Problem Solving Abilities and Anxiety on Students' Mathematical Resiliency

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ABSTRACT

This study aimed to examine the problem-solving abilities and anxiety influence the mathematical resilience of Grade 8 students at Apyao National High School during the academic year 2023-2024. The study focused on the problem-solving abilities and anxiety on students' mathematical resiliency. The students' problem-solving abilities were assessed using Polya's problem-solving steps, such as understanding the problem, devising a plan, carrying out the plan, and looking back. It is important to note that the information gathered in this study are limited to this specific group of students. The study aimed to determine the relationship between problem-solving skills, anxiety, and mathematical resilience, which refers to the ability to persevere, adapt, and succeed in mathematical tasks despite challenges or setbacks. By examining the students' self-perceived levels of mathematical anxiety and their problem-solving abilities, valuable insights were gained regarding the factors that contribute to mathematical resilience. However, generalizing these findings to other student populations or educational settings should be done cautiously due to the limited scope of the study.

Keywords: Problem-solving Abilities, Anxiety, Mathematical Resilience

INTRODUCTION

Mathematical resiliency is the ability to maintain a positive attitude and persevere in the face of mathematical challenges and anxiety. It is an essential skill for students to develop in order to succeed in mathematics and beyond (Johnston-Wilder et al, 2014). In the learning process, some students may have some unpleasant but inevitable experiences. Students have experienced failure and times of difficulties in the learning process. The experience is certainly irreversible, but its negative effects can be reduced or even eliminated by developing resilient learning abilities (Hutauruk & Priatna, 2017). The importance of recognizing that resilience is not a fixed trait but can be developed. Some students exhibit low mathematical resilience through behaviors like acting out when facing challenging concepts or perceiving math as pointless. (Bosman & Heck, 2022).

Polya's problem-solving method emphasizes the importance of understanding the problem, devising a plan, carrying out the plan, and looking back to ensure the correctness of the solution. By following these steps, students can develop their problem-solving skills and become more confident in their ability to solve mathematical problems. Despite the efforts of teachers to make math easy, student performance in the subject is still a significant concern in education. The Trends in International Mathematics and Science Study (TIMMSS) assessment in 2019 showed that the Philippines ranked last among 58 countries that took the test. In math specifically, only 19% of the Filipino students were on the Low Benchmark, while 81% still needed to reach this lowest level on the scale (Magsambol, 2020). This report is consistent with the Department of Education's (DepEd) National Achievement Test (NAT) results, in which the Mean Percentage Score in Mathematics was 48.63%, below the 50 percent requirement of DepEd. Some factors could affect the student's performance—the need for mastery of basic math skills and problem-solving techniques. Students' attitudes, teachers' competence, and pedagogies also contribute to students' performance.

Mathematics anxiety is a prevalent issue that affects many learners, impeding their mathematical thinking and

progress, and creating distress or a tendency to avoid mathematical thinking. High levels of mathematics anxiety can hinder individual mathematical progress, which is crucial for economic recovery. Mathematical resilience is a concept that can work against anxiety and for mathematical progress. It involves the development of resilience to manage emotions, including anxiety, and improve progress and uptake in mathematics. Problem-solving skills are crucial for developing mathematical resiliency. However, anxiety can hinder the development of these skills, leading to a vicious cycle of anxiety, poor problem-solving skills, and decreased mathematical resiliency. Therefore, it is essential to investigate the relationship between problem-solving skills and anxiety in the context of mathematical resiliency. (Windall, J. et.al., 2020)

According to the study of Fitriani et al. (2023) about "Mathematical Resilience and Mathematical Problem-Solving Ability in Junior High School", students with high mathematical resilience are able to overcome obstacles and negative situations related to the problem-solving process because they can successfully coach themselves. Mathematical resilience is negatively correlated with mathematics anxiety, indicating that higher mathematical resilience is associated with lower levels of mathematics anxiety. Additionally, the study found that mathematics support engagement is positively correlated with mathematical resilience, suggesting that providing mathematics support can help build mathematical resilience and reduce mathematics anxiety. Dilla et al. (2018) found that mathematical resiliency is an important soft skill that shows the quality of mathematics learning attitudes, including hard work, perseverance, willingness to discuss, reflect, and research. Isnawan et al. (2022) found that individual and environmental factors, such as supportive teachers and a conducive learning environment, can protect students from traumatic experiences that interfere with their mathematical resiliency.

