*Original Research Article*

The Mediating Effect of Study Habits on the Relationship Between Math Anxiety and Problem-Solving Skills of Grade 10 Mathematics Students in Philippines

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ABSTRACT

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| Math anxiety has affected the learning of many learners by blocking their mathematical problem-solving abilities. Students continue to believe that problem-solving is more difficult despite not being able to do so, only to find that they exert less effort in developing these skills. This study aimed to determine whether study habits significantly mediate the relationship between math anxiety and problem-solving of grade 10 mathematics students in the Division of Davao Oriental. A descriptive-correlational research design with mediation analysis was used. The respondents of this research were 224 Grade 10 learners from five public secondary high schools in Governor Generoso South District. Stratified random sampling was utilized. This study used two adapted questionnaires – Math Anxiety Scale developed by Erol (1989) as utilized by Olmez and Olmez (2019), and Study Habits Questionnaire adapted from Sakirudeen and Sanni (2017) – and one researcher-made questionnaire. Mean, Standard Deviation, Pearson r and Sobel’s z-test were used as statistical tools. The data was stored in encrypted digital files and kept in a locked cabinet for physical documents, accessible only to the researcher. Findings were analyzed using licensed statistical software and interpreted based on the study's objectives. Study findings revealed students’ math anxiety as moderately evident, their study habits as highly observed, and poor problem-solving skills. However, the results of the study showed no significant relationships in any pair of variables. Moreover, the results conclude that study habits do not significantly mediate the relationship between math anxiety and problem-solving skills. The researcher recommends that students focus on developing their problem-solving skills, rather than prioritizing extracurricular activities, and use their online and offline resources for their studies. Likewise, teachers must also encourage their learners to engage during class discussions and activities. Further, it is recommended that further research investigating other variables related to students' problem-solving skills as a function of their level of math anxiety and study habits be conducted. |

***Keywords****: Mathematics learning, problem-solving skills, math anxiety, mediation analysis, Sobel’s z-test,*

1. INTRODUCTION

For years, problem-solving skills have been shown to be essential to academic success, especially in disciplines like mathematics that require critical thinking and analytical abilities (Rusczyk, 2021). However, it remains unclear why learners remain uncomfortable and uneasy when performing mathematical procedures and solving math problems despite all the efforts to improve teaching strategies (Formentera, 2020). Additionally, students continue to believe that problem-solving is more difficult despite not being able to do so, only to find that they exert less effort in developing these skills (Ozturk et al., 2020). Moreover, observation of students with poor study habits shows that they are less likely to comprehend the concepts and techniques for problem-solving since they do not have the skills needed (Fitriani et al., 2018). These circumstances have been observed worldwide in mathematical learning journeys. Mathematics serves as the backbone in the advancement of modern science and technology. It is a basic subject taught globally in primary and secondary school education. The secondary school level mathematics curriculum includes arithmetic, algebra, geometry, statistics, trigonometry, mensuration and probability; all are interconnected to each other. Algebra is the basic field of mathematics, which is regarded as the language of mathematics that uses letters, symbols, and numbers in problem-solving (Lin et al., 2023; Hermano and Hinoguin, 2025).

Globally, math anxiety has affected the learning of many learners by blocking their mathematical problem-solving abilities. The report on the 2022 Programme for International Student Assessment (PISA) shows that many countries in Southeast Asia struggle with lower math proficiency, as they obtained scores below the Organization for Economic Cooperation and Development (OECD) average of 472. However, Singapore and Japan bested other Asian countries as shown in their math performance with an average score far above the OECD average (OECD, 2022). Also, the OECD added that most education systems with the lowest self-efficacy levels show the highest math anxiety levels, including countries such as Cambodia, the Philippines, and Malaysia. Meanwhile, the qualitative study of Mokhtar et al. (2019) shows that most of the students interviewed in Malaysia struggle to grasp the keywords and often cannot translate them into the appropriate mathematical expressions breaking the first step in problem-solving skills. Furthermore, another qualitative research study revealed that the 28 students interviewed in Indonesia were not particularly interested in reading math problems or practicing their mathematical skills. They struggled with solving math problems, assigning the correct values to units, and recognizing the symbols used for counting operations (Sakilah et al., 2018).

