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MEDIATING ROLE OF PROBLEM-SOLVING EFFICACY ON THE CORRELATION BETWEEN MATHEMATICAL DISPOSITION AND ACADEMIC RESILIENCE IN MATHEMATICS AMONG STEM STUDENTS

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ABSTRACT

Low resilience is a challenge in learning mathematics. The mediating role of problem-solving efficacy on the relationship between mathematical disposition and academic resilience in mathematics was determined. Using predictive research design, survey approach, data from 185 senior high school STEM students selected through stratified random sampling were analyzed using mediation analysis. It was found that problem-solving efficacy partially mediates the relationship between mathematical disposition and academic resilience in mathematics, supporting Social Learning Theory. Future research may explore potential mediators and qualitative study, while curriculum planners may adopt instructional approaches that enhance student mathematical attitudes and resilience practice.

KEYWORDS: *Mediating role of problem-solving efficacy, mathematical disposition, academic resilience in mathematics, STEM students*

INTRODUCTION

The Problem and Its Scope

Globally, low academic resilience remains a major issue that hinders student ability to cope with mathematical challenges and setbacks (Pulunga et al., 2022). In addition, students in many countries are experiencing a decline in academic resilience in mathematics, affecting their persistence and performance in the subject (Lau, 2022).

In Australia, students demonstrated low levels of mathematical resilience (Apostolidu & Johnston, 2023). Likewise, Indonesia continues to experience low mathematics resilience, as indicated by results from the Programmed for International Student Assessment (PISA) conducted by the Organization for Economic Co-operation and Development (OECD, 2023).

Students in the Philippines struggle with mathematical resilience, reflected in persistent low achievement, negative attitudes, and poor performance in Trends in International Mathematics and Science Study (TIMSS), National Achievement Test (NAT), and Programme for International Student Assessment (PISA) (Ramirez, 2025). Furthermore, high school students in Davao City with low mathematical resilience struggle with coping problems and develop negative attitudes toward difficult mathematics tasks (Simacon & Veloria, 2022).

Existing literature has primarily focused on the direct relationships among mathematical disposition, problem-solving efficacy, and academic resilience, with limited attention given to potential indirect or mediating effects among these variables. Furthermore, there is a scarcity of empirical studies specifically involving Science, Technology, Engineering, and Mathematics (STEM) senior high school students, and prior research has often examined academic resilience in a general context rather than addressing resilience specific to mathematics learning. Addressing this gap is urgent, as fostering resilience through supportive teaching and learning environments (Demir, 2023).

This study is expected to provide valuable insights and practical strategies for strengthening academic resilience in mathematics. The absence of resilience places students at greater risk of experiencing frustration, disengagement, and academic decline, which may negatively affect their long-term academic performance. Addressing this gap is therefore urgent, as fostering resilience through supportive teaching and learning environments may promote students' perseverance, confidence, and sustained engagement in mathematical learning (Duru et. at., 2024).

Significance of Study

This study highlights the mediating role of problem-solving efficacy in linking mathematical disposition and academic resilience. By supporting Sustainable Development Goal 4 (Quality Education), it fosters resilience that enhances achievement, persistence, and self-efficacy, promoting equitable learning despite adversity. The findings may guide administrators in designing supportive programs, help teachers refine strategies with technology and activities, and encourage students to build self-reliance and positive attitudes. Future researchers may also use this work to deepen understanding of the mediating effect in mathematics education.

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Statement of the Problem

It was aimed in this study to determine the mediating role of problem-solving efficacy on the relationship between mathematical disposition and academic resilience in mathematics. Specifically, the following objectives were pursued:

1. To determine the levels of Mathematical Disposition in terms of identity, utility, self-efficacy, and interest; Problem-Solving Efficacy in terms of social persuasions, physiological response, vicarious experience, and mastery experience; Academic Resilience in Mathematics in terms of value, struggle, and growth among STEM students
2. To determine the significance of the correlation between mathematical disposition, problem solving efficacy, and the academic resilience in mathematics.
3. To determine the significance of the direct effect of mathematical disposition on academic resilience, controlling for problem solving efficacy.
4. To determine the significance of the indirect effect of mathematical disposition on academic resilience, through problem solving efficacy.
5. To determine the significance of the total effect of mathematical disposition on academic resilience

Research Hypotheses

To objectively answer the problem of this study, the following hypotheses were tested at a 0.05 level of significance:

H_{O1}: Mathematical disposition and problem-solving efficacy do not significantly correlate with academic resilience in mathematics

H_{02}: The direct effect of mathematical disposition on academic resilience, controlling for problem solving efficacy, is not significant.