Mathematical resiliency, which involves maintaining a positive attitude and persevering in the face of challenges and anxiety, is crucial for students' success in mathematics. Factors such as mastery of basic math skills, problem-solving techniques, attitudes, teacher competence, and pedagogies all contribute to students' performance. By investigating the relationship between problem-solving skills and anxiety, we can develop interventions and strategies to enhance students' mathematical resiliency, reduce anxiety levels, and promote better mathematical outcomes. Moreover, previous studies have shown that mathematical resilience is associated with lower levels of anxiety and that supportive teachers and conducive learning environments can foster students' resilience.

Statement of the Problem

1. What is the level of students’ problem-solving abilities in terms of

    a. understand the problem;
    b. devise a plan;
    c. carryout the plan; and
    d. look back?

2. What is the level of students’ mathematical anxiety in terms of

    a. appraisal towards external stimulus;
    b. arousal;
    c. face expression; and
    d. action tendencies?

3. What is the level of students’ mathematical resiliency in terms of

    a. value;
    b. struggle;
    c. growth; and
    d. resilience?

4. What relationship exist between students’ mathematical resiliency and

    a. problem solving abilities; and

b. mathematics anxiety?

5. Which variables singly or in combination best predicts students' mathematical resiliency?

METHODS

This study utilized the descriptive-correlation research design to examine problem solving abilities and anxiety on students' mathematical resiliency. The participants were given a 35-item multiple choice test and survey questionnaires.

DISCUSSION

Data gathered for this study is presented in this section. The order of presentation is based on the order of specific problems in the statement of the problem.

Table I Students' Level of Problem-Solving Skills

Polya's Steps in Problem Solving	F	Mean Percent	Qualitative Interpretation
Understand the problem	95.56	52.22	Poor
Devise a plan	57.89	31.63	Very Poor
Carry out the plan	75.11	41.04	Very Poor
Look back	70.38	38.46	Very Poor
Mean	74.74	40.84	Very Poor

Legend:

Scores	Qualitative Interpretation
87.51 – 100	Very Good
75.01 – 87.50	Good
62.51 – 75.00	Fair
50.01 – 62.50	Poor
50.00 and below	Very Poor

The highest frequency in the table 1 is 95.56, which is understanding the problem with mean percentage of 52.22 with a qualitative interpretation "poor" suggesting that the overall performance in understanding the problem was not satisfactory. The lowest frequency is devising a plan which is 57.89. The mean percentage is 31.63, which is "very poor" highlighting the significant difficulty students faced in formulating a plan for problem-solving.

Overall, when considering the mean percentage across all four steps, which is 40.84, the performance of students in their problem-solving skills is categorized as "very poor." This suggests that students encountered difficulties throughout the problem-solving process, from understanding the problem to devising a plan, carrying out the plan, and looking back. The findings indicate a need for improvement in students' problem-solving skills.

Johnson et al. (2018) emphasizes the critical role of understanding the problem and devising a plan, echoing the challenges. The research underscores the significance of providing adequate support to help students overcome obstacles in these crucial stages. A study conducted by Smith and Brown (2020) examines the relationship between metacognitive skills and problem-solving performance among students. The findings reveal that students with higher metacognitive awareness tend to perform better in all stages of problem-solving, including

planning and reflection. This study aligns with the notion that enhancing students' problem-solving skills requires a focus on metacognitive strategies. Research by Lee and Chang (2019) investigates the effectiveness of educational interventions aimed at enhancing students' problem-solving abilities. The study emphasizes the need for targeted interventions that address specific challenges students face, such as difficulties in formulating plans. By providing tailored support and guidance, educators can help students navigate the problem-solving process more effectively.

Table II Students' Level of Mathematics Anxiety

Mathematics Anxiety	Mean	Qualitative Interpretation
Appraisal Towards External Stimulus	2.34	Anxious
Arousal	2.43	Anxious
Facial Expression	2.59	Anxious
Action Tendencies	2.99	Anxious
Overall Mean	2.59	Anxious

Legend:

Scale	Mean Range	Qualitative Description	Qualitative Interpretation
1	1.00 – 1.80	Strongly Agree	Highly Anxious
2	1.81 – 2.60	Agree	Anxious
3	2.61 – 3.40	Neutral	Moderately Anxious
4	3.41 – 4.20	Disagree	Less Anxious
5	4.21 – 5.00	Strongly Disagree	Not Anxious

Table 2 displays the overall mean of 2.59 and described as "Anxious." It also shows that the sub-factor action tendencies got the highest mean value of 2.99 described as "Anxious." On the other hand, the lowest mean value is the sub-factor appraisal towards external stimulus which is 2.34 described as "Anxious." This means when students experience mathematics anxiety, they may exhibit certain action tendencies like skipping class, finished the exams faster, etc. Students exhibit significant anxiety-driven behaviors when faced with mathematical challenges. This would inform teachers as well as parents that recognizing these tendencies can help them develop strategies to support students in managing their anxiety and creating a more conducive learning environment for mathematics.

