

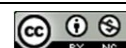
Affective Determinants of Mathematics Achievement: Examining Resilience and Attitude in a Global STEM Learning Perspective

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Abstract

Affective factors in mathematics learning, particularly attitudes and resilience, have long been recognized as important determinants of student achievement. However, international research remains inconclusive regarding their relative influence, especially in under-resourced contexts where learners often depend more on psychological strengths than external support. This study examined the comparative predictive power of mathematical attitude and mathematical resilience on mathematics performance among junior high school students in a rural Philippine setting. Using a descriptive-correlational design, data were collected from 91 students through the culturally validated 33-item Mathematics Attitude Scale (Facultad & Sebial, 2019), the Mathematical Resilience Scale (Kookan et al., 2016), and official first-quarter mathematics grades. Results showed that students generally exhibited positive attitudes toward mathematics, strong resilience, and moderate academic performance. Both mathematical attitude and resilience were significantly associated with achievement. Hierarchical multiple regression analysis revealed that mathematical resilience was a stronger predictor than mathematical attitude, with both variables jointly explaining 26.3% of the variance in performance. These findings contribute to the international literature by demonstrating that resilience may play a more critical role than attitude in shaping mathematical success under conditions of structural and resource constraints. The study highlights the value of resilience-building interventions as a practical strategy for improving learning outcomes in resource-scarce educational environments. More broadly, the findings support the integration of affective skill development into STEM education as a cost-effective and scalable approach to enhancing student achievement in developing contexts.

Keywords: Mathematics attitude, Mathematical resilience, Mathematics performance, Junior high school, Rural education, Affective factors



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INTRODUCTION

Mathematics education remains a priority in educational systems worldwide, as mathematical literacy is widely recognized as an essential skill and a prerequisite for the development of scientific and technological knowledge, economic prosperity, and responsible citizens in the 21st century. International comparisons of student achievement, such as those based on the Programme for International Student Assessment (PISA) instruments, have documented substantial differences across countries in mathematics, despite a complex array of cognitive, affective, and contextual factors influencing students' learning outcomes. In recent years, the role of non-cognitive variables is receiving more attention within educational research, in particular attitudes to mathematics and mathematical resilience as significant predictors of academic achievement, which in many cases may be equally or even more important than cognitive dimensions (Alemany-Arrebola et al., 2025; Pitsia et al., 2017). Based on their beliefs about the usefulness of learning mathematics, their reactions to mathematical tasks, and their own efficacy in learning the subject matter, which makes up students' attitudes (Dweck & Leggett, 1988; Mathey et al., 2002) and how students persist when encountering problems or anxiety, which is

known as mathematical resilience (Kookan et al., 2016). How these psychological variables, alone and in collaboration with each other, affect mathematics performance across a variety of contexts has now become a target for researchers worldwide who are striving to advance students' attainment.

In the Asian context, with a strong emphasis on mathematics teaching and learning, researchers have observed wide disparities in achievement levels and in the importance of affective variables across countries. Although students from high-achieving countries like Singapore, Japan, and South Korea perform well in international assessments, many other Southeast Asian countries have faced a major hurdle in ensuring that all their students have mathematical literacy. The Philippines dramatically illustrates these problems. In the PISA 2018, Filipino students were identified as low in mathematical literacy, as almost half of the 15-year-old test takers scored below the minimum level of proficiency in mathematics (Department of Education, 2019). This disturbing trend has continued, and PISA 2022 results recently confirmed that the Philippines trails other countries in mathematics (Chi, 2023). The consistent failure to make the grade has led researchers to seek explanations beyond curriculum content or instruction quality, which have drawn attention to affective and motivational elements that may contribute to mathematics under-performance among Filipino learners.

Within the Philippine educational system, the mathematics disparity is also worsened by local contextual factors, and difficulties faced in the rural schooling environment are particularly acute. Bernardo et al. (2022) observed apparent differences between low-performing mathematics students in public and private schools, suggesting that resource availability, school climate, and students' psychological orientation towards mathematics significantly affect achievement. Rural schools in the Philippines typically struggle with poor infrastructure, a scarcity of learning materials, insufficient numbers of qualified mathematics teachers, and low parental support. These can negatively influence the quality of mathematics education and frame students' psychological reactions to learning mathematics (Kusmawan, U. et al., 2026; Department of Education, 2019; Enu et al., 2015; Mbugua et al., 2012). In such environments, students may form particularly negative attitudes towards mathematics following repeated experiences of not finding support or of being unable to sustain the resilience needed to persevere in learning (Khumalo et al., 2022). Despite the apparent importance of these psychological components in mathematical achievement in disadvantaged contexts, there is limited research on how mathematical attitude and resilience relate to performance among junior high school students attending rural Philippine schools.

The development of culturally appropriate instruments has provided methodological foundations for investigating these relationships in the Philippine context. Facultad and Sebialb (2019) constructed and validated the Mathematics Attitude Scale (MAS), which was specifically designed to measure students' attitudes towards mathematics among high school students in Southern Philippines, and is sensitive to the intrinsic multidimensionality of Filipino students' attitudes towards the discipline. Likewise, the Kookan et al. (2016) Mathematical Resilience Scale has been cross-culturally validated, assessing students' ability to appreciate mathematics, view struggle as a regular part of learning, and hold growth-oriented beliefs. Further evidence worldwide has shown that both constructs significantly affect achievement through their effects on engagement, learning strategies, and motivational processes (Zheng et al., 2025; Kusmawan, U., 2017; Pitsia et al., 2017). However, the extent to which attitude is a stronger predictor than resilience remains an empirical question, especially within resource-poor educational settings where interventions need to be cost-effective in targeting influences on student success.

