].

Moreover, mathematics achievement (MA) being one of the core areas of learning that refers to the level of proficiency students acquire in the subject, often assessed through their grades during the school year and is influenced by several factors that could affect students' performance in the subject [18]. Meaning that, in many cases, some students excel in mathematics while others struggle which creates a significant gap in achievement [19]. In order to address the issues, understanding factors in enhancing MA is important as it can be a key of improving math proficiency.

One factor is the students' perception of mathematics (SPM) which is known as one of the most influencing factors in students' success [20]. Positive perceptions are largely influenced by a sense of hope and confidence in one's ability to learn mathematics, which in turn helps students achieve better outcomes [21]. Some studies shows that these perception towards mathematics are also a result of teacher interventions that provide students with attention and positive reinforcement of strategies both during the learning process and outside of the classroom [22], [23]. Consequently, it is evident that when students believe they are capable of succeeding in mathematics, they are more likely to persevere through challenges, resulting to perform better [24]. Another attribute that has been established to affect MA is mathematics self-efficacy (MSE), the level of self-confidence and belief that a student possesses while solving mathematical problems or doing any other mathematics activity that is assigned to them [25]. According to some studies [24], [25], students with strong beliefs in their abilities in mathematics tend to work harder and are most likely to be successful. In line with this, teachers are essential in fostering MSE by designing learning strategies that encourage students' belief in their abilities [26], [27].

Furthermore, Appiah *et al.* [22] argue that SPM and MA influence each other: perceived achievement can shape SPM, while SPM affects MA. Positive perceptions, supported by teachers and beliefs about the subject's usefulness that promote persistence and better outcomes, whereas negative perceptions hinder achievement [28]. A positive view of mathematics strengthens self-efficacy, which increases success, and research shows that self-efficacy is often a stronger predictor of performance than intelligence or personality traits [29], [30]. The link between SPM and MSE also strongly affects students' resilience and academic performance; positive perceptions raise self-efficacy and improve achievement, while negative perceptions lower self-efficacy and lead to avoidance and poorer performance [25], [31]. Overall, SPM and MSE are significantly related to MA, as positive attitudes enhance perception, and strong self-efficacy helps maintain it even when difficulties arise [21], [32], [33].

To emphasize the importance of understanding the foundation upon which this study is built, the research is anchored on three key theories: Bandura [34] social cognitive theory (SCT), Eccles *et al.* [35] expectancy-value theory (EVT), and achievement goal theory (AGT) by Dweck and Leggett [36]. These theories provide a strong conceptual basis for explaining students' perceptions, self-efficacy, and achievement in mathematics. An illustration of the theoretical framework is presented in Figure 1 to show the relationships among the variables. The first theory is Bandura's SCT, which states that individuals are active agents who influence their own behavior rather than merely responding to environmental conditions [34]. The main idea to SCT is the concept of self-efficacy, which refers to one's belief in their capability to perform a task successfully [37]. Within the context of this study, SCT explains how students' positive perceptions of mathematics can enhance their MSE, which in turn increases their effort, persistence, and eventually leads to better MA [38]. This highlights the mediating role of MSE where, how students interpret experiences could lead to the result of their achievement.