H_{03}: The indirect effect of mathematical disposition on academic resilience, through problem solving efficacy is not significant.

H_{04}: The total effect of mathematical disposition on academic resilience is not significant.

Theoretical and Conceptual Framework

This study is anchored on Albert Bandura's Social Learning Theory (1977), which emphasizes that learning occurs through the processes of observing, modeling, remembering, and reproducing behaviors within a social context. The theory highlights the core processes retention, reproduction, and motivation that determine whether observed behaviors are learned and enacted. Learning is further influenced by reinforcement, which shapes motivation and persistence in performing behaviors.

In the context of this study, mathematical disposition with indicators of identity, utility, self-efficacy, and interest (Young & Cunningham, 2021), stands for retention. Likewise, problem-solving efficacy, which has an indicator of social persuasions, physiological response, vicarious experience, and mastery experience (Dagdag et. al., 2020), stands for reproduction. These motivation factors influence students' academic resilience in mathematics as indicated by value, struggle, and growth (Hernane & Linagyn, 2025), Thus, this study focuses on the interconnection of retention, reproduction, and motivation within Social Learning Theory, explaining how mathematical disposition and problem-solving efficacy contribute to the development of academic resilience in mathematics. Furthermore, mathematical disposition, including identity, utility, self-efficacy, and interest in mathematics, is hypothesized to directly influence academic resilience, which encompasses value, struggle, and growth. Problem-solving efficacy, composed of social persuasions, physiological response, vicarious experience, and mastery experience, is proposed to mediate this relationship, enhancing students' ability to overcome challenges and persist in mathematics. Motivation component of the theory was excluded in the study. Hence, the study was partly anchored on Albert Bandura's Social Learning Theory.