Determining the stronger predictor of mathematics performance among Filipino junior high school learners has significant practical implications for intervention. If attitude is the stronger predictor, interventions could aim to modify mathematics-related beliefs and alleviate anxiety by enhancing perceived self-efficacy. Alternatively, if resiliency is found to be more impactful, interventions could focus on fostering students' knowledge and skills in learning through struggle, persisting despite challenges, and holding a growth mindset

about their ability to do mathematics. The current study responds to the urgent need to understand how mathematical attitude and mathematical resilience relate to learners' mathematics performance among junior high school students at a rural Philippine school. This research thus adds to the relatively scant literature on affective factors in mathematics learning in developing country contexts while also generating knowledge with implications for local educational practice and policy by systematically documenting this set of relationships.

Within the global STEM education landscape, there has been an increasing interest in the importance of non-cognitive factors in influencing students' academic outcomes, especially in mathematics. International studies consistently demonstrate that students' attitudes, beliefs, and resilience play a significant role in their engagement and achievement, often supplementing or even surpassing cognitive predictors. Large-scale and cross-national studies have shown that affective constructs such as motivation, self-efficacy, and persistence are significant determinants of performance across various educational systems. However, notwithstanding this expanding body of evidence, there is still a need for context-specific investigations that examine the role of these factors in under-resourced contexts. The significance of students' attitudes, beliefs and resilience in affecting their engagement and achievement is strongly underscored in international research, often complementing or replacing cognitive predictors. Large scale studies, including cross-national studies, have shown that affective constructs such as motivation, self-efficacy and persistence are critical determinants of performance across diverse educational systems. While this body of evidence has been growing, further context-specific investigations are needed to understand how these factors play out in under-resourced settings. This study contributes to the international discourse by providing empirical evidence from rural Philippines, offering insights into how mathematical attitude and resilience interact to influence student performance within a specific socio-educational context.

Research Objectives:

This study aims to examine the influence of mathematics attitude and mathematical resilience on the mathematics performance of junior high school learners at a rural school in Benguet, Philippines.

1. To determine the level of mathematics attitude among junior high school learners.
2. To assess the level of mathematical resilience among junior high school learners.
3. To identify the level of mathematics performance among junior high school learners.
4. To determine whether there is a significant relationship between mathematics attitude and mathematics performance among junior high school learners.
5. To determine whether there is a significant relationship between mathematical resilience and mathematics performance among junior high school learners.
6. To identify which of the two, mathematical attitude or mathematical resilience, is a stronger predictor of mathematics performance among junior high school learners.

RESEARCH METHOD

This study employed a quantitative research approach, using a descriptive-correlational design, to examine the relationships among mathematics attitude, mathematical resilience, and mathematics performance among junior high school learners. This research design permits describing variables in a structured way and studying relationships among them without manipulation (Creswell, 2014). The descriptive part sought the average mathematics attitude, mathematical resilience, and mathematics performance of the respondents, while the correlational part aimed to establish correlations among these variables and identify which of the two variables is a better predictor of school mathematics performance.

Three instruments were utilized to gather data for this study, each selected based on established validity and reliability, as well as appropriateness for the Philippine educational context. The students' attitude towards mathematics was measured using the Mathematics Attitude Scale established and validated by Facultad and Sebial (2019). This instrument was particularly developed for Filipino high school students in the Southern Philippines, and is thus culturally relevant to the place of interest. It has 33 items with four subscales: (1) Students' Perceived motivation and support in learning mathematics: measuring the students' perception of the value of mathematics and perceived support they receive from others when learning; (2) Students' perceived anxiety in learning mathematics: assessing the adverse reactions elicited by stressful mathematical encounters; (3) Students' perceived self-efficacy on learning mathematics that check student's belief about their capacity to do successfully math related tasks; and (4) teachers and parents' influences to students in learning mathematics. The Mathematical Resilience Scale developed by Kookan et al. (2016) was employed to assess students' mathematical resilience. This internationally validated instrument consists of 24 items capturing three dimensions of mathematical resilience: (1) Value measures students' recognition of the importance and utility of mathematics in their lives and future endeavors; (2) Struggle assesses the extent to which students normalize difficulty and view challenges as inherent to mathematical learning rather than indicators of personal inadequacy; and (3) Growth evaluates students' beliefs about whether mathematical ability is fixed or can be developed through effort and persistence.