The 2022 PISA result for the Philippines shows a dismal bottom ranking at 77th out of 81 countries (Congress of the Philippines, 2024). This means that our country is still not proficient in problem-solving skills in mathematics, with only 30.4% fluent, the second lowest among Southeast Asian countries (OECD, 2023). This is because the Philippines belongs to nations with the highest math anxiety levels among 15-year-old students (Atienza, 2024). For the record, the math anxiety level among Filipino students who joined the 2022 PISA is at 65% which led them to poor performance (De La Cruz, 2024). Lanzona in Atienza (2024) believes anxiety in mathematics stems from inappropriate preparation, together with the inability to relate math to reality, making it merely a conceptual subject. Meanwhile, the study by Behiga (2022) concludes that the National Achievement Test (NAT) result is undesirable and shows poor problem-solving skills since the implementing the K-12 curriculum. For example, the national Mean Percentage Score (MPS) in 2023-2024 was only 34.05%, the lowest among the subject areas, specifically the problem-solving category, 35.16%, having the same descriptive interpretation of Low Proficiency level (Department of Education, 2024). In Caraga region, grade 10 learners who took the 2023 NAT assessment showed improved problem-solving skills by 43.31 percent from 43.08 percent in 2020 (Lopez, 2024). Although the increase is significant, the description is still under the low proficiency level, which can be interpreted that students can strategize to solve problems, differentiate, and consolidate given data (Department of Education, 2024).

In Davao Region, the regional MPS of the grade 12 students in the most recent NAT is only 33.16%, which means low proficiency. Moreover, the Davao Oriental Division reached the highest percentage in NAT, 39.98%, however, it belongs to the same interpretation. Specifically, this division also got the highest rating, 42.65%, among all other divisions in the Davao region, still in the same description (Department of Education, 2024). One of the main factors that accounts for low performance in math is the poor problem-solving skills generally tested during standardized tests (Formentera, 2020). Meanwhile, in Governor Generoso South District, the proficiency level of all learners in mathematics in 2023-2024 is only 63.10% among grade 10 learners, the lowest percentage among all learning areas, interpreted as nearly proficient. The study could benefit students and teachers, especially in dealing with the engagement of students in mathematics. This study could improve how students engage in the classroom by improving their learning strategies and study habits, given that study habits and learning strategies may play a vital role in student engagement. The study has relevance in both society and the community because it may serve as a foundation for future trainings and policies that are required to develop students' study habits and learning strategies for the purpose of increasing students' engagement in mathematics (Grande and Edig, 2024).

The research results can be a reference in crafting policies, programs, interventions, and remediations for learning processes in mathematics. Besides, this research is relevant to the community as it encourages the learners to learn mathematics, influencing their daily dealings in numbers, for instance, in business, projects, problem-solving, and decision-making. The results of this research can be a reference for further research to be used in other studies relating to challenges faced by learners in understanding mathematics specifically in dealing with math anxiety, promoting study habits, and developing problem-solving skills.

* 1. **Objectives**

The study aimed to determine whether study habits significantly mediate the relationship between math anxiety and problem-solving skills of grade 10 students in the secondary schools of Governor Generoso South District, Division of Davao Oriental in the school year 2024-2025. Specifically, this study sought answers to the questions that follow:

1. What is the extent of math anxiety of students in terms of:

1.1 test and evaluation anxiety;

1.2 apprehension of Math lessons;

1.3 use of mathematics in daily life; and

1.4 self-efficacy for Math?

2. What is the level of the problem-solving skills of grade 10 students based on test scores?

3. What is the level of study habits of students in terms of:

3.1 note taking;

3.2 use of library; and

3.3 time allocation to study?

4. Is there a significant relationship between:

4.1 math anxiety and problem-solving skills of grade 10 students?

4.2 math anxiety and study habits?

4.3 study habits and problem-solving skills of grade 10 students?

5. Do study habits significantly mediate the relationship between math anxiety and problem-solving skills of grade 10 students?

* 1. **Conceptual Framework**

Figure 1 shows the conceptual paradigm of the study in which the relationship of the variables is visualized. The independent variable is math anxiety which has four (4) indicators, namely: test and evaluation anxiety, apprehension of math lessons, use of mathematics in daily life, and self-efficacy for math. Further, the dependent variable is evaluated through test scores using an instrument designed to measure its four indicators, such as: understanding the problem, planning, implementing the plan, and looking back at the process. Furthermore, the mediator variable is the study habits which has three (3) indicators, namely: note taking, use of library, and time allocation to study.

