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THE MEDIATING EFFECT OF MATH RESILIENCE ON THE RELATIONSHIP BETWEEN MATH SELF-EFFICACY AND STUDENT ENGAGEMENT IN MATHEMATICS

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ABSTRACT

This study aims to determine whether math resilience significantly mediates the relationship between math self-efficacy and student engagement in mathematics among grade 8 junior high school students in Laak District, Division of Davao de Oro. This quantitative research utilized descriptive and correlational designs. There were 293 respondents identified through stratified random sampling. Moreover, this study employed three adapted research instruments validated and treated using mean, standard deviation, Pearson-r, regression analysis, and bootstrapping. The findings revealed high levels of math self-efficacy, student engagement, and math resilience among the grade 8 respondents. The results also showed a significant relationship between math self-efficacy and student engagement in math. Math resilience also positively correlates with student engagement in math. The results also revealed a significant relationship between math self-efficacy and math resilience. Moreover, the findings indicate that math resilience partially mediates the relationship between math self-efficacy and student engagement in math. These results encourage educators and administrators to develop and broaden programs and interventions to improve math self-efficacy, math resilience, and student engagement in math. Furthermore, it is essential to replicate the study in various contexts and locales to validate the findings of this research and provide a more profound knowledge of these variables on a broader scale.

KEYWORDS: *Math resilience, math self-efficacy, student engagement in math, descriptive and correlational designs, regression analysis, bootstrapping, Davao de Oro, Philippines.*

BACKGROUND OF THE STUDY

The lack of student engagement has been identified as a problem in many classrooms worldwide (Urias, 2022). In mathematics classes, engaging students has been an ongoing problem (Joshi et al., 2022). The engagement of students is an essential factor in understanding how students behave during the teaching-learning process (Delfino, 2019). Additionally, teachers have difficulties engaging students in mathematical learning (Abu-Hilal & Abed, 2019). Moreover, problems with students' disengagement in mathematics are increasing, which is an important issue since a lack of engagement may jeopardize students' mathematical proficiency and performance (Cevikbas & Kaiser, 2022). Furthermore, school officials reported that more students have grown less active, have a weakened sense of societal connection, and feel disengaged from their studies (Karlson, 2021).

Cevikbas and Kaiser (2022) stated that as learners progress from elementary to secondary school, many of them become disengaged in mathematics. Indeed, Collie et al. (2019) mentioned that the issue is particularly prevalent in Australia; nevertheless, it has also been discovered in other nations such as the United States, France, and Finland. Additionally, between 40 and 60 percent of high school students in America exhibit chronic disengagement, as seen by their lack of effort, inattentiveness, and complaints of boredom (Holquist et al., 2020). Similarly, according to a recent Grattan Institute report in Australia, 40% of students are disengaged from learning, and an additional concern for schools is the growing number of disengaged students who are not enrolled, have low school attendance, and exhibit behavioral problems leading to suspension. Furthermore, in a study on mathematics learning engagement conducted in China, more than half of the 317 respondents claimed that they are not actively involved in preparation before class, discussions in the classroom, or even after class recovery (Lijie et al., 2020). In addition, the research revealed that a few learners have limited classroom involvement and are not particularly interested in mathematics learning. Furthermore, Joshi et al. (2022) stated that student engagement in mathematics has long been a problem in Nepal. Finally, the Programme for International Student Assessment (PISA) outcomes have informed East Asian countries and regions, especially Taiwan, that it is urgent to address issues concerning students' affective and cognitive engagement in mathematics learning (Lin et al., 2018).

According to a survey in the Philippines, student absenteeism is a problem in over 40% of schools (Trinidad, 2020), a warning sign of disengagement (Osher & Schanfield, 2019).

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Additionally, according to Lacson (2020), the recommended academic ease of the Department of Education is grounded in the reality that students are getting disengaged from their educational learning. Llego (2021) also mentioned that the country has had reports of student disengagement from learning for a long time. Moreover, a study conducted in Cotabato implies a need to increase student engagement to improve teaching and learning performance (Tan & Gumban, 2019). Furthermore, low student engagement is evident in most schools, and it can be observed during math class discussions that there is an increasing population of passive learners (Zantua & Lapinid, 2018). Yabo (2020) further stated that students are usually sleepy, inattentive, and disengaged during mathematics discussions in the country.