The MRS has demonstrated strong psychometric properties across multiple cultural contexts, with reported reliability coefficients ranging from 0.80 to 0.92 for the subscales. The scale has been validated in various international settings, including Nigeria (Awofala, 2021) and Turkey, confirming its cross-cultural applicability. Mathematics performance was measured using students' First Quarter Mathematics grades. These grades reflect a weighted average of their mathematical achievement throughout the first marking period, and include performance on different types of assessments as indicated in the Department of Education's assessment policies. The inclusion of actual course grades as a performance indicator gives the tests ecological validity by allowing for authentic academic performance within the genuine educational setting. First Quarter grades were chosen because they are ample, meaningful assessment data that occur after two months of instruction and do not invite the additional distraction from cumulative fatigue or disengagement that might occur later in the academic year. Scores were recorded using the Philippine grading system, which ranged from 60 to 100, with a passing score of 75.

Data were analyzed using both descriptive and inferential statistics, facilitated by statistical software including IBM SPSS Statistics version 26. The analytical procedures were selected to systematically address each specific research objective. Ethical principles in the research were strictly adhered to in order to safeguard the rights and welfare of the participant.

LITERATURE REVIEW

The relationship between affective factors and mathematics performance has attracted substantial attention in educational research, particularly in understanding how students' psychological orientations toward mathematics influence their academic outcomes. This review aims to consolidate studies on mathematics attitude and mathematical resilience, taking into account existing theoretical considerations and their relationships with mathematics performance, from international perspectives to how this can relate to or impact the Philippines' educational setting.

Mathematics attitude and performance

Students' orientations toward mathematics form a multidimensional construct involving cognitive, affective, and motivational elements that shape their engagement and achievement. Alemany-Arrebola et al. (2025) showed that students often experience negative emotions, such as rejection, dissatisfaction, fear, and anxiety, which strongly predict their performance in multicultural settings. Similarly, research affirms that the mathematics attitude is complex. Davadas and Lay (2020) identified teaching quality, parental involvement, peer influence, and self-perceived competence as major contributors, while Kiliç and Bölükbaş (2025) demonstrated, using a visualized attitude scale, that students' attitudes shift as mathematics becomes more abstract in middle school.

In the Philippine setting, the development of culture-sensitive instruments for measuring mathematics attitudes has been a significant methodological advancement. Facultad and Sebialb (2019) developed and validated the Mathematics Attitude Scale (MAS) specifically for high school students in the southern Philippines. It focuses on perceived motivation and support, anxiety, self-efficacy, teacher influence, and parent influence. This four-factor pattern corresponds to culturally bounded ways in which Filipino students experience and construct their relationship with mathematics, recognizing family-mediated instructional support as a significant contributor to attitudinal orientations. Capuno et al. (2019) also confirmed the relationships among these factors among junior high school students in the Philippine context. They found significant correlations among attitudes, study habits, and academic performance, with both anxiety and self-efficacy as highly influential domains.

Studies with an international comparative perspective have shed light on how attitudes towards mathematics operate across various educational systems and cultural contexts. Wang et al. (2022) investigated the influence of students' mathematical attitudes on intentions, behavioral engagement, and achievement among Chinese students. They found that attitudes exert both direct and indirect effects on achievement by mediating through student motivation and work ethic. Structural equation modelling results demonstrated that attitudinal constructs accounted for considerable variance of both behavioral engagement (59.4%) and mathematics achievement (30.7%), indicating the substantive value of attitudes as antecedents of academic outcomes. Wakhata et al. (2024) proposed another step toward this line of research: investigating overall attitudes toward mathematical word problems, finding that students' attitudinal responses differ across task types and matter in predicting performance.

Mathematical resilience

Mathematical resilience is a separate, yet related, psychological construct that has received significant attention in mathematics education research over the past decade. Kookan et al. (2016) defined the construct and conceptualized resourced mathematical resilience as three interrelated dimensions: value, struggle, and growth. Their development and validation of the mathematical resilience scale provided researchers with a robust psychometric instrument for assessing students' ability to sustain engagement in mathematics in the face of adversity, with reliability varying closely or strongly across samples and cultural contexts.

Lee and Johnston-Wilder (2017) developed the mathematical resilience theoretical model, embedding it within broader emotional regulation frameworks alongside growth mindset theory. They posited that mathematically resilient students have both more positive attitudes toward mathematics and the ability to apply strategies for coping with and alleviating math anxiety, reframing failure or setbacks as learning opportunities rather than personal shortcomings, and sustained engagement with challenging mathematical material. This characterization sets resilience apart from mere perseverance and highlights students' psychological engagement during periods of frustration or challenge, rather than focusing exclusively on the temporal duration of effort.

Some recent systematic reviews have been conducted to pool the increasing amount of empirical research on mathematical resilience. Akkan and Horzum (2024) published an extensive review of the mathematical resilience research field that uncovered recurring commonalities amongst studies: it was found that students with higher mathematical resilience are more likely to engage in complex problems, demonstrate more nuanced seeking behaviors when asking for help from peers or teachers, and hold higher self-concepts as learners of mathematics. Xenofontos and Mouroutsou (2023) conducted another systematic review focusing on resilience in mathematics education. They found that research on resilience has mainly centered on two conceptualizations: being resilient as achieving success despite disadvantage, or being resilient in terms of one's mathematical identity and learning disposition.