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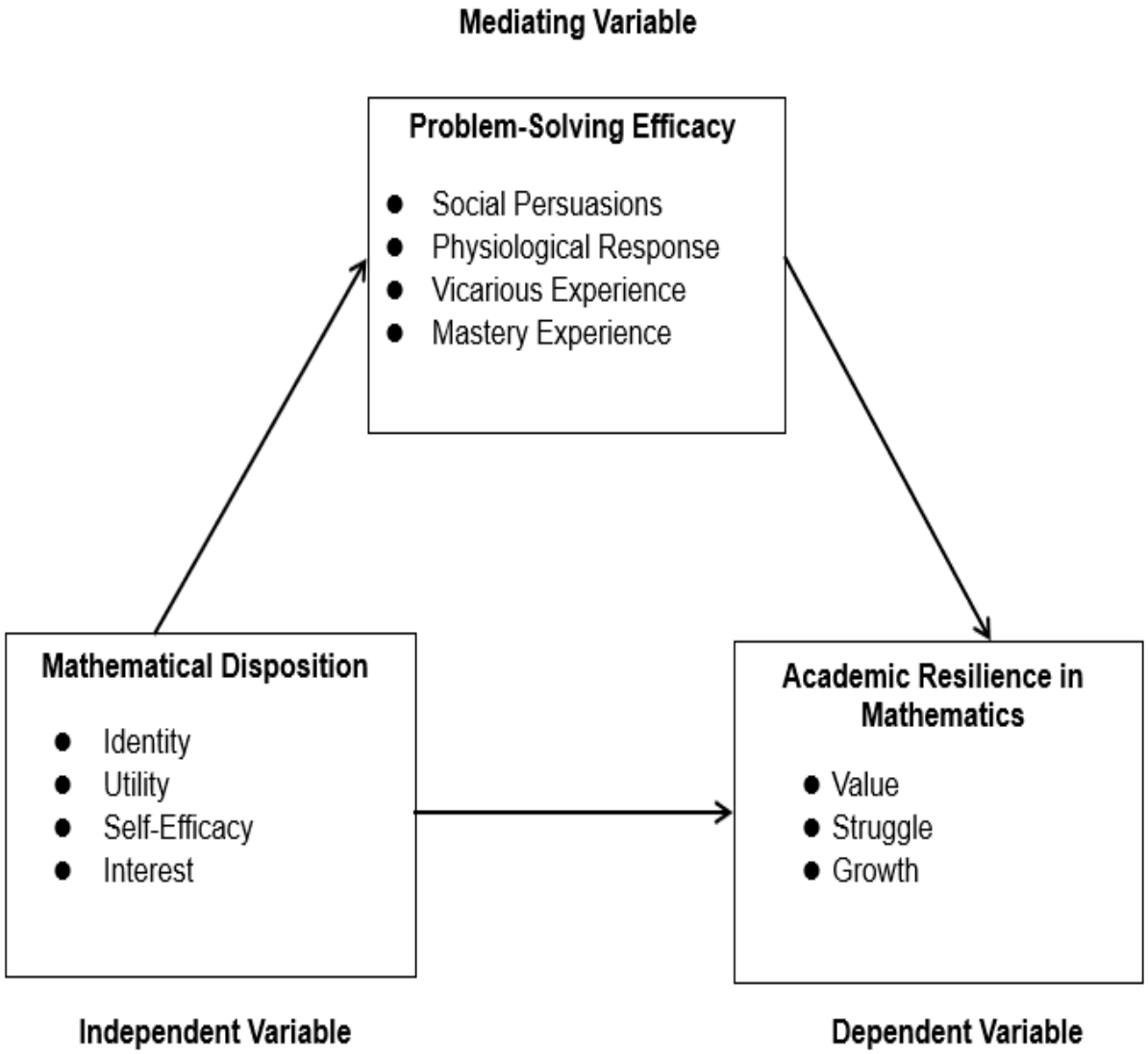


Figure 1. Conceptual Framework of the Study

METHOD

The research design, locale of the study, the sample and sampling technique, data analysis technique, and the ethical considerations are included in this chapter.

Research Design

This study employed predictive research design, which is a quantitative approach used to determine how well one or more independent variables can predict an outcome variable through statistical analysis (Hair et al., 2023). It is appropriate because it allows the analysis of predictive relationships among variables and the testing of mediation models using statistical techniques such as structural equation modeling (Kline, 2023). Furthermore, one of its key advantages is that it allows researchers to identify significant predictors and estimate the strength and direction of their influence, thereby providing a basis for evidence-based decision-making and intervention planning (Hair et al., 2023).

Research Locale

The study was conducted in selected private schools in Davao City, Region XI, Philippines. These schools were purposively selected based on several criteria: their willingness to participate in the study, the presence of a sufficient number of Senior High School STEM students to ensure adequate representation, strong academic performance that reflects established instructional practices, accessibility to facilitate efficient data collection, and official recognition by the Department of Education (DepEd). Davao City was chosen as the research setting because it hosts a wide range of reputable private secondary schools offering the STEM strand, providing a suitable and diverse context for

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examining students' mathematical disposition and academic resilience.

Sample and Sampling Technique

The respondents of this study were 185 senior high school STEM students enrolled in three private institutions in Davao City during the School Year 2025–2026. The inclusion criteria required that participants must be officially enrolled in the STEM strand, currently attending regular classes, and capable of providing both parental consent and student assent, ensuring that only active and eligible STEM students were included in the study. In contrast, the exclusion criteria covered students who were not enrolled in the STEM strand, those not currently attending classes, those who failed to submit the required consent and assent, and those enrolled in special education programs with individualized learning plans, in order to maintain consistency and reduce possible confounding factors. From this carefully defined pool, the final sample of 185 students was selected, which was considered adequate for the non-experimental quantitative design of the study. Raosoft software, as noted by Lopez and Garcia (2021), was used to compute the appropriate sample size from a population of 335 students.

To further ensure proper representation, stratified random sampling was applied following Etikan and Bala (2017), allowing respondents to be fairly selected across different strata and strengthening the generalizability of the findings to the broader STEM student population.