**PROBLEM-SOLVING SKILLS**

* Test Scores

**Dependent Variable**

**Independent Variable**

**MATH ANXIETY**

* Test and Evaluation Anxiety
* Apprehension of Math Lessons
* Use of Mathematics in Daily Life
* Self-Efficacy for Math

**Mediating Variable**

**Mediating Variable**

**STUDY HABITS**

* Note taking
* Use of library
* Time allocation to study

Figure 1. The Conceptual Paradigm of the Study

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* 1. **Theoretical Framework**

This study is anchored on the proposition of Karasel et al., cited by Formentera (2020), highlighting the connection between math anxiety and problem-solving skills. Karasel et al. (2010) claimed that math anxiety and problem-solving skills have a significantly inverse correlation, which means that math anxiety leads them to be unable to find the solution. This claim is supported by the study of Rusyda et al. (2021), concluding that the higher the math anxiety of the students, the lower the ability to develop problem-solving skills. Moreover, Habibah (2023) also concluded in his study that math anxiety greatly influenced problem-solving skills, emphasizing the negative correlation between the two variables indicating that as the students’ math anxiety level is high, their problem-solving skills become low.

This study is also anchored to the claim that there is a deep connection between math anxiety and students’ study habits (Fernandez et al., 2021). According to their research, students with math anxiety tend to avoid studying due to their fear of the subject. This is supported by the study of Weir (2023), which shows that math anxiety drives students to avoid studying, thus interfering with their learning. These claims are theorized as the Cognitive Load Theory (Sweller, 1988) which explains that overloaded memory, such as loading the mind with too many cognitive, psychological, and emotional concerns, can affect students’ learning. When the anxiety level increases, the students struggle to focus on their studies, making it harder to engage in effective study habits to understand new concepts or practice solving math problems (Williams, 2023).

This study is also anchored to the idea that regular and consistent study periods lead to developing problem-solving skills (Rendiza & Andrada, 2023). This idea is supported by the concept that the more often we practice something, the better we become at it based on the principle of Thorndike’s Law of Exercise (1911). Students who consistently engage in regular study periods are more likely to develop effective study habits and improve their problem-solving skills (Castillo et al., 2023). Moreover, studies show that the learner’s poor study habits are to be blamed for their low problem-solving skills (Fitriani et al., 2018). Also, the development of effective problem-solving skills can be significantly influenced by students' study habits in which regular and organized study techniques help students contribute to better retention of information and improved performance in mathematics (Aljaffer et al., 2024).

2. material and methods

2.1 Research Design

This study employed a quantitative research method, utilizing descriptive and correlational design with mediation analysis. Quantitative research, as defined by Creswell and Creswell (2017), uses objective assessments and evaluation of the findings utilizing its appropriate statistical tool. It focuses on gathering numerical data through surveys, test scores, questionnaires with quantifiable responses, and the like. Also, Adao et al. (2015) define the quantitative method as a research method where data can be quantified by transforming it into numbers. Likewise, this study employed a descriptive research approach which required gathering, analyzing, classifying, and tabulating data about timely circumstances, practices, and tendencies before providing an adequate and exact explanation of such data using statistical tools (Frey, 2018). Using this approach for the context of this research, the researcher examined and described the existing phenomenon utilizing the adapted research questionnaires that required descriptive statistics to understand why the problem exists in the locale. Further, it also aimed to collect numerical and quantifiable data and information that were tested and analyzed using statistical analysis.

**2.2 Research Respondents**

The respondents of this research were the Grade 10 students from five public secondary schools of Governor Generoso South District, Division of Davao Oriental, in the school year 2024-2025. The other three schools in the district were newly opened institutions that did not have enrollees in Grade 10 for this school year. Hence, the five schools were selected. There were 533 officially enrolled grade 10 students in the district for this school year. Thus, using the Raosoft sample size calculator set with a 0.05 margin of error, the sample respondents of this study were 224 grade 10 students.

**2.3 Research Instruments**

This study used two adapted research tools and one researcher-made tool. The two adapted tools were Math Anxiety Scale (MANX) as utilized by Olmez and Olmez (2019) was used to measure the level of students’ math anxiety, and Study Habits Questionnaire (SHQ) adapted from Sakirudeen and Sanni (2017) was used to measure the extent of the students’ study habits. These instruments were assessed for validity and reliability and pilot-tested on 40 students in Grade 10 who were not taking part as study respondents but had the same characteristics and attributes as respondents.

MANX was composed of 45 items in total, comprising 17 items for apprehension in mathematics containing 17 items, 17 items for test and evaluation anxiety, 7 items for the use of mathematics in daily life, and 4 questions for self-efficacy in math (Erol, 1989). The Cronbach’s alpha value of MANX after the pilot test was 0.72, showing acceptable test items; hence, this questionnaire was used for the survey. The respondents were requested to rate each item on a 5-point Likert scale ranging from 5 for “Always” to 1 for “Never”.