Substantial research has focused on validating instruments for mathematical resilience across diverse cultural and school contexts. Awofala (2021) confirmed the three factors of the mathematical resilience scale among Nigerian twelfth-grade students through a confirmatory factor analysis and found a significant relationship between the dimensions and mathematics performance. The Nigerian validation study found high reliabilities ($\alpha = 0.92$ for struggle, 0.88 for value, and 0.86 for growth) and provided evidence of the scale's robustness across African educational contexts. Johnston-Wilder et al. (2016) investigated the emergence of mathematical resilience through pedagogical interventions in further education. They found that targeted teaching techniques focused on growth mindset principles, normalized difficulty, and explicit value discussions significantly improved students' resilience in responding to mathematical challenges.

Links between math resilience and aspects of mathematics performance have been investigated empirically. Attami et al. (2020) explored the mathematical problem-solving capabilities of junior high school students based on their levels of mathematical resiliency, finding that students with high resilience employed more effective problem-solving strategies than peers with low resilience, demonstrated higher persistence in complex problems, and used advanced metacognitive processes more frequently. This study provides some evidence on the impact of resilience, showing that it affects not only students' achievement outcomes but also the quality of their mathematical thinking.

Relationship between attitude, resilience, and performance

The interrelationships among mathematics attitude, mathematical resilience, and academic performance represent a complex web of direct and indirect effects that have been explored through various methodological approaches. Pitsia et al. (2017) conducted a multilevel analysis of PISA data to examine how students' self-beliefs, motivation, and attitudes predict math achievement across countries. Their results indicated that attitudinal constructs, such as self-efficacy, anxiety, self-concept, and a general attitude toward mathematics, emerged as significant predictors of achievement, even after controlling for demographic variables and SES. The hierarchical nature of their analysis revealed that these effects are evident at both the individual and school level, with school-level attitudinal climates moderating individual-level relationships.

Gjicali and Lipnevich (2021) employed the theory of planned behavior to explain, both directly and indirectly, the impact of mathematics attitudes on performance using U.S. PISA data. They showed that attitudes affect performance both directly and indirectly through the mediation of intention and, subsequently, behavior. In particular, attitudes accounted for 21.1% of the variance in intentions to enter mathematics and, combined with intentions, predicted 59.4% of the variance in behavioral engagement (conceptualized as work ethic in learning mathematics). In a combined model, attitudinal constructs, intentions, and work ethic accounted for 30.7% of the variation in mathematics performance—an indication of the substantial predictive power of these non-cognitive predictors.

Recent work has started to explore the concerted effects of mathematics attitude and resilience, analyzing their relative and joint predictive usefulness. Fatimah et al. (2025) conducted a correlational study of

mathematical resilience, attitude, learning habits, and gender to predict students' interpretations. They found strong, positive relationships among resilience, attitudes, and performance; mathematical resilience accounted for 24.8% of the variance in mathematics achievement. Their results suggest that resilience and attitude, while related, are distinct constructs that may have different relationships to performance characteristics.

Recent scholars have investigated the role of other psychological constructs in mediating the relationship between attitude and resilience. Supervía et al. (2022) also examined the mediating role of self-efficacy in the linkages between resilience and students' achievement among adolescents, showing that, while there are multiple ways for their resilience to affect performance, some of the impact stems from resilient students having greater beliefs in their abilities. This mediation implies that resilience operates through two mechanisms: direct effects on persistence and indirect impact through cognitive perceptions of ability. Zheng et al. (2025) continued this line of research by investigating mediated relationships and found that math interest exerts its effects on achievement through a chain mediation process, first via self-control and then via resilience; thus, further revealing the intricate connections among different motivational and self-regulatory constructs.

Oszwa (2022) suggested that mathematical resilience is a holistic concept and that interventions focused on resilience should strive to fulfil students' fundamental human needs of autonomy, competence, and relatedness in learning mathematics. This model reframes resilience as more than a characteristic of the person and instead as an outcome of educational settings that consistently reinforce students' ability to engage productively with mathematical difficulty. Zanganeh et al. (2025) examined the role of mathematical self-efficacy in linking mathematics resilience and performance specifically for humanities students—a cohort typically typified by their avoidance of mathematics—and reported that self-esteem partly mediates the relationship between resilience and achievement, hinting that interventions designed to enhance resilience should adopt a particular focus on efficacy beliefs.

Philippine context and mathematics education

The Philippine educational context presents unique challenges and considerations for understanding the relationships among mathematics attitude, resilience, and performance. The program for international student assessment results have consistently revealed significant deficits in Filipino students' mathematics achievement relative to global benchmarks. The Department of Education (2019) reported that in PISA 2018, Filipino 15-year-olds achieved a mean mathematics literacy score of 353 points, substantially below the OECD average of 489 points, with more than 50% of students performing below level 2 (the baseline proficiency level). These results positioned the Philippines among the lowest-performing participants in mathematics, raising urgent questions about the factors contributing to such widespread underachievement.

Acido and Caballes (2024) conducted a comparative analysis of PISA results from 2018 and 2022, examining whether improvements had occurred and investigating correlations with the Philippines' human development index. Their study revealed that while marginal improvements were evident in some areas, mathematics performance remained critically low, with persistent disparities between public and private schools, urban and rural contexts, and different socioeconomic groups. This pattern of stratified achievement suggests that both individual psychological factors and contextual variables contribute to mathematics outcomes in complex ways.