Data Gathering Technique

In this study, the survey technique was applied. It uses structured questionnaires to systematically collect information on respondents' attitudes, perceptions, or behaviors (Creswell & Creswell, 2023). It is applied when researchers need to gather data from a large population efficiently, and its advantages include being cost-effective, time-efficient, and capable of producing quantifiable data for statistical analysis (Creswell & Creswell, 2023).

In this study, three adapted and modified survey questionnaires were used. The first instrument measured the mathematical disposition and was adapted from the study of Young and Cunningham (2021). It consists of 20 items designed to assess students' mathematical disposition, particularly their attitudes, beliefs, confidence, and appreciation toward mathematics. This adapted instrument was pilot tested for reliability, with Cronbach's alpha of 0.864.

The second instrument measured problem-solving efficacy and was adapted from the study of Dagdag et al. (2020). It is composed of 30 items intended to evaluate students' confidence in solving mathematical problems and their perceived capability in handling challenging mathematical tasks. This questionnaire also utilized a four-point Likert scale. Pilot testing revealed a Cronbach's alpha of 0.868

The third instrument measured academic resilience in mathematics and was adapted from the study of Hernane and Linagyn (2025). It includes 15 items designed to assess students' ability to cope with academic difficulties, recover from setbacks, and persist in learning mathematics despite challenges. Similar to the previous tools, this instrument employed a four-point Likert scale and a Cronbach's alpha of 0.731

Data Analysis Technique

In this study, the data analysis techniques used were descriptive, correlation, and mediation analysis. Descriptive data analysis is a statistical method used to summarize and organize data to describe its main features, such as through averages, frequencies, and graphs. It is applied at the early stage of research to understand data, identify patterns, and present findings clearly (Wolniak, 2024). In this study, the mean and standard deviation statistical tools were used. Moreover, correlation data analysis is a statistical method used to measure the strength and direction of the relationship between two or more variables, without implying causation (Chee, 2025). The Pearson Product-moment correlation statistical tool was used. Lastly, mediation data analysis is a statistical method used to examine how and why an independent variable influences a dependent variable through an intermediate variable (mediator). It helps identify whether the effect is direct or occurs indirectly through a specific pathway (Schuler et al., 2024).

The matrix containing the scale, descriptive level, and corresponding interpretation assigned to each variable involved in this study is presented. This measure is used particularly in describing the level of problem-solving efficacy, mathematical dispositiona, and academic resilience in mathematics.

Scale	Level	Problem-Solving Efficacy	Mathematical Disposition	Academic Resilience in Mathematics
1.00 – 1.74	Very low	Very poor	Very poor	Very poor
1.75 – 2.49	Low	Poor	Poor	Poor
2.50 – 3.74	High	Good	Good	Good
3.75 – 4.00	Very high	Very Good	Very Good	Very Good

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Standard Deviation Value Ranges and Interpretation

Range	***Description***	***Interpretation***
SD ≤ 0.50	Highly Consistency Response	No intention
SD = 0.51	Moderately Consistency Response	Less intention
SD = 1.01 – 1.50	Low Consistency Response	More intention
SD > 1.50	Very Low Consistency Response	Much intention

In this study, the significance of the correlation is tested at 0.05 confidence level. The following standard measure for the interpretation scale of *r*-value was used:

Computed r	*Descriptive Interpretation*
+/- 1.00	Perfect correlation
Between +/- 0.75 – +/- 0.99	High correlation
Between +/- 0.51 – +/- 0.74	Moderately high correlation
Between +/- 0.31 – +/- 0.50	Moderately low correlation
Between +/- 0.01 – +/- 0.30	Low correlation
0.00	No correlation

The standard measure for the interpretation of the strength of the mediation is as follows:

Proportion Mediated	*Interpretation*
< 0.20	Weak Mediation
0.20 – 0.50	Moderate Mediation
> 0.50	Strong Mediation

Ethical Consideration

This study maintains the study's integrity, the researcher adhered to all ethical standards, including obtaining informed consent and student assent form, ensuring confidentiality, and minimizing harm or discomfort. The researcher follows the ethical guidelines of the Holy Cross of Davao College – Society for Moral Integrity and Legal Ethics (HCDC-SMILE), which checks and approves the study and its instruments, ethical principles, participants were clearly informed about the study's purpose, their rights, and how their data would be used. Moreover, the respondents voluntarily provided written consent and may withdraw from participation at any time without consequence. The survey included an informed consent form that promotes transparency, allowing participants to decline if they feel uncertain. Respondents were also assured of their right to skip sensitive questions, inquire about the study, and access its findings.