On the other hand, SHQ consisted of 15 items in total. Indicators such as note taking consisted of 5 items, use of library comprised 5 questions, and time allocation to study had 5 items to be answered. Considering a good reliability coefficient of Cronbach’s alpha value at 0.84 after the pilot testing, the instrument was used to measure this variable. The respondents were requested to rate each item on a 5-point Likert scale ranging from 5 for “Strongly Agree” to 1 for “Strongly Disagree”.

The third questionnaire was a researcher-made questionnaire following Polya’s problem-solving method to contextualize the questions based on the 3rd quarter competencies in Grade 10 Mathematics. This was used to measure the level of problem-solving skills of the Grade 10 students and was based on the Most Essential Learning Competencies (MELCs) in the 3rd Quarter of the same grade level. The test had 5 problems where students were asked to apply Polya’s steps in solving problems, such as understanding the problem, planning, implementing the plan, and looking back at the process. After the pilot testing, the questionnaire was used in the survey with an acceptable reliability score of 0.71.

**2.4 Data Gathering**

Prior to conducting this research study, the protocol was submitted to the Research Ethics Committee (REC) of St. Mary’s College of Tagum, Inc. for a thorough ethics review to ensure the technical and ethical soundness of the study. Once approved, an SMCTI-REC Clearance for Implementation were issued, granting official authorization to proceed. Following this, an endorsement letter signed by the Dean of Graduate Education were secured. The letter of permission to conduct the study was forwarded to the Schools’ Division Superintendent of the Division of Davao Oriental. The approved official letter from the superintendent was attached to request permission from the public school district supervisor and principals or school heads of the selected five secondary schools in the Governor Generoso South District where the study took place.

The recruitment process involved directly reaching out to prospective respondents through their school administrators and teachers. Information about the study was disseminated through printed letters handed personally to respondents and their parents. A formal orientation session was conducted before seeking consent, allowing respondents and their parents to fully understand the study’s purpose, procedures, potential risks, and benefits. Parental Informed Consent Forms were distributed first, followed by the Informed Assent Forms for the respondents since they are minors. During the orientation, the researcher thoroughly explained the contents of these forms and provided opportunities for questions and clarifications. As proof of voluntary participation, all consent and assent forms were signed and submitted before any data collection began.

To ensure security and effective administration of the questionnaire, respondents completed the survey in a private and controlled setting on the agreed-upon date. As the questionnaire was administered face-to-face, the researcher was available to provide clarifications when needed. Each respondent discreetly completed the survey, ensuring their responses remain confidential. The entire survey process lasted for one hour. When the respondents completed the survey, the researcher immediately collected and reviewed the questionnaires to ensure completeness.

Collected data were carefully reviewed and encoded while maintaining strict confidentiality. Personal information such as name, age, and sex will be collected solely for demographic profiling and data analysis purposes, ensuring that all responses remain anonymous in the final reports. The data was stored in encrypted digital files and kept in a locked cabinet for physical documents, accessible only to the researcher. Findings were analyzed using licensed statistical software and interpreted based on the study's objectives. The compiled data was submitted to the REC and other regulatory bodies for verification upon request while adhering to data privacy protocols. After the study's conclusion, all data were archived for three years, digital files would be permanently deleted, and physical copies will be securely shredded to prevent unauthorized access, use, or disclosure.

**2.5 Statistical Analysis**

The statistical tools below were used to make this research more comprehensive in its interpretation and data analysis.

**2.5.1 Mean**

This determined the level of math anxiety, study habits, and students’ problem-solving skills.

**2.5.2 Standard Deviation**

This was used to measure the dispersion of the dataset from its mean. This was presented alongside the mean and used to determine the degree of proximity of the mean scores.

**2.5.3 Pearson r**

This was utilized to determine the correlation between math anxiety and students’ problem-solving skills.

**2.5.4 Mediation Analysis using Sobel’s z-test**

This was used to determine the mediating effect of study habits on the relationship between math anxiety and students’ problem-solving skills considering the sample for the research.

3. results and discussion

3.1 The Extent of Math Anxiety of Grade 10 Mathematics Students

Table 1 summarizes the extent of students’ math anxiety. As observed in the table, the indicator with the highest mean score is test and evaluation anxiety, which obtained 3.22 with a descriptive equivalent of moderately extensive and SD of 1.14. Meanwhile, the least mean among the four is self-efficacy for math, with a rating of 2.82, described as moderately extensive, and an SD of 1.04.

It is observable that the descriptive equivalent of all indicators is moderately extensive. The overall mean for the extent of math anxiety of students is 2.98, with a descriptive equivalent of moderately extensive. This indicates that math anxiety among grade 10 students is sometimes evident. Moreover, the measure of variability among the indicators is moderate, with the standard deviation of 1.12, which is higher than 1.0, indicating a spread of the data that is not so close to the mean. This implies that the math anxiety of the students is heterogenous by nature and shows diverse experiences among students.