Bernardo et al. (2022) employed machine learning approaches to contrast the profiles of low-performing mathematics students in Philippine public and private schools, revealing that distinct constellations of factors characterize underachievement in these contexts. In public schools, resource constraints, large class sizes, and limited instructional materials emerged as particularly salient, while in private schools, motivational factors and learning strategies were more discriminating. This research underscores the importance of considering contextual moderators when examining relationships between psychological factors and achievement, as the

mechanisms linking attitude and resilience to performance may operate differently under varying resource conditions.

Contemporary trends in Philippine mathematics education have emphasized the need for pedagogical innovations that address both cognitive and affective dimensions of learning. Luzano (2025) conducted a scoping review of quality learning practices in mathematics education, identifying contemporary trends such as technology integration, collaborative learning structures, and culturally responsive pedagogy as promising approaches for improving student outcomes. These innovations often implicitly target attitudinal and resilience-related factors by creating more engaging, supportive, and relevant mathematical learning experiences. Luzano (2024) further analyzed the multifaceted structures of mathematics education in the Philippines through case studies, revealing tensions between the centralized system and the specific challenges and issues in the Philippine education system. These are important to consider when examining the role of mathematics attitude, resilience, and achievement. Results of the Program for International Student Assessment have consistently reported that Filipino students lack proficiency in mathematics compared to their international counterparts. The Department of Education (2019) also reported that Filipino 15-year-old learners scored a mean of 353 points in mathematics literacy in PISA 2018, which was significantly below the OECD average of 489; more than half performed at or below level 2 (basic proficiency). These findings placed the Philippines among outlier countries with poor mathematics performance, prompting an inquiry into the causes of this pervasive underachievement.

Acido and Caballes (2024) subjected PISA results from 2018 and 2022 to comparative analysis, determined whether positive changes were noted, and explored if there were relationships with the human development index of the Philippines. According to their study, although there was some improvement, children's mathematics performance remains disastrously poor, with intergenerational imbalances across public and private schools, urban and rural areas, and household income groups. This stratification of achievement patterns supports the possible dual roles of individual psychological characteristics and context variables in mathematics competence: a phenomenon held together in different ways.

Bernardo et al. (2022) used machine learning methods to compare profiles of underachieving mathematics students from Philippine public and private schools, finding evidence that non-overlapping combinations of predictive factors have been identified as underachievement in these two groups. For public schools, resource constraints, class size, and inadequate instructional materials were highly salient; for private schools, motivational issues and learning strategies were more discriminating. This study highlights the importance of context-specific moderators in studies of psychological predictors and achievement, as the ways in which attitude and resilience are linked to performance may differ across contrasting resource environments.

Recent movements in Philippine mathematics education have called for innovations and pedagogical activities that couched both the cognitive and affective nature of learning. Luzano (2025) conducted a scoping review of quality practices in learning and teaching in mathematics education, highlighting recent trends such as technology, collaborative learning systems, and culturally responsive pedagogy as potential models for student achievement. In supporting student engagement and resilience, such innovations often target attitudinal and resilience-related variables by establishing more engaging, supportive, and relevant mathematical learning. Luzano (2024) also explored the complex structures of mathematics education in the Philippines by examining individual cases, which revealed tensions between centralized curriculum imperatives and local implementation constraints, especially in rural, under-resourced schools, where the localized adaptation of proscribed pedagogies to resource-endowed spaces is problematic.

The synthesis of international evidence on affective factors in mathematics learning, alongside Philippine-specific contextual considerations, highlights the following opportunities for empirical inquiry. Although considerable evidence has been provided that already shows the importance of mathematics attitude

and resilience for achievement across different international contexts, little is actually known about how these operate in Philippine educational settings, which are so rich in terms of their cultural values concerning education and family involvement with learning, characterized by specific resource constraints. In addition, there is a need to investigate the relative predictive power of attitude-resilience for students in the Philippines regarding their mathematics achievement, despite the practical implications this knowledge would provide for designing targeted interventions in resource-constrained settings where comprehensive educational reform might be challenging to establish. This study aims to bridge these gaps, explores the interrelationships of mathematics attitude and mathematical resilience performance among junior high school students in a rural Philippine school, and adds knowledge not only in international literature about affective factors in math learning but also provide context in locally relevant knowledge that can be utilized to inform educational practice and policy.

FINDING AND DISCUSSION

Level of Mathematics Attitude Among Junior High School Learners

Table 1. Descriptive Statistics for Mathematics Attitude by Grade Level and Factor

Grade Level	n	Overall MAS Mean (SD)	Factor 1: Motivation & Support	Factor 2: Anxiety (reversed)	Factor 3: Self-Efficacy	Factor 4: Teacher/Parent Influence	Interpretation
Grade 7	27	3.79 (0.71)	4.12 (0.62)	2.95 (0.84)	3.88 (0.76)	3.61 (0.73)	Positive
Grade 8	23	3.64 (0.63)	3.98 (0.58)	2.87 (0.79)	3.71 (0.69)	3.52 (0.67)	Positive
Grade 9	17	3.56 (0.69)	3.89 (0.65)	2.78 (0.86)	3.64 (0.74)	3.46 (0.71)	Positive
Grade 10	24	3.71 (0.58)	4.05 (0.55)	2.92 (0.76)	3.79 (0.68)	3.58 (0.65)	Positive
Overall	91	3.68 (0.64)	4.02 (0.58)	2.89 (0.81)	3.76 (0.72)	3.54 (0.69)	Positive

Note. MAS was measured on a 5-point Likert scale. Interpretation: 1.00-1.80=Very Negative, 1.81-2.60=Negative, 2.61-3.40=Neutral, 3.41-4.20=Positive, 4.21-5.00=Very Positive.