Moreover, according to Deluao and Deluao (2018), the frequency of absences incurred by students in a year at a certain school in Davao is typically between 2 and 10, with an average of 50%. Additionally, according to Dodongan (2022), the belief that mathematics is a challenging subject complicates the scenario in the mathematics system of learning. He also stated that the students show no interest and are unwilling to learn about the subject, as evidenced by his study conducted in Davao de Oro, which revealed low levels of student participation. Further, only a few students engaged in mathematics learning, which was observed during discussions. Students were inattentive and refused to participate in class activities, as recorded in the Learning Action Cell (LAC) agenda and minutes.

Furthermore, the researcher has come across literature indicating that the problems mentioned above can be brought about by math self-efficacy and math resilience; hence, the researcher decided to consider these variables in the study. Moreover, math self-efficacy associated with math engagement has been studied by Sun et al. (2020) and Ozkal (2019); however, the former respondents were Chinese students while the latter were Turkish. Similar studies were also conducted on student engagement in mathematics, but in the flipped mathematics classroom context (Cevikbas & Kaiser, 2022; Lo & Hew, 2021). Additionally, Fitri et al. (2019) only focused on improving mathematical resilience in high school students. Further, the researcher has not encountered research similar to the current proposed study that was conducted in the locality, specifically on the mediating effect of math resilience on the relationship between math self-efficacy and student engagement in math, particularly among grade 8 junior high school students.

Student engagement is vital for learning since it is associated with several favorable results, such as lower dropout rates (Terrenghi et al., 2019; Abín et al., 2020). Disengaged students are less inclined to study and develop the skills required for success (Pagan, 2018). For that reason, in addition to the current research gap with other studies conducted in different settings, it is necessary to conduct the study in Laak District, Division of Davao de Oro. Moreover, the results of this research will benefit students, instructors, parents, school administrators, DepEd officials, and future researchers. The students will be the primary beneficiaries of the interventions, programs, and activities focusing on student engagement in math that the teachers and DepEd officials will develop and implement. Also, this study will help math teachers focus more on creating fun, enjoyable, and meaningful classroom activities that engage students in the subject.

Most importantly, the results will be the basis for intervention in the problem of student engagement in the subject and serve as a guide for upcoming researchers. Furthermore, the results will be disseminated in LAC sessions of mathematics teachers and during local, regional, or national research forums. Finally, the researcher looks forward to publishing this study as a broader means of disseminating the findings.

STATEMENT OF THE PROBLEM

This research aimed to determine whether math resilience significantly mediates the relationship between math self-efficacy and student engagement in mathematics among grade 8 junior high school students in Laak District, Division of Davao de Oro.

Specifically, this sought answers to the following questions:

1. What is the level of math self-efficacy of students in terms of:
    1.1. mastery experience;
    1.2. vicarious experience;
    1.3. social persuasions; and
    1.4. physiological state?
2. What is the level of student engagement in mathematics in terms of:
    2.1. cognitive engagement;
    2.2. behavioral engagement; and
    2.3. affective engagement?
3. What is the level of math resilience of students in terms of:
    3.1. value;
    3.2. struggle; and
    3.3. growth?
4. Is there a significant relationship between math self-efficacy and student engagement in mathematics?
5. Is there a significant relationship between math resilience and student engagement in mathematics?
6. Is there a significant relationship between math self-efficacy and math resilience?
7. Does math resilience significantly mediate the relationship between math self-efficacy and student engagement in mathematics?

METHODOLOGY

RESEARCH DESIGN

This quantitative, non-experimental research utilized descriptive and correlational designs since the researcher would seek to gather and interpret numerical data on the mediating effect of math resilience on the relationship between math self-efficacy and student engagement in mathematics without manipulating the variables. Specifically, a descriptive approach will be utilized since the study intends to describe the current level of math self-efficacy, student engagement in math, and math resilience in terms of their indicators. Moreover, this study will also utilize the correlational approach to assess the statistical relationship between math self-efficacy and student engagement in mathematics, math resilience and student

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engagement in mathematics, and math self-efficacy and math resilience. Furthermore, the study will examine the role of math resilience as a mediator of math self-efficacy in influencing student engagement in math.

STATISTICAL TREATMENT OF DATA

The following statistical tools were used for the data to provide a more thorough interpretation.

Mean. It is the mathematical average of a set of two or more numbers. This statistical tool was utilized to calculate the extent of students' math self-efficacy, student engagement in math, and math resilience.