**Table 1. The Extent of Math Anxiety of Grade 10 Mathematics Students**

|  |  |  |  |
| --- | --- | --- | --- |
| **Indicators** | **Mean** | **SD** | **Descriptive Equivalent** |
| Test and Evaluation Anxiety | 3.22 | 1.14 | Moderately Extensive |
| Apprehension of Math Lessons | 2.98 | 1.15 | Moderately Extensive |
| Use of Mathematics in Daily Life | 2.89 | 1.16 | Moderately Extensive |
| Self-efficacy for Math | 2.82 | 1.04 | Moderately Extensive |
| **Overall Mean** | **2.98** | **1.12** | **Moderately Extensive** |

Since the overall mean for math anxiety is described as moderately extensive, this implies that the level of math anxiety of the students is not high enough to experience severe anxiety in mathematics. However, it is also not low enough to suggest a comfortable or relaxed attitude towards mathematics. It simply implies a noticeable worry or unease among the grade 10 students in mathematics. Moreover, math anxiety among students can be triggered by various aspects such as listening to explanations, looking at the formulas, working on problems independently, participating in class discussions, being called upon to answer questions, and taking quizzes or tests.

The results relate to the statement of Santos et al. (2019), which posited that most secondary students are neither confident enough nor very scared in mathematics. However, it cannot be denied that they still feel anxiety, as shown by the result. It means that there are still possibilities for them to be uninterested in mathematics as soon as their anxiety increases. Additionally, Rada and Lucietto (2022) added that this can result in a lack of self-esteem and confidence, issues with memory and focus, difficulties in solving simple problems, and a fear of failing. Further, math anxiety can result in a lack of confidence, a fear of failing, and a sense of powerlessness, making students feel overburdened and causing them to put off doing their math homework (Taleyarkhan et al., 2021).

**3.2 The Level of Problem-Solving Skills of Grade 10 Mathematics Students**

Table 2 shows the level of problem-solving skills of grade 10 students based on test scores. The mean score for problem-solving skills is 6.10 out of 50 points, which is very low. This indicates that the students’ problem-solving skills are poor. The standard deviation of this variable is 3.81, which means that the scores are spread out away from the mean. This implies that there is heterogeneity among students’ responses and they widely vary from the common response.

The result shows that the students demonstrated limited ability to effectively tackle the problems presented in the test. This very low score signifies that the grade 10 students cannot perform effective problem-solving skills in the tested area. They have difficulties understanding the problem since they can hardly interpret the situation, gather information, or visualize the scenario. They also have difficulties analyzing, planning, and strategizing to solve the problem. Most students wrote only a few details about the given problem or a formula that they think is useful for solving, while others skipped this part of the test. Although some tried to solve the problems, their solutions can be described as weak or inaccurate since they have no concrete plan or formula to solve the problem. However, the students who tried solving the test did not review their process. Moreover, this very low score results in a lack of foundational knowledge or skills necessary for problem-solving in the test questionnaire provided. They have missed key concepts, procedures, or understanding required to begin solving the problem. The result suggests that the students have difficulty developing their problem-solving skills necessary to solve problems in real-life scenarios.

**Table 2. The Level of Problem-Solving Skills of Grade 10 Mathematics Students**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Mean Score** | **SD** | **Descriptive Equivalent** |
| Problem-solving Skills | 6.10 | 3.81 | Very Low |

The finding shown in the table confirms the study of Ghofur et al. (2023) with 67.93% of their research respondents having poor problem-solving skills. Also, the study of Tan (2020) portrayed student’s poor abilities in problem-solving through inability to use appropriate techniques, lack of necessary knowledge and processes needed in solving mathematics problems, misinterpreting and misrepresenting the problem, and inability to combine logical and innovative thinking. Moreover, many students today are still struggling with problem-solving skills, considering various factors that may affect them (Formentera, 2020). Some studies also suggest that students with poor problem-solving skills struggle to relate their knowledge of mathematics and face difficulties in understanding and applying problem-solving strategies (Chirimbana et al., 2022; Pentang et al., 2024).

**3.3 The Level of Study Habits of Grade 10 Mathematics Students**

Table 3 summarizes the students’ level of study habits. Among the three indicators, note taking obtained the highest mean score of 3.80 with its descriptive equivalent of high. It is followed by the time allocation to study, which obtained a 3.39 mean score, then followed by use of library with a mean of 3.12, both with the descriptive equivalent of moderate.

