



The Correlation of Mathematical Performance and Mathematical Anxiety, Mathematical Confidence and Mathematical Interest

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Abstract: This research study investigates the correlation between Mathematical Performance and factors such as Mathematical Anxiety, Mathematical Confidence, and Mathematical Interest among STEM students at San Felipe Neri Catholic School. Utilizing a quantitative research design, a survey was conducted among senior high school students in the STEM strand at San Felipe Neri Catholic School, employing descriptive-correlational methodology to assess attitudes, emotions, and perceptions regarding mathematics. The study's findings reveal that mathematical confidence is positively related to academic performance in mathematics ($r=0.28$ for highest grades and $r=0.22$ for lowest grades) and mathematical interest ($r=0.67$), implying that confidence improves performance and engagement in mathematics. On the other hand, mathematical anxiety inversely correlates with mathematical confidence ($r=-0.45$) and mathematical interest ($r=0.40$), highlighting the negative impact of mathematical anxiety. Additionally, a moderate positive correlation between mathematical interest and academic performance in mathematics ($r=0.12$ for highest grades and $r=0.08$ for lowest grades) demonstrates a visible but little impact of interest on academic performance in mathematics but also highlights the importance of educational interventions that foster confidence and interest while reducing anxiety in order to improve academic outcomes in mathematics among the STEM students.

Introduction

Mathematics has gotten a perspective of being a difficult curriculum despite its complexity and it is often associated with multi-step problems, such as math problems that consist of more than one operation. The term "mathematical anxiety" refers to a state of tension and dread that impairs one's ability to conduct mathematical operations, manipulate numbers, and solve mathematical problems in a range of real-world and academic contexts. This study will assess how different STEM students' experiences with mathematical anxiety relate to their performance in mathematics. Mathematical anxiety is a result that can be brought on by a variety of unfavorable experiences that STEM students may have, such as recitation, tests, and quizzes. This is, arguably, distinct from statistics anxiety where the negative state is the result of encountering statistics at any level but related to but distinct from mathematical anxiety.

Concerns related to the measure of mathematical anxiety among STEM students and their academic performance in mathematics, in the global setting, Wahid (2014) explained that this issue is a crucial connection: higher levels of mathematical anxiety were found to be linked with lower mathematical performance among students pursuing higher education, within senior high school students and collegiate level students. Expanding upon this line of inquiry, Al-Shannaq (2020) stated that discourse emphasizes a negative relationship between mathematics anxiety and mathematics performance, particularly among students in scientific faculties. These findings underscore the significance of understanding the repercussions of math anxiety on academic outcomes. It serves as a cornerstone for further research in the STEM field. Furthermore, Foley (2017) underscored the bidirectional nature of the relationship between math anxiety and performance. This highlights the critical importance of considering math anxiety when striving to enhance math achievement. The insights from the above literature, it becomes apparent that the connection of math anxiety is substantial. Moreover, Furner (2022) emphasized the importance of addressing math anxiety in the inclusive classroom to promote confidence in mathematics among all students. This emphasizes the significance of developing confidence in mathematics in all students. Overall, this literature suggests that math anxiety can have a detrimental impact on the academic performance of STEM students in mathematics.

Mathematics is viewed by many students as one of the most challenging subjects ever taken in the Philippines. The result of the 2018 Programme for International Student Assessment (PISA) shows that the Philippines ranked the lowest in the areas of mathematics, science, and reading. Although the Philippine educational system has a strong dedication to mathematics, there are a continuous number of problems associated with the teaching and acquisition of the subject (San Juan, 2019). This is in agreement with the statement made by Alkan (2013), who stated that since the incorporation of mathematics into the curriculum, it has consistently been perceived as a challenge for pupils in the Philippines. With the new curriculum implemented in the country for mathematics education in basic education (K–12 curriculum), students are expected to be better prepared for learning mathematics in higher education. When it comes to learning mathematics and the performance of students, anxiety may have an adverse effect



(Navida, 2022). In undergoing mathematical practices, multiple factors are significantly responsible for students' mathematical anxiety, such as personality traits, socio-environmental factors, and a lack of foundational knowledge from previous mathematics classes (Dominice, 2023).