Standard Deviation. It gauges the dispersion of a dataset in reference to the mean. This tool was utilized for measuring the scores' degree of dispersion or proximity to the mean.

Pearson r. It gauges the direction and intensity of the connections between two variables. This data analysis tool was utilized to determine if a significant relationship exists between math self-efficacy and student engagement in math, math resilience and student engagement in math, self-efficacy in math, and math resilience.

Regression Analysis. It is a statistical technique utilized to evaluate the relationship between two or more variables and how they affect each other. This tool was used to identify if there are relationships between the independent variables and the dependent variable.

Bootstrapping. The bootstrap test is the most advanced technique for testing the indirect effect in mediation models since its distribution is typically asymmetric. This tool was utilized to determine the mediating effect of math resilience on the relationship between math self-efficacy and student engagement in math.

RESEARCH RESPONDENTS

The respondents of this study are the grade 8 junior high school students of four public schools in Laak District, Division of Davao de Oro, enrolled during the school year 2023-2024 under the face-to-face learning modality. Specifically, two schools are from the Laak North District, and two are from the Laak South District. These schools are purposefully chosen according to the Brigada Eskwela school category, which is based on the number of teachers in each school, to come up with a reliable number of samples. One school was chosen from the mega-large category, another from the large category, and the remaining two from the medium category.

The researcher utilized the Raosoft sample size calculator with a 95% confidence level and a 5% margin of error in determining respondents' sample size. Based on the computation, from a total population of 1229 grade 8 students, the sample size consisted of 293 respondents. Additionally, the researcher employed stratified random sampling to guarantee that respondents will be distributed evenly across all schools. The procedure provided 139 samples from School A, 77 samples from School B, 50 samples from School C, and 27 samples from School D, for a total sample of 293. Respondents in each school were identified through simple random sampling. Moreover, the respondents were recruited through a printed letter given directly to individual participants in person with the help of the school gatekeepers. Furthermore, the researcher ensured that parental consents were obtained for the voluntary participation of the research respondents in this study.

RESULTS AND DISCUSSION

The following are the results of the study.

Table 1
Summary on the Level of Math Self-efficacy of Students

Indicators	Mean	SD	Description
Mastery Experience	3.59	0.72	High
Vicarious Experience	4.07	0.74	High
Social Persuasions	3.29	0.95	Moderate
Physiological State	3.07	0.95	Moderate
Over-all Mean	**3.50**	**0.56**	**High**

The overall mean for this variable is 3.50, which has a high descriptive equivalent and indicates that learners' self-efficacy in math is evident. The calculated standard deviation of 0.56 reveals that most of the responses are centered around the mean. This result implies that most respondents have given responses that are similar to each other. This also means that the respondents have similar levels of math self-efficacy. This indicates that the students strongly believe in their own potential to face and surpass math difficulties. They have confidence in their skills to solve specific math problems successfully. Additionally, it implies that these students with high self-efficacy in math tend to be the ones who succeed, accomplish tasks, and do well in math challenges.

This finding varies with most prior research findings, indicating that students' math self-efficacy was moderate. According to Awofala's (2023) research, learners' self-efficacy views in math result from a combination of high and low mastery and vicarious experience, social persuasion, and physiological state. Mendi and Eamoraphan (2020) also found a moderate degree of learners' math self-efficacy among their respondents. The findings also show that, on average, the students believed in and were confident in their self-efficacy in the subject (Batiibwe et al., 2020). Furthermore, unlike learners with poor mathematics self-efficacy, learners with high mathematics self-efficacy complete mathematical tasks more precisely and quickly (Arifin et al., 2021).

Table 2
Summary of the Level of Student Engagement in Mathematics

Indicators	Mean	SD	Description
Cognitive Engagement	4.16	0.59	High
Behavioural Engagement	4.28	0.71	Very High
Affective Engagement	3.76	0.50	High
Over-all Mean	**4.07**	**0.53**	**High**

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In conclusion, this indicator's overall mean is 4.07, which is described as high and implies that student engagement in mathematics is observed. The low standard deviation of 0.53 demonstrates that most respondents provide consistent answers. This means that the respondents have similar levels of student engagement in math. This also means that the students demonstrated active engagement in mathematics by actively participating in class discussions and showing concentrated attention throughout instructional sessions. Additionally, attending math classes and solving challenging math problems brings them joy. Moreover, they skillfully create connections between mathematical ideas, facts, and their usefulness in actual situations.