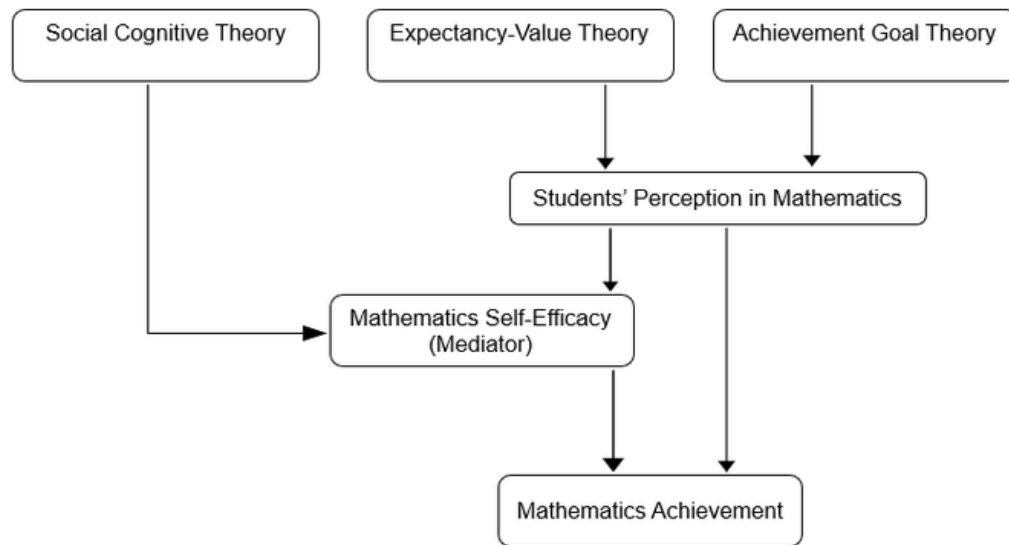


Figure 1. Theoretical framework

Another theory that is anchored in this study is the EVT of Eccles *et al.* [35], which explains how students' motivation and ability to perform are influenced by their expectations for success and the value they allocate to a task. EVT emphasizes two major components: expectancies for success and task value, which both components determine learners' effort, persistence, and quality of engagement. In this study, SPM reflects both students' beliefs about the usefulness of the subject and expectations of success. These perceptions influence their motivation and strengthen their MSE, which subsequently affects MA [39].

Furthermore, AGT by Dweck and Leggett [36], which describes how the goals learners adopt shape their motivation, behaviors, and patterns of achievement. According to AGT, students can choose between performance goals, which emphasize showcasing ability or avoiding failure, and mastery goals, which concentrate on learning and developing competence [37]. In relation to this study, SPM influences the type of goals students pursue, while their level of self-efficacy affects their confidence in attaining those goals. Consequently, both SPM and MSE guide the adoption of mastery or performance-oriented goals, which strongly contribute to the result in students MA [40].

Identifying these factors, SPM and their MSE is important in anticipating academic achievement which suggests that they can lead to better student outcomes [16], [29], [38], [39]. Consequently, there are only limited literatures that examine MSE as a mediator to other math related variables however, there's no study showing directly MSE acting as a mediator between SPM and MA. This research seeks to fill this gap by exploring the role of MSE in the relationship between SPM and MA. Furthermore, by focusing on MSE as a mediator, we were able to give a better understanding of how students' views and feelings about mathematics affect their success. On top of that, the purpose of this study is to build a math learning enhancement plan that can be used in school programs for the development of improved strategies and interventions. Specifically, this study seeks to answer the following queries:

- What is the level of respondents' perception towards mathematics?
- What is the level of MSE of the respondents?
- What is the level of MA of the respondents?
- Is there a significant relationship between the respondents' perception towards mathematics and their MA; respondents' perception towards mathematics and their MSE; respondents' MSE and their MA?
- Does MSE significantly mediate the relationship between the respondents' perception of mathematics and their MA?

2. METHOD

2.1. Research method

A descriptive correlational design was used to examine how MSE influence the connection between SPM and MA. This design is suitable for this study because it helped determine the levels of SPM, their MSE, and their MA among Grade 9 students. The SPM and their MSE were measured using adopted questionnaires, while their MA was assessed based on their first quarter grades. This was used in the study as

this focused on whether MSE affected the relationship between SPM and their MA, which is central to the research goals. The study tested the following null hypothesis:

- Ho₁: There is no significant relationship between respondents' perception of mathematics and their MA.
- Ho₂: There is no significant relationship between respondents' perception of mathematics and their MSE.
- Ho₃: There is no significant relationship between the respondents' MSE and their MA.
- Ho₄: MSE does not significantly mediate the relationship between the respondents' perception of mathematics and their MA.

2.2. Participants

The respondents of this study consisted of 544 students of Grade 9 high school students from three public secondary schools located in Mandaue City, Cebu. These Grade 9 students were chosen as the respondents because they are at a critical point in their math education, where attitudes and confidence in math were essential for handling more advanced topics. These students also had experience with math classes from earlier years, which makes them suitable for investigating on how MSE could mediate the relationship between SPM and their MA. A simple random technique was used to determine the respondents because this ensures that every student was equally and fairly evaluated to be selected as a data in this study, which helps reduce biases. Through that, the study ensured that the data gathered had no bias and make the sample more representative of the entire population. Additionally, Cochran's formula was used, a reliable and statistically significant population representation was guaranteed.