This study will be conducted at the San Felipe Neri Catholic School, which is located in Mandaluyong, Philippines. San Felipe Neri Catholic School has been recognized for its dedication to providing quality education in the fields of Science, Technology, Engineering, and Mathematics (STEM). The school provides an appropriate setting for investigating the relationship between STEM students' mathematical anxiety levels and academic performance because of its dedicated faculty and supportive learning environment. STEM students of San Felipe Neri Catholic School have a population of two hundred forty-nine (249) STEM students. Using the Krejcie and Morgan Table (1970), one hundred fifty-two (152) sample size of STEM students in San Felipe Neri Catholic School will be included in the study, with a random selection method being used by the researchers to provide an accurate representative sample. The researchers assume that mathematical anxiety and mathematical confidence may have a negative impact on the academic performance in mathematics and math interest of STEM students at San Felipe Neri Catholic School. It implies that higher levels of mathematical anxiety and lower levels of mathematical confidence may negatively affect the academic performance in mathematics and the level of interest in math.

The study utilizes the theory of personal construct by Cherry (2023). The theory explains that people can see a certain situation differently as we all have factors such as histories, lived experiences, and knowledge that affect how we perceive the world around us. Moreover, the theory states that those different personal experiences explain the build-up of unique mental frameworks each person uses to interpret a certain situation or information. Consistently, the researchers' assumption that mathematical anxiety may have a negative impact on the academic performance of STEM students at San Felipe Neri Catholic School finds alignment with the theory's discussion on how different students view a certain situation so differently with regards to the unique experiences they had and the mental framework they have built. On the other hand, an established mathematical confidence can be drawn if the incident of a math challenge is low.

This study titled “The Correlation of Mathematical Performance and Mathematical Anxiety, Mathematical Confidence, and Mathematical Interest.” aims to quantify the mathematical anxiety level experienced by STEM (Science, Technology, Engineering, and Mathematics) students at San Felipe Neri Catholic School. Moreover, this study also investigates the relationship between these students' academic performance in mathematics and mathematical interest, mathematical confidence, and their mathematical anxiety. Lastly, it will aim to create recommendations to enhance their level of confidence in mathematics in order to maintain academic performance with the subjects that have a process of needing mathematical skills.

General Question: What is the impact of mathematical anxiety among the STEM students in San Felipe Neri Catholic School on their Academic Performance in mathematics?

Specific Questions:

1. What is the profile of the respondents in terms of:
 - 1.1. Grade Level
 - 1.2. Sex
2. What is the academic profile of the respondents in terms of:
 - 2.1. Highest grade in math
 - 2.2. Lowest grade in math
3. How are STEM students prepared on Mathematics in terms of:
 - 3.1. Mathematical Anxiety
 - 3.2. Mathematical Confidence
 - 3.3. Mathematical Interest
4. How are the following significant with one another?
 - 4.1. Relationship between High academic performance in Mathematics and Math Anxiety, Math Confidence and Math Interest
 - 4.2. Relationship between Low academic performance in Mathematics and Math Anxiety, Math Confidence and Math Interest

Scope and Limitation

This research titled “The Correlation of Mathematical Performance and Mathematical Anxiety, Mathematical Confidence, and Mathematical Interest” is focused on exploring the relationships between mathematical anxiety, confidence, interest, and the academic performance in mathematics of STEM students at San Felipe Neri Catholic School. The study encompasses a sample size of one hundred fifty-two (152) STEM students, derived from a total population of two hundred forty-nine (249) students at the institution, using a random selection method based on the Krejcie and Morgan Table (1970). The research aims to quantify the levels of mathematical anxiety experienced by these students and examine how this anxiety, alongside their mathematical confidence and interest, correlates with their performance in mathematics. This study is expected to provide insights into the impact of mathematical anxiety on students’ academic achievements and offer recommendations to enhance their confidence and interest in mathematics. The research methodology employs a quantitative approach, utilizing a survey to collect data on students’ perceptions and experiences related to mathematics. This study is confined to the specified educational setting, limiting its findings to the STEM student population of San Felipe Neri Catholic School, which may limit the generalizability of the findings to other settings or populations. Furthermore, while the study aims to explore the relationship between mathematical anxiety, confidence, interest, and academic performance in mathematics, there may be other factors not considered in this research that also significantly affect students’ academic performance in mathematics.