The overall mean for the level of study habits of the students is 3.44, which can be described as high, meaning the students’ study habits are highly observed. The standard deviation for this variable is 1.11, indicating the wide dispersion of the data that is not close to the mean.

Students with highly observed study habits typically engage in regular and sustained effort in their learning. They established routines for studying, employing study techniques that support their learning, and taking academic responsibilities seriously.

**Table 3. The Level of Study Habits of Grade 10 Mathematics Students**

|  |  |  |  |
| --- | --- | --- | --- |
| **Indicators** | **Mean** | **SD** | **Descriptive Equivalent** |
| Notetaking | 3.80 | 1.03 | High |
| Use of Library | 3.12 | 1.16 | Moderate |
| Time Allocation to Study | 3.39 | 1.15 | Moderate |
| **Overall Mean** | **3.44** | **1.11** | **High** |

From the study of Rendiza and Andrada (2023), students also acquired high extent of study habits, which basically means they maintain good study routines. Additionally, Dainur et al. (2020) highlighted the critical indicators for study habits such as regular study sessions, preparation for classes, and creating conducive learning environments. Moreover, Fergina et al. (2024) emphasized the importance of time management as an enhancer of study habits. This claim is supported by the study of Magulod (2019) at Cagayan State University which revealed that students manifested good study habits and skills in time management, concentration, note taking, reading comprehension, test preparation, and managing test anxiety.

**3.4 Significance of the Relationship Between the Variables**

Presented in Table 4 is the computed data on the relationship between math anxiety and problem-solving skills, math anxiety and study habits, and study habits and problem-solving skills.

The table shows that the relationship between math anxiety and problem-solving skills has an r-value of -0.043, and a p-value of 0.543; between math anxiety and study habits, the r-value is 0.001, and the p-value is 0.989; and between study habits and problem-solving skills, the r-value is 0.096, and the p-value is 0.172. For all pairs of variables correlated, it is observed that their respective p-values are higher than the significance level of 0.05, which implies that there are no significant relationships between them. Therefore, the null hypotheses are accepted.

**Table 4. Significance of the Relationship Between the Variables**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables Correlated** | **r** | **p-value** | **Decision on Ho** | **Decision on Relationship** |
| Math Anxiety &  Problem-solving Skills | -0.043 | 0.543 | Do not reject | Not Significant |
| Math Anxiety &  Study Habits | 0.001 | 0.989 | Do not reject | Not Significant |
| Study Habits &  Problem-solving Skills | 0.096 | 0.172 | Do not reject | Not Significant |

This result on math anxiety and problem-solving skills conforms to the local study of Formentera (2020), in which her study concluded no significant relationship between these variables. It means that math anxiety cannot affect the development of a student’s problem-solving skills. Additionally, Ching (2019) stressed that students’ problem-solving skills are unaffected by their negative feelings. It implies that being anxious in mathematics does not lead to the improvement of a student’s mathematical skill in problem-solving. This could further mean that other variables have a stronger relationship with problem-solving skills.

While some studies suggest connections between math anxiety and study habits, the result of this research contradicts most of them. This contradiction is supported by the study of Luu-Thi et al. (2021) stating that math anxiety does not directly link to study habits. The results of their study suggest that students experiencing math anxiety to a moderate extent does not affect their study habits. This further shows that there are other factors that affect their connection, such as learning styles or self-efficacy (Milovanović, 2020). Moreover, the study of Gurang and Guhao (2024) concluded that moderate level of math anxiety barely allows students to pursuit learning due to their discomfort of doing so. This indicates that math anxiety has no effect towards study habits (Zakaria & Nordin, 2008).

Moreover, the result is parallel to the study of Enerosa and Abuzo (2024) in which they concluded that study habits and problem-solving skills have no significant relationship at all. Also, the result of this study supports the claim of Chin and Lin (2018) where they found no significant relationship between the two variables. They also suggest that study habits do not hold responsible when the problem-solving skills of the learners do not improve. It indicates that some other factors hinder their learning like intrinsic motivation and critical thinking training. Additionally, David et al. (2024) supported that academic skills can be improved with the help of study habits, but not necessarily mean it can enhance problem-solving skills. Problem-solving skills can be developed with consistent mental exercise and religious study habits.

**3.5 The Mediating Effect of Study Habits on the Relationship Between Math Anxiety and Problem-Solving Skills of Grade 10 Mathematics Students**

Table 5 displays the mediation analysis to determine whether study habits mediate the relationship between math anxiety and problem-solving skills. One of the hypotheses stated that math anxiety affects the problem-solving skills of the students. Moreover, it was hypothesized that study habits would mediate the relationship of the two variables.