RESULTS

Included in this chapter are the descriptive, correlation, regression, and mediation tabular presentation, and the corresponding analysis and interpretation of the statistical results. This chapter ends with the summary of findings.

Descriptive Results

Shown in Table 1 are the descriptive results of the study. Contained in the table are the variables involved, namely; mathematical disposition, problem-solving efficacy, and academic resilience in mathematics; and the number of samples, standard deviation, mean and descriptive level specifically corresponding with each of the variables.

Table 1: Descriptive Statistics (N = 185)

Variables	**Standard Deviation**	**Mean**	**Descriptive Level**
Mathematics Disposition	**0.59**	**3.22**	**Very High**
Mathematics identity	0.72	3.03	High
Mathematics utility	0.56	3.37	Very High
Mathematics self-efficacy	0.58	3.22	Very High
Mathematics interest	0.51	3.24	Very High
Problem Solving Efficacy	**0.55**	**3.33**	**Very High**
Social persuasions	0.46	3.55	Very High
Physiological response	0.62	3.16	High
Vicarious experience	0.51	3.37	Very High
Mastery experience	0.6	3.23	Very High

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Academic Resilience in Mathematics	**0.48**	**3.38**	**Very High**
Value	0.45	3.40	Very High
Struggle	0.48	3.39	Very High
Growth	0.51	3.34	Very High

It can be observed in the table the mathematical disposition variable obtained a mean of 3.22, described as very high. This indicates that the respondents generally hold a positive outlook and value the practical use of mathematics in their daily lives. All its indicators obtained are described as very high level, except for mathematics identity, which obtained a high level. The standard deviation of 0.59, described as moderately consistent responses, signifies an acceptable consistency. Furthermore, problem-solving efficacy variable obtained a mean of 3.33, described as very high. This signifies that the students feel confident and supported by their social environment, they may still experience some level of physical or emotional stress when engaging in mathematical problem-solving tasks. All its indicators obtained a very high level, except physiological response, which obtained high level. The standard deviation of 0.55, described as moderately consistent responses, denotes acceptable consistency. Finally, the academic resilience in mathematics variable obtained 3.38, described as very high. This indicates that students demonstrate a strong capacity to recover from setbacks and maintain a growth mindset. All its indicators are described as very high level. The standards deviation of 0.48 is described as highly consistent, indicating strong and uniform perception.

The results showed that all variables are generally interpreted at a very high level, with respondents demonstrating confidence, perseverance, and a positive attitude toward mathematics, enabling them to effectively cope with academic challenges and setbacks. Moreover, the consistency of responses indicated that the participants share relatively similar perceptions regarding the variables being studied.

Correlation Results

Table 2 is correlation table. It contains determinant and criterion variables. Aside from the variables, it also contained the number of samples, *r*-value, p-value, decision on null hypothesis, and the corresponding interpretation.

Table 2: Correlation Table (n=185)

Variables	**Academic Resilience in Mathematics**			
	***r*-value**	**p-value**	**Decision on *H*0**	**Interpretation**
Mathematical Disposition	0.797	0.000	Reject ***H*0**	High significant correlation
Problem-solving Efficacy	0.717	0.000	Reject ***H*0**	Moderate significant correlation

Level of Significance: 0.05
Decision Rule: Reject H_0 if $p < 0.05$

As shown in the table the correlation between mathematical disposition and academic resilience in mathematics variables obtained a p-value of 0.000. Such value is less than 0.05 level of significance; hence, the null hypothesis was rejected. It indicates that the correlation is statistically significant. The corresponding r-value of 0.797 reflects a highly significant correlation between mathematical disposition and academic resilience in mathematics. This implies that students who possess a more positive attitude and interest toward the subject tend to demonstrate higher levels of resilience when facing academic difficulties. Similarly, problem-solving efficacy yielded a p-value of 0.000, which is lower than the 0.05 level of significance. Hence, the null hypothesis was rejected. This indicates that the correlation is statistically significant. The r-value of 0.717 shows a moderately significant correlation between problem-solving efficacy and academic resilience in mathematics. This implies that a student's belief in their own capability to solve mathematical problems is a significant factor in their ability to recover from setbacks and persist through complex tasks.