Table 1 shows that 544 students participated in the survey. Most of them (72.24%) are 14 years old, followed by 15-year-olds (22.24%). There are 25 students (4.60%) who are 16 years old, while only a few are younger than 17 (0.55%) or exactly 17 years old (0.37%). In terms of gender, the table indicates that there are more female respondents (57.17%) than male respondents (42.83%). This means that more females participated in the survey. Majority of the respondents are 14 years old, which suggests that the study was done among early high school students, where this age group is common.

Table 1. Distribution of the respondents

Variable	Profile	f	%
Age	>17	3	0.55
	17	2	0.37
	16	25	4.60
	15	121	22.24
	14	393	72.24
	Total	544	100.00
Gender	Female	311	57.17
	Male	233	42.83
	Total	544	100.00

2.3. Data collection tools

This study used three adopted survey instruments to gather data from the respondents. These instruments assessed SPM, MSE, and MA. The complete questionnaire used in this study is presented in Appendix.

- Sociodemographic profile, the first part of the questionnaire gathered background information such as age, gender, parents' educational attainment, and monthly income. These data were used to describe the personal and academic characteristics of the respondents.
- SPM, the questionnaire was adopted from Appiah *et al.* [22], used to measure SPM consist of five questions through a 5-point Likert scale which is 1 for strongly disagree to 5 for strongly agree. These items measure attitudes, interest, and perceived relevance of the subject. The questionnaire was reviewed by experts and pilot tested for clarity. In Appiah *et al.* [22] validation, confirmatory factor analysis (CFA) produced satisfactory factor loadings of 0.613–0.844, with a composite reliability (CR) of 0.6508 and an average variance extracted (AVE) of 0.514, meeting the average need for convergent validity. Additionally, the instrument's internal consistency was high, with a Cronbach's alpha of 0.836 which shows that this is a good instrument.
- MSE, the questionnaire was adopted from Tengaa [41], used to assessed students' MSE using seven questions through a 5-point Likert scale. To ensure content validity, items were reviewed by experts. In Tengaa's validation, CFA was performed and showed a factor loading ranging from 0.682 to 0.960, with a CR of 0.921 and an AVE of 0.630, supporting convergent validity. Also, the consistency of the instrument was also good, with Cronbach's alpha of 0.817 showing that the questionnaire is reliable for this study.

Additionally, MA data was measured using the Grade 9 students' first quarter math grades for school year 2024–2025, which are obtained from school records with proper consent. This served as indicators of students' academic achievement in the subject.

2.4. Data analysis

The researcher conducted various statistical analyses to analyze the data which would provide insights into patterns and relationships among the variables. The data were analyzed using Jamovi [42] and Microsoft Excel. Frequency count was used to examine demographic characteristics such as age, gender, and other relevant background factors of the Grade 9 respondents. The percentage tool analyzed responses to each Likert scale item, showing the percentage of students who strongly agreed, agreed, were neutral, disagreed, or strongly disagreed with statements about their view of mathematics and self-efficacy. The weighted mean (WM) was applied to Likert type responses to generate an average rating of SPM and MSE. Standard deviation (SD) measured the spread of responses for the variables in this study. Pearson's r correlation coefficient was used to determine the strength and direction of the correlation between SPM, their MSE, and their MA. Since Pearson's r requires a normal distribution among the variables, it was appropriate for this study [43]. Multiple regression analysis was employed to investigate the connections between SPM, MSE, and MA. Specifically, it was used to test the mediation effect of MSE, following the method developed by Preacher and Hayes [44] for testing mediation.

3. RESULTS AND DISCUSSION

3.1. Results

As reflected in Table 2, the results show that students generally hold a neutral perception of mathematics, with an overall WM of 3.15 and a SD of 1.04. Many students reported enjoying doing and studying mathematics (WM=3.67, SD=0.94) and expressed interest in the subject (WM=3.61, SD=0.96), indicating a moderately positive attitude. However, their responses were more neutral regarding the importance of mathematics compared to other subjects (WM=3.00, SD=1.06) and their preference for it over other disciplines (WM=2.85, SD=1.09), these findings suggest that SPM range from positive to neutral.

The results further illustrate that although students may enjoy mathematics, they do not necessarily view it as more important than other subjects (WM=3.00, SD=1.06) or find it easy to learn (WM=2.61, SD=1.16). This suggests that many students continue to experience difficulties in understanding mathematical concepts. These challenges may explain why their overall perception of mathematics remains neutral rather than strongly positive.