Before treating the data with statistical tools, the assumptions were checked and ensured to be met. There are three datasets for this research and the dataset per variable is independent to each other. There are 204 observations which are large enough for quantitative data analysis. Moreover, independent and dependent variables have a linear relationship. Also, the p-value is greater than 0.05, meaning the assumption is met. Using collinearity diagnostics as another test, it shows none among the variance proportions results are greater than 0.7, thus the assumption for multicollinearity is met. Further, the variance of the residuals remains constant across all levels of the independent variables. This means that the spread of the residuals does not increase or decrease with the predicted values. Lastly, there are 20 potential extreme outliers which strongly suggest removal, so assumption is met. Since the assumptions are all met, the data are treated by multi-regression analysis.

Moreover, step 1 in table 5 shows path C, math anxiety and problem-solving skills, having an unstandardized Beta value of -0.354, standard error of 0.580, and the p-value of 0.543, which is higher than the level of significance. It implies in this path that there is no significant relationship between math anxiety and problem-solving skills. Parallel to the study of Deleg et al. (2019), this result holds true that math anxiety negatively affects students’ problem-solving skills. The result is also supported by the study of Dela Cruz et al. (2022) stating that math anxiety is not a contributory factor for developing problem-solving skills.

Meanwhile, step 2 shows path B, study habits and problem-solving skills, with an unstandardized Beta value of 0.582, standard error of 0.424, and p-value of 0.172, which is higher than the significance level. It suggests that better study habits may improve problem-solving skills, but the relationship shows no significance. Enerosa and Abuzo (2024) further explained that strong study habits might focus on merely reading and memorization rather than the practice of solving a problem, tending to evade the opportunity to tackle harder questions focusing on the development of problem-solving skills. Additionally, study habits can, at some point, improve a student’s learning skills, except for problem-solving. Students must consider taking the harder questions while studying and use their technological aids to help them understand the problem and solve it. Training their minds with challenges is to take care of their developmental growth which is basically getting confidence in dealing with harder questions (Kazemi et al., 2022).

**Table 5. The Mediating Effect of Study Habits on Math Anxiety and Problem-solving Skills of Grade 10 Students**

|  |  |
| --- | --- |
| Independent Variable | Math Anxiety |
| Dependent Variable | Problem-solving Skills |
| Mediating Variable | Study Habits |
| **Step 1. Path C (IV and DV)** |  |
| Unstandardized Beta (B) | -0.354 |
| Standard Error (e) | 0.580 |
| p-value | 0.543 |
| **Step 2. Path B (MV and DV)** |  |
| Unstandardized Beta (B) | 0.582 |
| Standard Error (e) | 0.424 |
| p-value | 0.172 |
| **Step 3. Path A (IV and MV)** |  |
| Unstandardized Beta (B) | 0.001 |
| Standard Error (e) | 0.096 |
| p-value | 0.989 |
| **Step 4. Combined influence of IV and MV on DV** |  |
| **Study Habits** |  |
| Unstandardized Beta (B) | 0.582 |
| Standard Error (e) | 0.425 |
| Standardized Beta | 0.096 |
| Part Correlation | 0.096 |
| **Math Anxiety** |  |
| Standardized Beta | -0.043 |
| Part Correlation | -0.043 |
| Total R-squared | 0.011 |

Furthermore, step 3 shows path A, math anxiety and study habits, with the unstandardized Beta value of 0.001, standard error of 0.096, with a p-value of 0.989, much higher than the significance level, confirming no significant relationship between them. It implies that anxiety does not trigger students’ interest in performing activities in line with study habits. It implies further that a person’s level of math anxiety does not predict or relate to the quality or frequency of their study habits in mathematics.

This result is anchored with the Deficit Theory postulating that math anxiety is not associated with study habits alone but with the involvement of testing skills and academic preparation (Wittmaier, 1972; Tobias, 1985). It clearly explains that a student with math anxiety is only triggered to take steps on studying only when challenged to take on changes and improvement (Ramirez et al., 2018). However, students with math anxiety who are contented with their low performance in mathematics and practically not aiming to perform better in this learning area do not motivate themselves to study (Namkung et al., 2024). In other words, there are some other underlying factors that trigger math anxiety and study habits to commit themselves to study such as their motivation to learn, social capital, and attitude towards mathematics (Comahig & Abuzo, 2023).