Both mathematics disposition and problem-solving efficacy show significant positive correlation with academic resilience in mathematics, with mathematical disposition exhibiting a high correlation compared to problem-solving efficacy

Mediation Results

Table 3 is mediation table. It contains the number of samples, and the determinant, mediator, and criterion variable. It also contains the direct, indirect and total effect of mathematical disposition variable controlling and going through the mediator, and its total effect, respectively. Finally, it contains the estimate beta, standard error, Z-value, p-value, decision on null hypothesis and corresponding interpretation.

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Table 3. Mediation Table (n = 185)

Label	Path / Effect	Estimate (B)	SE	Z-value	p-value	Decision on H_0	Interpretation
A	Mathematical Disposition → Problem-Solving Efficacy	0.725	0.50	15.58	0.000	Reject Ho	Significant
B	Problem-Solving Efficacy → Academic Resilience in Mathematics	0.223	0.09	2.38	0.017	Reject Ho	Significant
c'	Mathematics Disposition → Academic Resilience in Mathematics (Direct Effect)	0.568	0.08	6.87	0.000	Reject Ho	Significant
a × b	Indirect Effect (Mediation)	0.161	0.07	2.44	0.015	Reject Ho	Significant
c (Total Effect)	Mathematics Disposition → Academic Resilience in Mathematics (Total)	0.730	0.05	16.15	0.000	Reject Ho	Significant

Level of Significance: 0.05
Decision Rule: Reject H_0 if $p < 0.05$
%Mediation: Direct - 77.9%; Indirect - 22.1%

The table specifically shows that the direct effect of mathematical disposition on academic resilience in mathematics controlling for problem-solving efficacy variable obtained estimate Beta coefficient of 0.568, with a corresponding p-value of 0.000, which is less than the 0.05 level of significance. Hence, the null hypothesis was rejected. This indicates that the direct effect is significant. This implies that while a positive mindset helps build resilience through increased confidence, it also continues to influence a student's ability to stay resilient through other factors not measured in this specific model. Similarly, the indirect effect of mathematical disposition on academic resilience in mathematics through problem-solving efficacy obtained an estimated Beta of 0.161, with a p-value of 0.015, which is less than 0.05 level of significance. Thus, the null hypothesis was rejected. This indicates that the indirect effect is significant. This implies that as students become more confident in their skills, they develop a greater capacity to remain persistent despite difficulties. Lastly, the total effect of mathematical disposition on academic resilience in mathematics obtained as estimated Beta of 0.730, with a p-value of 0.000, which is lower than 0.05 level of significance. Thus, the null hypothesis was rejected. This indicates that the total effect of mathematical disposition on the criterion is significant. This implies that mathematical disposition plays an important role in influencing students' academic resilience in mathematics. Students who possess positive attitudes, confidence, perseverance, and interest in mathematics are more likely to become resilient when facing mathematical challenges and difficulties.

The table likewise specifies the mediated proportion of 22.1%, indicating that mediating effect of problem-solving efficacy on the relationship between mathematical disposition and academic resilience in mathematics is moderate. Since the direct effect of mathematical disposition on academic resilience in mathematics, and the indirect effect is also significant, the results indicate partial mediation.

Summary of Findings

Based on statistical results, it was specifically found that:

1. Mathematical disposition and problem-solving efficacy significantly correlate with academic resilience in mathematics.
2. The direct effect of mathematical disposition on academic resilience, controlling for problem solving efficacy, is significant.
3. The indirect effect of mathematical disposition on academic resilience through problem solving efficacy, is significant.
4. The total effect of mathematical disposition on academic resilience, is significant.