Table 2. Level of respondents' perception towards mathematics

S/N	Indicators	WM	SD	Verbal description
1	I enjoy studying mathematics	3.67	0.94	Positive
2	I rate mathematics higher than all other core subjects	3.00	1.06	Neutral
3	I have an interest in mathematics	3.61	0.96	Positive
4	I prefer mathematics to other subjects	2.85	1.09	Neutral
5	Mathematics is easy to learn	2.61	1.16	Neutral
	Aggregate WM	3.15		Neutral
	Aggregate SD		1.04	

Legend: 4.21-5.00 (very positive); 3.41-4.20 (positive); 2.61-3.40 (neutral); 1.81-2.60 (negative); 1.00-1.81 (very negative)

Based on the data in Table 3, Grade 9 students have a neutral level of MSE, with an aggregate WM of 3.26 and a SD of 0.94. The majority of students believe that through hard work, they can improve their math skills (WM=4.32, SD=0.76). They also feel confident in their ability to overcome difficulties in learning mathematics (WM=3.45, SD=1.01) and believe they are capable of understanding complex mathematical concepts (WM=3.32, SD=0.85). However, some students lack confidence in solving complex problems (WM=3.03, SD=0.96) and are uncertain about their ability to perform well on math tests and exams (WM=2.96, SD=0.86). Similarly, certain students feel unsure about their ability to explain mathematical ideas to others (WM=2.94, SD=1.12) and struggle with finding solutions to unfamiliar math problems (WM=2.81, SD=1.01). This means that while students believe they can work hard and improve their math skills in Math, they are only somewhat confident in solving difficult problems and doing well in exams.

Table 4 presents the level of MA among the respondents. The data shows that of all 544 Grade 9 students, most of them performed at a satisfactory level, with a mean score of 84.07 and a SD of 5.73. These findings show that, even though students most likely regarded math as a hard subject majority of them still

thrive to have a better performance. Consequently, this result suggests that students with strong self-confidence are more likely to stay engaged, keep trying even when facing challenges, and improve their skills and performance in the subject, mathematics.

Table 3. Level of self-efficacy of the respondents

S/N	Indicators	WM	SD	Verbal description
1	I am confident in my ability to solve complex math problems.	3.03	0.96	Moderate
2	I believe that if I work hard, I can improve my math skills	4.32	0.76	Very High
3	I feel capable of understanding complex mathematical concepts	3.32	0.85	High
4	I am certain that I can perform well on my math tests and exams	2.96	0.86	Moderate
5	I am confident that I can overcome difficulties in learning math	3.45	1.01	High
6	I am confident that I can explain mathematical ideas to others	2.94	1.12	Moderate
7	I am certain I can figure out solutions to unfamiliar math problems	2.81	1.01	Moderate
Aggregate WM		3.26		Moderate
Aggregate SD			0.94	

Legend: 4.21-5.00 (very high); 3.41-4.20 (high); 2.61-3.40 (moderate); 1.81-2.60 (low); 1.00-1.81 (very low)

Table 4. Level of MA of the respondents

Level	Numerical range	f	%
Outstanding	90-100	108	19.85
Very satisfactory	85-89	144	26.47
Satisfactory	80-84	172	31.62
Fairly satisfactory	75-79	103	18.93
Did not meet expectations	Below 75	17	3.13
Total		544	100.00
Mean		84.07	
St. Dev.		5.73	

Table 5 shows the correlation analysis among SPM, their MSE, and their MA. The result showed that there is a moderate positive correlation ($r=0.627$) between SPM and their MSE, which suggests that students who view math positively are more likely to have a greater confidence in their ability to do math. Furthermore, there is a negligible positive correlation between SPM and MA ($r=0.216$), indicating that students who perceived better in mathematics tend to perform slightly better in the subject. Similar with MSE and MA which also shows a weak but significantly related ($r=0.205$), revealing that students who have greater confidence and believe in their math skills are more likely to achieve higher scores. All relationships are statistically significant at $p<0.001$ showing that these relationships are positively related. Students who view math more positively and believe in their abilities to do complex problems tend to achieve better performance in math.