The findings of Baranova et al. (2019) align with this finding that the students have high student engagement in math. When learners enjoy mathematics, recognize the value of classroom instruction and its application to their current and future lives, and find connections between the mathematical concepts they learn in the classroom, they are engaged with mathematics (Attard and Holmes, 2020). Ozkal (2019) also supports this finding that engaged students try to finish their tasks by internalizing them through greater effort and caution.

Table 3
Summary of the Level of Math Resilience of Students

Indicators	Mean	SD	Description
Value	4.39	0.71	Very High
Struggle	4.31	0.74	Very High
Growth	3.32	0.76	Moderate
Over-all Mean	**4.01**	**0.60**	**High**

Additionally, a high description and an overall mean of 4.01 for math resilience reveal that students' math resilience is manifested. The data responses are clustered around the mean, as indicated by the standard deviation 0.60. This implies that students learn mathematics with a positive mindset that enables them to overcome any challenges in the subject. Their mindset reflects growth, and they grasp the concept of struggle. Additionally, they have confidence in their ability to tackle mathematical tasks and recognize the value of seeking help when necessary.

The summary reveals that students have a high level of math resilience, which is consistent with the study of Amelia et al. (2020). Even under unfavorable circumstances, students have shown strong mathematical resilience by ensuring the success of the mathematics learning process (Agustin et al., 2022). Furthermore, students with high mathematical resilience exhibit an optimistic approach to their mathematics learning, enabling them to overcome challenging problems confidently. Conversely, students with low mathematical resilience may feel anxious and disappointed when faced with mathematical problems, ultimately failing to solve the given problem (Rohmah et al., 2020).

Table 4
Significant Relationship Between Math Self-Efficacy and Student Engagement in Mathematics

Independent Variables	Student Engagement in Mathematics		
	r	p-value	Remarks
Math Self-Efficacy	.608	0.000	Significant

The relationship between math self-efficacy and student engagement in mathematics is presented in Table 4. It shows that there is a significant positive correlation between math self-efficacy and student engagement in mathematics ($p<0.05$). This means that the null hypothesis is rejected. The r-value of .608 indicates a moderate positive correlation between math self-efficacy and student engagement in mathematics. This means that when the math self-efficacy among Grade 8 students is high, student engagement in mathematics is also high. Conversely, when math self-efficacy is low, student engagement in mathematics is also low.

The results are consistent with the research of Salvan and Frias (2021), which found a strong correlation between students' mathematical self-efficacy and their student engagement in mathematics. Additionally, the Ozkal (2019) study showed that students' strong self-efficacy increased student engagement in the mathematics classroom and reduced dissatisfaction. Furthermore, Zakariya et al. (2019) discovered that learners with greater self-efficacy engage more in tasks.

Table 5
Significant Relationship Between Math Resilience and Student Engagement in Mathematics

Independent Variables	Student Engagement in Mathematics		
	r	p-value	Remarks
Math Resilience	.716	0.000	Significant

Table 5 shows the relationship between math resilience and student engagement in mathematics. It shows a significant positive correlation between math resilience and student engagement in mathematics ($p<0.05$). Hence, the null hypothesis is rejected. The r-value of .716 indicates a highly positive correlation between math resilience and student engagement in mathematics. This means that when math resilience among Grade 8 students is high, student engagement in mathematics is also high. Conversely, student engagement in math is also low when math resilience is low.

The results corroborate the discovery of Rokhmah et al. (2019), who found that learners with strong mathematical resilience engage more in mathematics. Additionally, Reshma (2022) found that mathematical resilience allows students to persevere in their mathematical learning in the face of difficulties and setbacks. Reshma (2022) also mentioned that mathematical resilience aims to encourage engagement and perseverance in mathematics.

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Table 6
Significant Relationship Between Math Self-Efficacy and Math Resilience

Independent Variables	Math Resilience		
	r	p-value	Remarks
Math Self-Efficacy	.620	0.000	Significant

Table 6 displays the findings on the correlation between math self-efficacy and math resilience. The table shows a significant positive correlation between math self-efficacy and math resilience ($p<0.05$). This implies that the null hypothesis is rejected. The r-value of .620 indicates a moderate positive correlation between math self-efficacy and math resilience. This means that when math self-efficacy among Grade 8 students is high, math resilience is also high. Conversely, when math self-efficacy is low, math resilience is also low.