DISCUSSIONS

Discussed in this section are the findings of the study. The descriptive, correlation and mediation analysis are presented.

Mathematical Disposition and Academic Resilience in Mathematics Correlation

The finding of this study, asserting that there is a significant positive relationship between mathematical disposition and academic resilience in mathematics, affirms the study of Bacatan (2024), demonstrating that mathematical resilience is significantly associated with mathematical disposition, indicating that students with stronger resilience tend to exhibit more positive attitudes and confidence toward mathematics. Similarly, the current finding affirms the study of Aquino and Ibarra (2024), which found that positive dispositions such as confidence and perseverance contribute to better engagement in mathematical tasks, supporting the idea that constructive attitudes in mathematics strengthen students' ability to persist and adapt when facing mathematical challenges. However, the current finding contrasts with the study of Punzalan (2026), reporting a non-significant correlation between math productive disposition and mathematics resilience performance. Since the study focused on achievement rather than resilience, the difference in findings

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suggests that resilience may influence students' dispositions and persistence in mathematics without necessarily translating directly into academic performance.

Problem-Solving Efficacy and Academic Resilience in Mathematics Correlation

The finding that problem-solving efficacy has a moderately positive correlation with academic resilience in mathematics supports the study of Booc et al. (2026), found that students with higher self-efficacy in mathematical problem solving engage more confidently, persistently, and effectively with mathematical challenges, which strengthens their ability to overcome academic difficulties. Similarly, the current finding affirms the study of Pelandas and Salva (2026), explaining the strong positive correlation between mathematics self-efficacy and resilience in problem-solving, indicating that students with greater confidence in their abilities tend to perform better in solving mathematical problems. This supports the present result that confidence in problem solving contributes to students' persistence and adaptability in mathematics. However, the current finding contradicts the study of Hidayati and Mahmudi (2025), explaining that mathematical resilience is primarily associated with persistence and perseverance in facing mathematical challenges rather than with students' confidence in problem-solving abilities, suggesting that problem-solving efficacy may not always have a direct influence on academic resilience in mathematics.

Problem-Solving Efficacy Partially Mediates the Correlation Between Mathematical Disposition and Academic Resilience in Mathematics

The findings of this study, asserting that problem-solving efficacy partially mediates the correlation between mathematical disposition and academic resilience in mathematics variables, affirms the study of Hu (2025), demonstrating that student with a positive mathematical disposition are more likely to develop stronger beliefs in their problem-solving abilities, which consequently enhance their capacity to cope with challenges and persist in difficult mathematical tasks, suggesting that problem-solving efficacy plays a significant role in fostering academic resilience. Similarly, the current finding agrees with the claim of Coşkun (2024), emphasizing that mathematical self-efficacy mediates the relationship between students' attitudes toward mathematical problem posing and their problem-solving attitudes, supporting the idea that positive mathematical disposition enhances academic resilience through cognitive and motivational mechanisms such as self-efficacy. In both studies, self-efficacy functions as a key pathway that translates favorable dispositions into adaptive outcomes when students encounter mathematical challenges. However, the current finding contradicts the study of Labong et al. (2025), asserting that self-efficacy in mathematics did not significantly mediate the relationship between disposition and mathematical resilience despite significant correlations among the variables, suggesting that the mediating role of problem-solving efficacy may vary across different educational contexts and learner characteristics.

Conclusion

Based on the findings, it is concluded that the problem-solving efficacy partially mediates (22.1%) strength but significantly mediates the correlation between mathematical disposition and academic resilience in mathematics. This result partly affirms the Social Learning Theory, positing retention, reproduction, and motivation collectively explain how positive mathematical attitudes and problem-solving confidence foster resilience.

Recommendation

Based on the conclusion, it is recommended that future research may explore potential variables that might mediate the connection between mathematical disposition and academic resilience in mathematics. Qualitative research may be explored to extract themes which may help clarify the unexplained 77.9% variance in the mediation effect observed in the relationship between the cause and outcome variable, while curriculum planners may adopt instructional approaches that enhance student mathematical attitudes and coping activity.

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