Table 5. Correlation analysis

No.	Variables	1	2	3
1	SPM	1		
2	MSE	0.627*	1	
3	MA	0.216*	0.205*	1

*Significant at $p<0.001$

The data presented in Table 6 was performed using multiple regression analysis to assess whether MSE links the relationship between SPM and their MA. Using the Preacher and Hayes [44] approach with 5,000 bootstrap samples, the analysis determines if self-efficacy significantly affects the relationship between SPM and MA. As shown in Table 6, the total effect of SPM on MA was found to be significant ($\beta=1.78$, $t=4.72$, $p<0.001$). Moreover, when MSE was included as a middle factor, the effect of SPM on MSE stayed strong and significant ($\beta=1.189$, $t=2.68$, $p=0.007$). Furthermore, the indirect effect of SPM on MA through MSE was also significant ($\beta=0.597$, $t=2.08$, $p=0.037$) which indicates that, MSE partially mediates the relationship between SPM and MA.

Based on the path analysis in Table 7, it showed that SPM significantly affects MSE ($\beta=0.510$, $t=19.01$, $p<0.001$) which can be seen in Figure 2, the Path a, indicating that students who believe that mathematics is understandable, enjoyable, or useful are more likely to believe that they can perform well in the subject in the future. When they are high on self-efficacy, they will tend to have higher academic aspirations, work harder, and be more resilient towards adversity, hence leading to better overall performance in mathematics [45]. Furthermore, MSE significantly affects MA ($\beta=1.169$, $t=2.10$, $p=0.037$), the Path b,

wherein the students with mathematics ability confidence perform well and self-efficacy was observed to influence academic motivation, persistence, and performance. Moreover, SPM also had a direct effect on MA ($\beta=1.189$, $t=2.68$, $p=0.007$) and the indirect effect through MSE was also seen to be significant ($\beta=0.597$, $t=2.08$, $p=0.037$) which can be seen in Path c, it shows evidence that MSE partially mediates the relationship between SPM and MA.

Table 6. Mediation analysis

Code item	Total effect	Direct effect	Indirect effect of self-efficacy
β	1.78	1.189	0.597
t-value	4.72	2.68	2.08
p-value	<0.001	0.007	0.037
CI	(1.0318; 2.51)	(0.443; 0.3091)	(1.15; 2.08)
% mediation	100.0	66.6	33.4

Table 7. Path analysis

Variables	Label	Estimate	SE	95% confidence interval			
				Lower	Upper	t	P
SPM→MSE	a	0.510	0.0268	0.4561	0.562	19.01	<0.001
MSE→MA	b	1.169	0.5574	0.0280	2.241	2.10	0.037
SPM→MA	c'	1.189	0.4430	0.3091	2.096	2.68	0.007

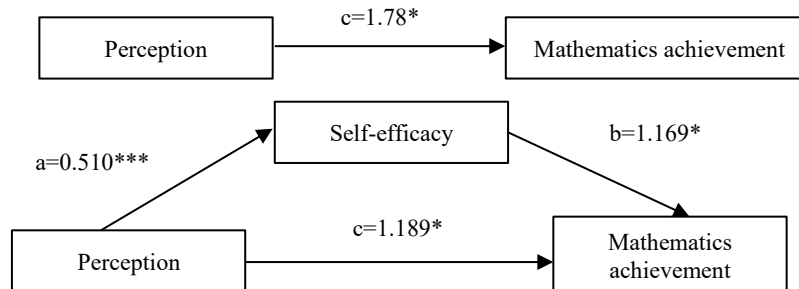


Figure 2. Path estimates of the variables

3.2. Discussion

Addressing the research question, the findings of this study indicate that most participants hold a neutral perception of mathematics. While some students enjoy learning math and find it interesting, many remain undecided about whether math is easy or whether they prefer it to other subjects. These results are aligned with the findings of Kaku and Arthur [46], who discovered that students who have a more positive attitude toward mathematics typically do better academically. According to Salifu and Bakari [47], students that demonstrate greater interest in mathematics are also expected to be rewarded academically. Conversely, Irmayanti *et al.* [48] indicated that students are likely to fail if they think math is dull and uninteresting. This supports the idea that encouraging a more positive perception of math through engaging lessons and supportive environments can boost both performance and confidence [49].

Regarding to MSE, the students generally feel neutral about their math abilities. Many believe that hard work and continuing to gain knowledge towards this subject can help improve their skills; however, they are not very confident regarding their capability to solve difficult problems, understand well and explain math concepts to others, or figure out solutions to unfamiliar problems. This aligns with Bandura [34] that self-efficacy includes students’ belief that they can complete tasks. Students with low self-efficacy often struggle with problem-solving and eventually become unmotivated [50]. Orakcı *et al.* [51] emphasized that teachers should design learning conditions that promote self-efficacy, although a lack of teaching resources can hinder this goal. As Maciejewski [52] stated, students with greater confidence are more likely to persevere through challenges and develop strong problem-solving skills, resulting in better grades. These findings support the need for strategies that promote self-belief, motivation, and classroom belonging [53].