Lastly, step 4 shows the combined influence of math anxiety and study habits on problem-solving skills. The standardized Beta of math anxiety is -0.043, while standardized Beta of study habits is 0.096. The total R2 value of the two variables is 0.011, which explains only 1.1% variance in problem-solving skills, bearing a very small and non-significant effect to the latter. Hence, there is no evidence of a significant mediation effect of study habits on the relationship between math anxiety and problem-solving skills. Therefore, study habits do not significantly mediate the relationship between math anxiety and problem-solving skills of grade 10 students. This result is similar to the study of Enerosa and Abuzo (2024) showing no significant mediation effect of study habits between mathematical reading comprehension and problem-solving skills. Study habits can be ineffective if the study focuses on reading, taking notes, or memorization routines (Ponnuraj, 2023) rather than understanding deeply the concept of mathematical lessons like practicing the steps of problem-solving (Martin-Requejo et al., 2023).

4. ConclusionS AND RECOMMENDATIONS

**4.1 Conclusions**

Based on the findings, the following conclusions were drawn:

1. The math anxiety of the students is sometimes evident.
2. The problem-solving skills of grade 10 mathematics students are poor, which further concludes that they are not ready to take harder problems in mathematics.
3. The study habits of the students are highly observed, which implies that students are portraying good study habits.
4. There are no significant relationships between math anxiety and problem-solving skills, math anxiety and study habits, and study habits and problem-solving skills.
5. Study habits do not significantly mediate the relationship between math anxiety and problem-solving skills of grade 10 students. Thus, study habits do not explain the connection between math anxiety and problem-solving skills of the students.

**4.2 Recommendations**

Based on the findings discussed and conclusions drawn, the researcher suggests the following recommendations:

1. Considering the students’ poor problem-solving skills, it is recommended that students pay attention during class discussions and participate in the activities to build strong foundations on basic principles, not hesitate to clarify misunderstood concepts, seek help from peers who have better problem-solving skills, and prioritize their learning progress over extracurricular activities. They must also utilize learning resources such as their notes, textbooks, online tutorials, practice worksheets, and study groups. Also, during their study period, it is encouraged that they spend in practicing the steps on problem-solving.
2. Teachers must provide constructive feedback from the mistakes of their learners to highlight their strengths and areas to improve. They must also shift from speed tests and fast calculations to a deeper understanding of the concepts without the pressure of time limits. Teachers must also allow the students to solve problems by themselves, individually or with peers, to gain self-confidence and incorporate praise on their efforts and participation. Lastly, teachers must emphasize openness towards their learners, encourage them to open their negative insights or misunderstanding towards the lesson, and lessen intimidating aura towards the students so that they will not be hesitant to ask their teacher.
3. School administrators should support the initiative of the teachers in enhancing the teacher-learning process by providing technological innovations through prioritizing budgets from the school Maintenance and Other Operating Expenses (MOOE). Providing such devices is of great help especially in far flung areas like Governor Generoso South District.
4. In line with the existing issue on poor problem-solving skills, DepEd officials must formulate policies and provide interventions to cater to the needs of the students in improving their skills. They must also ensure that teachers review effective and updated teaching approaches and strategies to address this need by inviting math teachers to seminars, trainings, or workshops based on recent studies. Also, instruct the school administrators to unload teachers with the ancillary tasks to allow teachers to focus on their teaching and monitoring of their students’ progress.
5. Future researchers may conduct another study exploring other affective and cognitive factors that link with problem-solving skills or investigate on environmental and pedagogical factors. Moreover, researchers may conduct similar study with respondents coming from a different grade level.

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**CONSENT**

The researcher conducted an orientation before the survey and ensured that the respondents and their parents were fully informed about this research. Since the respondents were minors, parental informed consent was first secured, signed by their parents/guardians. Afterward, the respondents signed the informed assent form agreeing to provide complete and relevant information in the study. Moreover, the researcher ensured that the questionnaires were clear and comprehensive. Also, the researcher explained the potential benefits of participating in the study. With the help of gatekeepers, the questionnaires were distributed to the respondents. No respondent was involved in the study without the approval of the school principal or head of the selected school.

**ETHICAL APPROVAL**

This quantitative research faced significant ethical challenges due to its methods and data collection. These problems related to the study’s conduct and data gathering fall under ethical conflicts. The researcher ensured the study was adhering to ethical standards such as (1) social value, (2) informed consent, (3) vulnerability of the research respondents, (4) risks, benefits and safety, (5) privacy and confidentiality, (6) justice, (7) transparency, (8) qualification of the researcher, (9) adequacy of facilities, and (10) community involvement. The Research Ethics Committee (REC) reviewed the research protocol which outlined the ten essential elements of research ethics

Disclaimer (Artificial intelligence)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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