The findings are similar to the results obtained by Bron (2022), who investigated the correlation between math self-efficacy and math resilience and discovered a significant positive relationship, showing that learners with greater levels of math self-efficacy also have high levels of math resilience. The findings are also consistent with the research conducted by Hay et al. (2022), who found that students' learning depends on their mathematical self-efficacy beliefs since they influence how resilient the students would be to a mathematical task or challenge.

Table 7
Regression Weights, Standardized Total Effects, and Indirect Effects

Variables	Estimate	S.E	C.R.	Total Effect	p-value	Indirect effect	p-value
Student engagement in math ←Self-efficacy in math	0.66	0.049	13.51	0.578	0.001	0.324	0.001
Math resilience ←Self-efficacy in math	0.254	0.047	5.378	0.66	0.001		
Student engagement in math ←Math resilience	0.491	0.044	11.072	0.491	0.002		

In summary, there is a significant total effect of the independent variable on the mediator variable; a significant total effect of the mediator variable on the dependent variable; and the direct effect and indirect effect of the independent variable on the dependent variable are both significant; thus, there exists a partial type of mediation in this study. This means that math resilience partially mediates the relationship between math self-efficacy and student engagement in math. This also means that math self-efficacy directly influences student engagement in math without math resilience, and math self-efficacy also indirectly influences student engagement in math through math resilience. More specifically, the findings indicate that students' math self-efficacy with regard to mastery and vicarious experience, social persuasion, and physiological states directly influences student engagement in math in terms of cognitive, behavioral, and affective engagement. Moreover, students' math self-efficacy also indirectly influences student engagement in math through students' math resilience in terms of value, struggle, and growth.

The results corroborate the findings of Zakariya (2022), indicating that student's engagement with math tasks is determined by their level of self-efficacy in math. They engage in activities that they sense they can do and avoid activities that they sense are beyond their scope of expertise. Emmett et al. (2013) also asserted that students with low self-efficacy get disengaged from learning math. Moreover, to encourage our students' engagement with mathematics, Trueman (2002) states that we must help them develop math resilience. Further, resilient learners in mathematics engage to mitigate the danger of dropping out of the subject area, according to Khumalo et al. (2022). Furthermore, mathematical resilience enables students to develop into mathematical thinkers, which provokes their willingness to engage with mathematics (Soebagyo et al., 2021).

RECOMMENDATIONS

The following suggestions are made in light of the data and conclusions presented.

1. Conduct orientations for teachers, parents, and students about how positive feedback, appreciation for efforts and achievements, and support and encouragement can help increase students' math self-efficacy. Social persuasion is important for the students to believe in their ability to do mathematical tasks, which helps them develop the essential skills required to succeed in mathematics.
2. Conduct specialized training for teachers, specifically mathematics teachers, about teaching techniques, approaches, and methods that reinforce positive classroom environments to prevent or minimize stressful classroom situations. Utilization of math manipulatives such as puzzles, games, and other psychomotor activities can also be incorporated during mathematics classroom

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instruction to encourage students' positive physical and emotional perceptions and responses to the subject.

3. Organize seminars for teachers on effective teaching strategies, including strategic intervention materials and other methods that make mathematical topics easier for students to understand, including problem-solving. If the students understand the topic discussed with them, even if they are not good at math, it will help them develop resilience in mathematics.
4. Future researchers may investigate the results of this study to develop methods, interventions, and programs aimed at improving student engagement in math as well as their math self-efficacy and math resilience. They could also use this study as a reference for undertaking a similar study in a new context or setting.

CONCLUSIONS

Based on the findings of this study, the following conclusions were drawn.

1. Math self-efficacy is high among Grade 8 students.
2. Student engagement in math is high among Grade 8 students.
3. Math resilience is high among Grade 8 students.
4. A significant and moderately positive relationship exists between math self-efficacy and student engagement in math among grade 8 students. Thus, the higher the student's math self-efficacy, the more they are engaged in math.
5. A significant and highly positive relationship exists between math resilience and student engagement in math. Thus, the higher the math resilience of the students, the higher their engagement in math.
6. A significant and moderately positive relationship exists between math self-efficacy and resilience. Thus, the student's math self-efficacy is high, and their math resilience is also high.
7. Math resilience partially mediates the relationship between math self-efficacy and student engagement in math.

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