For students’ MA, it was found that the average grades of the participants mostly fall under the satisfactory level. This indicates that even though most of the students who meets the necessary standards for mathematics, there’s still a room for improvement to those who did not. This in lines with the study of Oloo and Nyongesa [54] which stated that motivation, self-confidence, and instructional techniques it affects in

MA. The 3.13% of students who obtained grades below 75 may have been affected by lack of foundational knowledge, learning difficulties, or low self-motivation. Moreover, as study emphasized the need for engaging and interactive lessons, while another study suggested that using real-life examples and group work helps improve understanding [55], this highlights that, when students receive support and are encouraged to ask questions and practice more, it can positively affect both their attitudes and performance in class.

Moreover, the study confirmed that there is a significant moderate positive relationship between SPM and MSE. This indicates that students with a positive attitude toward mathematics are likely to feel confident in their mathematical abilities and skills. Similarly, Zhang *et al.* [56] stated that students who had a positive view of mathematics and found the topic enjoyable had higher self-efficacy because they were more motivated and participated in class activities. In addition, it was emphasized that little academic achievements can boost motivation and self-belief and, noted that a favorable learning environment influences students' confidence [57].

On the other hand, positive perception towards mathematics will encourage students to engage in the subject, but it does not always guarantee better performance. This indicates that a positive perception will not be enough to boost their academics, it must be paired with consistent studying and belief to achieve success in a subject like mathematics. This explains the weak relationship between SPM and MA and between MSE and MA found in the study, which showed only negligible positive correlations. This is supported by Juárez-Moreno *et al.* [58] who noted that enjoyment of mathematics increases participation but does not guarantee achievement without practice, while other studies [59], [60] emphasized the importance of homework completion, problem-solving practice, and teacher support. Similarly, previous studies [22], [61] reported that self-efficacy must be reinforced by effective strategies and consistent study habits before it can meaningfully improve achievement.

Furthermore, through multiple regression analysis, it was found that MSE partially mediates and shows how SPM affects their MA. Based on the findings of our data gathered, MSE contributed to about 33.4% of the total effect, while SPM had a stronger influence at 66.6% showing that SPM as a whole has a bigger influence on their MA than their MSE, or confidence in their abilities, which is essential for success. This finding is in line with Juárez-Moreno *et al.* [58] which claim that self-efficacy fosters drive and resilience, both of which are critical for academic achievement. Additionally, self-efficacious students are more likely to put in a lot of study effort and overcome obstacles to learning, according to Schunk and DiBenedetto [50]. Furthermore, the mediation model used in the study is in line with the approach of Preacher and Hayes [44], confirming that SPM influences MA both directly and indirectly through MSE. It also shows how their view towards mathematics and sense of self-efficacy has a significant impact on their achievement in the subject. In addition, the mediating role of self-efficacy in this study does not weaken but rather strengthens the relationship between SPM and MA. Although the direct path from SPM to MA is stronger, the presence of MSE enriches this relationship by providing an internal mechanism through which perception translates into performance [21], [27]. In short, students' belief in their capacity amplifies the effect of a positive perception, reinforcing its impact on achievement [36], [20].

These findings support a growing body of literature suggesting that both SPM and MSE should be addressed simultaneously in educational interventions. A classroom environment that promotes positive attitudes and builds students' confidence in their abilities is likely to foster better academic outcomes [18], [23]. Consequently, while SPM plays a foundational role, nurturing students' self-efficacy is essential in creating attitudes into meaningful academic success.

4. CONCLUSION

This study examined the relationships among SPM, MSE, and MA of Grade 9 students, emphasizing the mediating role of self-efficacy. Findings showed that students generally held positive perceptions of mathematics, had favorable self-efficacy levels, and demonstrated satisfactory MA. Significant positive relationships were found among SPM, MSE, and MA, with MSE partially mediating the effect of SPM on MA. This indicates that positive views of mathematics strengthen students' confidence, which in turn enhances performance. These results highlight the need for learning environments that support positive attitudes and build students' belief in their abilities.