The results support the study of Ablian, J. and Parangat, K. (2021) where students with mathematics anxiety tend to keep silent during math class because they are afraid to be asked by the teacher. They avoid recitations during math class because they feel uneasy performing mathematics calculations. When students get worried about answering difficult questions, they avoid mathematics in their modules at the earliest.

Table III Students' Level of Mathematical Resiliency

Mathematical Resiliency	Mean	Qualitative Interpretation
Value	4.54	Above average resilience
Struggle	4.78	Above average resilience
Growth	4.08	Average resilience
Resilience	4.57	Above average resilience
Overall Mean	4.49	Above average resilience

Legend:

Scale	Mean Range	Qualitative Description	Qualitative Interpretation
1	1.00-1.85	Completely Disagree	Very low resilience
2	1.86 – 2.71	Disagree	Low resilience
3	2.72 – 3.57	Slightly Disagree	Below average resilience
4	3.58 – 4.43	Neutral	Average resilience
5	4.44 – 5.29	Slightly Agree	Above average resilience
6	5.30 – 6.15	Agree	High resilience
7	6.16 – 7.00	Completely Agree	Very high resilience

Table 3 shows the overall mean of 4.49 and described as "Above average resilience." It also shows that the indicator struggle got the highest mean value of 4.78 described as "above average resilience." On the other hand, the lowest mean value is the indicator growth which is 4.08 described as "average resilience."

In contradiction of the study of Hutauruk and Priatna (2017) states that the highest mean goes to indicator value followed by struggle, growth, and resilience. Students with a high level of mathematics resilience have more remarkable persistence in learning mathematics in the face of adversity. In contrast, students' low-level resilience would reduce persistence despite adversity. Students have a very high level of value to mathematics. Student with high-value levels perceive mathematics as an essential tool in achieving their current and future goals according to Kooken, J., Welsh, M., McCoach, D., Johnston-Wilder, S. and Lee, C. (2015). Thus, the majority of the students believe that mathematics valuable subject and is worth studying.

Table IV Relationship between Students' Problem-Solving Skills and Mathematics Anxiety towards Mathematical Resiliency

Indicators	Correlation Coefficient (r)	Probability
PROBLEM SOLVING SKILLS	.155	.036*
Understand the problem	.163	.028*
Devise a plan	.025	.741
Carry out the plan	.185	.012*
Look back	.083	.263
MATHEMATICS ANXIETY	-.107	.149
Appraisal Towards External Stimulus	-.299	.000**
Arousal	-.125	.092
Face Expression	-.071	.338
Action Tendencies	-.060	.417
*. Correlation is significant at the 0.05 level (2-tailed).		
**. Correlation is significant at the 0.01 level (2-tailed).		

Table 4 shows that appraisal towards external stimulus have highly significant relationship with mathematical resiliency. A negative correlation coefficient of -0.299 at 0.01 level of significance indicates that higher resilience is associated with lower anxiety levels in terms of appraisal towards external stimulus. Mathematics anxiety in terms of appraisal towards external stimulus is correlated with mathematical resiliency. This suggests that how students perceive and evaluate external factors related to mathematics can have a meaningful impact

on their experience of anxiety. Understanding the problem, and carrying out the plan are significant at 0.05 level of significance. The result implies that problem solving abilities in terms of understanding the problem, and carrying out the plan is correlated with mathematical resiliency.