The overall attitude toward mathematics among the 91 junior high school students was positive ($M = 3.68$, $SD = 0.64$), indicating generally favorable attitudes toward mathematics. Students scored highest on Perceived Motivation and Support ($M = 4.02$, $SD = 0.58$), reflecting strong recognition of mathematics' value and appreciation for supportive learning environments, consistent with Facultad and Sebial's (2019) findings that Filipino students particularly value familial and instructional support. Perceived anxiety showed the lowest scores ($M = 2.89$, $SD = 0.81$), indicating moderate mathematics anxiety remains a concern, aligning with Alemany-Arrebola et al.'s (2025) observation that anxiety represents a significant barrier to achievement. Grade 7 students exhibited the highest attitudes ($M = 3.79$), with slight declines in Grades 8-9. This is consistent with a well-established international pattern in mathematics education research indicating that students' attitudes toward mathematics tend to decline as they progress through higher grade levels. Empirical evidence shows that while learners in the early grades often exhibit positive dispositions toward mathematics, these attitudes become less favorable during middle and secondary schooling, largely due to reduced enjoyment, increasing anxiety, and changing academic demands (Kılıç and Bölükbaş's, 2025; Mullis, et al., 2012)

Level of Mathematical Resilience Among Junior High School Learners

Table 2. Descriptive Statistics for Mathematical Resilience by Grade Level and Dimension

Grade Level	n	Overall MRS Mean (SD)	Value Dimension	Struggle Dimension	Growth Dimension	Interpretation
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Grade 7	27	3.06 (0.52)	3.42 (0.56)	2.95 (0.61)	2.81 (0.65)	High Resilience
Grade 8	23	2.87 (0.49)	3.31 (0.52)	2.84 (0.57)	2.64 (0.59)	High Resilience
Grade 9	17	2.85 (0.51)	3.28 (0.54)	2.81 (0.59)	2.58 (0.62)	High Resilience
Grade 10	24	2.95 (0.45)	3.37 (0.51)	2.91 (0.55)	2.71 (0.58)	High Resilience
Overall	91	2.94 (0.48)	3.35 (0.54)	2.89 (0.58)	2.68 (0.61)	High Resilience

Note. MRS was measured on a 4-point Likert scale. Growth dimension reverse-scored. Interpretation: 1.00-1.75=Low, 1.76-2.50=Moderate, 2.51-3.25=High, 3.26-4.00=Very High Resilience.

The results showed that students had a moderate to high level of mathematical resilience overall ($M = 2.94$, $SD = 0.48$), and that across all dimensions, students' highest scores were on the Value dimension ($M = 3.35$, $SD = 0.54$), indicating high levels of valuing for mathematics as important in terms of goals for future outcomes. In terms of means, the Struggle dimension ($M = 2.89$, $SD = 0.58$) depicts moderate normalization of struggle, and the Growth dimension ($M = 2.68$, $SD = 0.61$) indicates some students' continued belief in fixed mathematical ability, which resonates with Awofala's (2021) observation that developing a growth mindset is the most challenging resilience component to embrace fully. Grade 7 displayed maximal resilience ($M = 3.06$), declining slightly in Grades 8-9 and bouncing back in Grade 10, lending partial support to Lee and Johnston-Wilder's (2017) model of the developmental process of building resilience.

Level of Mathematics Performance Among Junior High School Learners

Table 3. Mathematics Performance (First Quarter Grades) by Grade Level

Grade Level	n	Mean Grade (SD)	Range	Performance Level Distribution
Grade 7	27	80.15 (6.91)	70-93	Below 75: 6 (22.2%); 75-79: 9 (33.3%); 80-84: 8 (29.6%); 85-89: 3 (11.1%); 90-100: 1 (3.7%)
Grade 8	23	79.70 (6.42)	70-93	Below 75: 5 (21.7%); 75-79: 9 (39.1%); 80-84: 6 (26.1%); 85-89: 3 (13.0%); 90-100: 0 (0%)
Grade 9	17	78.82 (7.01)	72-93	Below 75: 4 (23.5%); 75-79: 7 (41.2%); 80-84: 4 (23.5%); 85-89: 2 (11.8%); 90-100: 0 (0%)
Grade 10	24	79.21 (6.25)	71-91	Below 75: 8 (33.3%); 75-79: 7 (29.2%); 80-84: 6 (25.0%); 85-89: 2 (8.3%); 90-100: 1 (4.2%)
Overall	91	79.44 (6.58)	70-93	Below 75: 23 (25.3%); 75-79: 32 (35.2%); 80-84: 24 (26.4%); 85-89: 10 (11.0%); 90-100: 2 (2.2%)

Note. DepEd Classification: Below 75=Did Not Meet Expectations; 75-79=Fairly Satisfactory; 80-84=Satisfactory; 85-89=Very Satisfactory; 90-100=Outstanding.