The findings have practical implications for teachers, school leaders, and policymakers. Training programs can focus on improving instructional practices that boost confidence and motivation, while schools may offer professional development to help teachers create supportive mathematics classrooms. Teachers can also adopt strategies that reduce anxiety, foster persistence, and build self-belief, and curriculum planners may integrate real-life applications to make lessons more meaningful. Strengthening these areas can improve mathematics performance and reduce achievement gaps.

Furthermore, the insights from this study may be applied to other grade levels and educational contexts. Students across different ages benefit from learning environments that foster positive attitudes and

confidence in mathematics. These findings may also be relevant to other regions or countries facing similar educational challenges. Despite the fact that this study gives valuable insight, certain limitations should be taken into consideration. The use of self-report questionnaires may be influenced by personal bias or students' desire to present themselves favorably. Additionally, as a cross-sectional study, the data were collected at a single point in time, making it difficult to determine how these relationships change or develop over time. Consequently, the study's focus on Grade 9 students from only three public schools in one city also limits the result.

For future studies, they may consider using longitudinal designs to track changes in SPM, MSE, and MA over time, or experimental designs to test interventions aimed at enhancing students' attitudes and confidence in mathematics. In the same settings, the study particularly used the method multiple regression analysis, which can also be replicated, replaced or expanded upon in future studies exploring other subjects or grade levels, since this research focused only on high school students. Additionally, other methods of approach are also recommended, such as interviews or group discussions as these could provide deeper understanding into students' experiences and other factors. Future researchers may also explore additional variables to gain more in-depth knowledge of the factors influencing MA. Addressing these could not just add additional information regarding this research but also widen and would further strengthen the understanding of how SPM and MSE contribute to MA across different educational settings.

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C : Conceptualization

M : Methodology

So : Software

Va : Validation

Fo : Formal analysis

I : Investigation

R : Resources

D : Data Curation

O : Writing - Original Draft

E : Writing - Review & Editing

Vi : Visualization

Su : Supervision

P : Project administration

Fu : Funding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data of this research are available upon request from the corresponding author, [BUM].

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APPENDIX

Part I. Student's Profile

Name: _____ Age: _____ Gender: **M** ___ **F** ___

Directions: Put a check mark (/) on the appropriate answer of your profile below.

Parent's Highest Educational Attainment:

Father	Mother
_____ College Graduate	_____ College Graduate
_____ College Level	_____ College Level
_____ High School Graduate	_____ High School Graduate
_____ High School Level	_____ High School Level
_____ Elementary Graduate	_____ Elementary Graduate
_____ Elementary Level	_____ Elementary Level
_____ No Formal Education	_____ No Formal Education

Combined Family Monthly Income: (Father, Mother, Siblings)

_____ Above P30,000	_____ P 15,001 – P20,000
_____ P 25,001 – P30,000	_____ P 10,001 – P15,000
_____ P 20,001 – P25,000	_____ P 10,000 and below

Part II: Students' Perception in Mathematics Survey

Directions: This inventory consists of statements about your perception toward mathematics. There are no correct or incorrect responses. Read each item carefully. Please think about how you feel about each item. Please check (/) the appropriate level of your agreement toward these statements as you perceived them to be true to you. Please rate each statement on its truthfulness.

Legend:

5- Strongly Agree	2- Disagree
4- Agree	1- Strongly Disagree
3- Undecided	

S/N	INDICATORS	5	4	3	2	1
1	I enjoy studying mathematics					
2	I rate mathematics higher than all other core subjects					
3	I have an interest in mathematics					
4	I prefer mathematics to other subjects					
5	Mathematics is easy to learn					

Part III: Self Efficacy Survey

Directions: Below is a list of statements that describe mathematics self-efficacy. Please indicate your level of agreement about each statement below by putting a check mark (✓) on the numerical scale that best describes your level of self-efficacy. Please be very truthful and describe yourself as you really are, not as you would like to be.




Legend:

5- Strongly Agree	2- Disagree
4- Agree	1- Strongly Disagree
3- Undecided	




S/N	INDICATORS	5	4	3	2	1
1	I am confident in my ability to solve complex math problems					
2	I believe that if I work hard, I can improve my math skills					
3	I feel capable of understanding complex mathematical concepts					
4	I am certain that I can perform well on my math tests and exams					
5	I am confident that I can overcome difficulties in learning math					
6	I am confident that I can explain mathematical ideas to others					
7	I am certain I can figure out solutions to unfamiliar math problems					

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