A study by Johnston-Wilder, Brindley and Dent (2014) of primary and secondary school students showed evidence that students with high levels of resilience could handle stressful situations efficiently and were less likely to experience mathematical anxiety. Therefore, the results of the present study are consistent with previous studies in the academic field. In this sense, students' successive experiences in academic contexts and the challenges they have faced are key to building resilience. Thus, the more resilient students are, the better they will be able to manage their anxiety in the face of a new academic challenge. The results of Trigueros, Parra, Mercader, Campoy, and Carrion (2020) study which have shown evidence that academic resilience and mathematical anxiety were negatively correlated. Similarly, a study conducted by Trigueros, Padilla, Aguilar-Parra, Rocamora, Morales-Gázquez and López-Liria (2020) with university students showed that students with high levels of resilience felt less anxiety when faced with an exam. The study of Attami, Budiyono, and Indriati (2020) investigated the relationship between mathematical resilience and problem-solving abilities among junior high school students, revealing a significant positive correlation between mathematical resilience and students' problem-solving abilities. This study emphasized the impact of positive responses to learning mathematics, emotion regulation, curiosity, and optimism in mathematical resilience beliefs on problem-solving abilities.

Table V Regression Analysis of Students' Problem-Solving Skills and Anxiety on Mathematical Resiliency

Variables	**Unstandardized Coefficients (B)**	**Std. Error**	**Standardized Coefficients (Beta)**	**t**	**Sig.**
(Constant)	5.282	0.294	—	17.977	0
Appraisal Towards External Stimulus	-0.428	0.107	-0.283	-4.007	0
Carry Out the Plan	0.621	0.283	0.155	2.193	0.03
R = 0.337 **R²** = 0.113 **F** = 11.507 **Sig.** = 0.000					

$$Y = 5.282 - 0.428X_1 + 0.621X_2$$

where:

Y = students' mathematical resilience

X = variables

X_1 = Appraisal Towards External Stimulus

X_2 = Carry Out the Plan

The stepwise multiple regression analysis in finding the best predictor of the Grade 8 Students' Mathematical resilience at Apyao National High School. Grade 8 students were influenced by the independent variables included in the regression analysis. Appraisal towards external stimulus and carry out the plan were found to be significant predictors of the students' mathematical resilience. Students' mathematical resilience is listed in the following beta weight: appraisal towards external stimulus (β = -0.283) and carry out the plan (β = 0.155). The R-squared value of 0.113 suggests that the combined influence of the independent variables. This indicates that 11.3% of grade 8 students' mathematical resilience was explained by the predictor of appraisal towards external stimulus, and carry out the plan. Hence, there are other factors not included in the analysis that also contribute to students' resilience in mathematics which is 89.7%.

The findings are supported by study by Hernandez-Martinez and Williams (2013) found that "resilience in

mathematics students in transition" was related to how students appraised their previous math experiences. Appraisals of previous math experiences play an important role in mathematical resilience. Mathematical resilience, which includes positiveness response to learning mathematics, emotion regulation, curiosity and optimism, is positively correlated with and contributes to students' mathematical problem-solving ability (Moala, J. & Hunter, R., 2021). This result indicates the "positiveness response to learning mathematics, emotion regulation, curiosity and optimism in mathematical resilience beliefs were associated with mathematical problem-solving ability." Additionally, the results of the study of Santosa, A., Maison, and Huda, N. (2023) suggest that "mathematical problem-solving ability requires students to have self-resilience because in solving problems, a person needs to have confidence in his ability to face problems." This indicates that the ability to carry out the plan when solving mathematical problems is a significant predictor of mathematical resilience.

CONCLUSION

Grade 8 students' problem-solving abilities is categorized as "very poor." Thus, students encountered difficulties throughout the problem-solving process, from understanding the problem to devising a plan, carrying out the plan, and looking back. Also, students' mathematics anxiety is described as anxious. Students experience mathematics anxiety, they may exhibit certain action tendencies like skipping class, finished the exams faster, etc. Students exhibit significant anxiety-driven behaviors when faced with mathematical challenges. Students' mathematical resilience is above average resilience. This means that students are mathematically resilient to surpass difficulties.

Moreover, problem solving abilities in terms of understanding the problem and carrying out the plan is significant to mathematical resiliency. This means the lower their problem-solving abilities, the lower their level of mathematical resiliency. Mathematics anxiety in terms of appraisal towards external stimulus is highly significant. This implies that the higher resilience is associated with lower anxiety levels in terms of appraisal towards external stimulus.

Lastly, regression analysis showed that appraisal towards external stimulus and carrying out the plan are the two variables which predict students' mathematical resilience. The regression model is $Y = 5.282 - 0.428X_1 + 0.621X_2$, where Y = students' mathematical resilience, X = variables, X_1 = Appraisal Towards External Stimulus and X_2 = Carry Out the Plan.

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