The mean mathematics performance ($SD = 6.58$) was 79.44 and fell between "Fairly Satisfactory" and "Satisfactory". Although 74.7% of the students passed, performance was concentrated at lower levels, with only 13.2% attaining Very Satisfactory and Excellent grades. This follows the general pattern of poor performance in Philippine mathematics education, as reported by the Department of Education (2019), but still compares favorably with the national PISA average. Bernardo et al. (2022) noted that rural schools are particularly disadvantaged, so these findings are relatively positive, given the constraints they face. This is consistent with international studies showing that students in rural areas generally demonstrate lower or moderate mathematics achievement than their urban peers. Evidence indicates that while rural students may begin at similar levels, their academic growth is often slower, resulting in widening performance gaps over time. These outcomes are largely attributed to structural constraints such as limited resources, fewer qualified teachers, and socioeconomic challenges (Balang, 2026; Aquilina et al., 2024).

Relationship Between Mathematics Attitude and Mathematics Performance

The following table presents correlation results between mathematics attitude (overall and by factor) and performance.

Table 4. Pearson Correlations Between Mathematics Attitude and Performance

Variable	r	p-value	Interpretation
Overall Mathematics Attitude	.412**	< .001	Moderate positive correlation
Factor 1: Motivation & Support	.438**	< .001	Moderate positive correlation
Factor 2: Anxiety (reversed)	-.324**	0.002	Moderate negative correlation
Factor 3: Self-Efficacy	.397**	< .001	Moderate positive correlation
Factor 4: Teacher/Parent Influence	.286**	0.006	Small positive correlation

Note. N = 91. **p < .01. Effect size interpretation (Cohen, 1988): .10-.29=small, .30-.49=medium, .50-1.0=large.

A significant, moderate positive correlation exists between overall mathematics attitude and performance ($r = .412$, $p < .001$), indicating that students with more positive attitudes obtain higher grades. (Perceived Motivation and Support had the highest correlation ($r = .438$, $p < .001$), with a moderate negative correlation for anxiety ($r = -.324$, $p < .01$), such that higher anxiety is related to lower achievement. This result is consistent with Wang et al. (2022), who found that attitudes account for a significant portion of performance variance, and with Capuno et al. (2019), who conducted a national study in the Philippines and showed that anxiety and self-efficacy are salient factors across all values of test-anxiety items. Research in STEM education consistently finds that mathematics attitude is positively related to academic performance, although the strength of this relationship varies across contexts.

Relationship Between Mathematical Resilience and Mathematics Performance

Table 5 shows correlations between mathematical resilience and performance.

Table 5. Pearson Correlations Between Mathematical Resilience and Performance

Variable	r	p-value	Interpretation
Overall Mathematical Resilience	.456**	< .001	Moderate positive correlation
Value Dimension	.487**	< .001	Moderate positive correlation
Struggle Dimension	.368**	< .001	Moderate positive correlation
Growth Dimension	.291**	0.005	Small to moderate positive correlation

Note. N = 91. **p < .01.

Mathematical resilience demonstrated a significant moderate positive correlation with performance ($r = .456$, $p < .001$), slightly stronger than the relationship between attitude and performance. The strongest relationship was observed in the Value dimension ($r = .487$, $p < .001$), indicating that students who feel math is important receive higher grades, consistent with the results of Obribhador et al. (2023) and Vergara (2021). The stronger relationship compared to attitude is consistent with Lee and Johnston-Wilder's (2017) conceptualization, which holds that resilience measures active coping strategies rather than affective traits, and with Fatimah et al.'s (2025) results, which indicate that 24.8% of academic performance was attributed to resilience.

This aligns with existing research showing a significant positive relationship between mathematical resilience and mathematics performance. Studies consistently show that students with higher resilience are more likely to persevere through challenges, engage in problem-solving, and maintain effort, leading to better academic outcomes. Moreover, resilience functions not only as a direct predictor of achievement but also as a

mediating factor that translates motivation and self-beliefs into improved performance. This supports the present result that resilience plays a critical role in enhancing mathematics achievement, particularly in contexts where learners face academic and environmental challenges (Fatimah et al., 2025).

Comparative Predictive Power: Mathematics Attitude versus Mathematical Resilience

The following table presents the results of the hierarchical multiple regression analysis.

Table 6. Hierarchical Multiple Regression Analysis Predicting Mathematics Performance

Predictor	B	SE B	β	t	p	VIF
Mathematical Resilience	4.68	1.37	.342**	3.41	0.001	1.76
Mathematics Attitude	2.95	1.03	.287**	2.86	0.005	1.76

Note. N = 91. $R^2 = .263$, Adjusted $R^2 = .246$, $F(2, 88) = 15.73$, $p < .001$. ** $p < .01$.

The regression model was significant and accounted for 26.3% of the variance in performance shared between predictors (Adjusted $R^2 = .246$). Mathematical resilience was the stronger predictor ($\beta = .342$, $p = .001$) than mathematical attitude ($\beta = .287$, $p = .005$), but both entered uniquely and significantly. For each standard deviation increase in resilience, performance improves by 0.34 standard deviations, and for attitude, by 0.29 standard deviations, controlling for the other variable. When VIF values are less than 2.0, it can be considered that there is no multicollinearity issue.

The stronger predictive power of resilience has significant implications. Where attitude is an affective orientation, resilience includes active psychological processes such as coping and continued engagement in the face of adversity (Oszwa, 2022). Our results are consistent with the chain-mediation model proposed by Zheng et al. (2025), which posits that resilience is a more proximal predictor of achievement. In practical terms, such interventions are likely to be those which focus on the recognition of value, the normalization of struggle, and the development of a growth mindset—which were demonstrated by Johnston-Wilder et al. (2016)—may generate robust gains in rural Philippine schools with poverty of resources yet richness of psychological strengths.

The findings of this study align with international research demonstrating that both mathematics attitude and resilience are significant predictors of academic performance. Similar patterns have been reported in research from various educational systems where resilience is often a more robust predictor, owing to its role as a mechanism to sustain engagement in the face of adversity. The more prominent predictive power of resilience found in this study is in line with theoretical models positioning active coping and persistence as vital drivers of achievement. Yet, the importance of resilience in this rural setting might be related to the specific challenges faced by students in resource-scarce environments where external support is limited and internal psychological resources become critical. This suggests that the relationship between affective factors and performance is universally recognized but influenced by contextual factors, pointing to the importance of adaptive and context-sensitive educational interventions.

CONCLUSION

This study investigated the influence of mathematics attitude and mathematical resilience on the mathematics achievement of junior high school learners in a rural Philippine setting. Results indicated that both attitude and resilience significantly affected learners' mathematics achievement, with resilience being a stronger predictor of their performance. While learners generally exhibited fairly positive attitudes and resilience, their achievement levels were moderately satisfactory, suggesting a complex relationship between affective factors

and academic success. The results showed that mathematical resilience ($\beta = .342$) had a greater effect than attitude ($\beta = .287$) in predicting performance, accounting for 26.3% of the variance.

This research contributes to the theoretical development of mathematics education, providing further evidence for the cross-cultural universality of affective constructs. The results are consistent with international research, demonstrating that the relationships between attitude, resilience, and achievement are not confined to specific contexts but are comparable across different educational systems, including under-resourced rural areas. These findings add to the increasing global evidence that affective dimensions are crucial for learning mathematics. Importantly, the identification of resilience as a stronger predictor enhances the current understanding of how affective factors impact achievement, particularly in environments where learners encounter challenges related to structure and resources.

From an international STEM education perspective, the findings carry significant implications for both practice and policy. They suggest that strengthening students' psychological capacities—especially resilience—should be prioritized alongside cognitive skill development in mathematics curricula worldwide. In many education systems, particularly in developing and resource-limited contexts, large-scale infrastructure reforms remain slow and costly. This study demonstrates that resilience-oriented interventions—such as fostering growth mindsets, normalizing productive struggle, and reinforcing the perceived value of mathematics—offer a scalable and cost-effective pathway to improving student outcomes. These approaches align with global STEM priorities that emphasize not only knowledge acquisition but also adaptability, persistence, and problem-solving dispositions essential for 21st-century learning.

Furthermore, the results inform international policy discussions by highlighting the need to embed affective learning goals within STEM frameworks, teacher training, and curriculum standards. Integrating resilience-building pedagogies into everyday instruction can help mitigate declining student engagement and negative attitudes observed across grade levels worldwide. Ultimately, this study provides evidence that investing in students' affective competencies is not merely complementary but central to advancing equitable and sustainable mathematics achievement on a global scale.

LIMITATION & FURTHER RESEARCH

Several limitations warrant acknowledgment. First, the number of students (91) in one rural school was relatively small, making it difficult to generalize the findings to other contexts. The present study should be replicated within several schools in different geographical regions of the Philippines to see whether these relationships remain consistent across different resource areas. Second, given the cross-sectional design, relationships may exist at a single point in time, but whether these factors have a causal influence on achievement beyond existing levels could not be determined. Longitudinal investigations following students over multiple school years would provide insight into developmental trajectories and infer temporal precedence needed for making causal inferences. Third, mathematical attitude and resilience were measured via self-reports, which may be biased by social desirability. In subsequent work, researchers may triangulate self-report measures with behavioral observations, teacher ratings, or qualitative approaches to gain deeper insight into these constructs. Fourth, although the regression model accounted for 26.3% of the variance in performance, a large portion of the variance remains attributable to unmeasured factors (e.g., prior achievement, cognitive ability, quality of instruction, and socio-economic status) that should be explored in more complete models.

Nevertheless, the present evidence supports resiliency-oriented educational interventions in rural Filipino settings. Subsequent research should develop and evaluate, with methodological soundness, randomized controlled trial designs and resilience-building interventions suitably adapted for Philippine cultural settings to determine causal efficacy. There is also potential for culturally rooted theory building, as Philippine cultural values such as pakikipagkapwa, bayanihan, and tibay ng loob could influence mathematical

resilience in ways inadequately accounted for by Western constructs. Indigenous research methodologies might identify culturally bound expressions of mathematical resilience and possibly develop instruments that capture the lived realities of Filipino students, thereby contributing to international knowledge production and ensuring more culturally specific assessments in Philippine educational settings.

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