Review of Related Literature and Studies

For many individuals, "MATH" is an intimidating four-letter word; people generally dislike it and doubt their proficiency in mathematics (Yang, 2014). People who feel tension, apprehension, and fear of situations involving this subject are said to have mathematical anxiety. The study of Barbara *et al.* (2023) has shown a negative correlation between math anxiety and math competence. Individuals with higher levels of math anxiety tend to have lower math competence, including problem-solving and mental arithmetic, and perform inadequately in tasks that include mathematics. According to the study of Zanaabazar *et al.* (2014), factors contributing to math anxiety in university and college students revealed that teacher-related and family-related factors played a significant role, potentially attributed to inadequate teaching, insufficient professional skills, limited communication between students and teachers, and familial pressure. In addition, interest is the result of a person's readiness and their existing knowledge, which helps them engage with higher-level subjects effectively. Students' level of interest in mathematics is significantly influenced by teacher-and-student-related factors, as well as mathematical anxiety, which collectively predicts their engagement with the subject (Anigbo, 2016). Similarly, a research inquiry was conducted to look at any potential relationships between students' interest in mathematics and reading and their academic achievement in the study of Viljaranta (2014). The study's substantial negative linear correlation shows that lower academic performance is linked to a lower interest in mathematics, most likely as a result of low motivation and engagement in these subjects. In relation, self-confidence is a trait that students must have in order to engage in learning processes. Low self-confidence often results from a tendency to frequently avoid challenging problems and a persistent doubt about the possibility of finding solutions to encountered problems (Reddy, 2014).

Methodology

This study titled "The Correlation of Mathematical Performance and Mathematical Anxiety, Mathematical Confidence, and Mathematical Interest." aims to quantify the mathematical anxiety level experienced by STEM (Science, Technology, Engineering, and Mathematics) students at San Felipe Neri Catholic School. Also, this study will investigate the relationship between these students' academic performance in mathematics and mathematical interest, mathematical confidence, and mathematical anxiety. Lastly, will provide recommendations to enhance their level of confidence in mathematics to maintain the academic performance in mathematics of the students. This study adopts a quantitative research framework. From the works of Creswell (2014), quantitative design is a means to evaluate objective theories by exploring the relationship among variables. Quantitative data is usually gathered in numerical form and subjected to statistical analysis. The quantitative research design will be utilized through a survey for the data collection procedure. The survey method is an effective and efficient way to gather data from a large number of participants. It allows for the collection of standardized and quantifiable data, which can be analyzed statistically to draw meaningful conclusions. Participants will be provided with a printed survey containing a set of scaled questions and a few statements in the "The Mathematics Attitudes and Perception Survey

(MAPS)” (Code, 2016) that is also related to their attitudes, emotions, and perceptions about mathematics. The survey will assess various aspects such as math anxiety, math interest, math confidence, and academic performance in mathematics. The survey will be administered to the STEM students in San Felipe Neri Catholic School who will be asked to rate their responses on rating scales. This study will apply a descriptive-correlational methodology. In the literature of Bhat (2023), descriptive-correlational methodology is a type of quantitative research that aims to describe the characteristics of variables and examine the natural relationships between them without manipulating the variables. Descriptive research is a type of analysis where characteristics are objectively and methodically described through behavior observation. On the other hand, correlational research describes and predicts the natural relationships between variables in the actual world without the researcher trying to change the variables or establish a cause-and-effect relationship.

Results and Discussion

Table 1

Frequency Distribution for Senior High School Students in Science, Technology, Engineering, and Mathematics (STEM) Strand

<i>Grade Level</i>	<i>Frequency</i>	<i>Percentage (%)</i>
Grade 11	60	44.78%
Grade 12	74	55.22%
Grand Total	134	100%

Table 1 shows the frequency distribution for senior high school students in Science, Technology, Engineering, and Mathematics Strand in San Felipe Neri Catholic School in regards to their grade level. 60 of the students who responded to the survey is from grade 11, which comprises to 44.78%, meanwhile for the grade 12 over 74 of our respondents were from them comprising in 55.22%, As seen in the table the respondents are a little bit much more in favor to the grade 12 meaning that there is a small effect on the study in regards of grade level since it's a little much more favorable for grade 12 students.

Table 2

Frequency Distribution for Senior High School Students in Science, Technology, Engineering, and Mathematics (STEM) Strand

<i>Sex</i>	<i>Frequency</i>	<i>Percentage (%)</i>
Male	69	51.49%

Female	65	48.51%
Grand Total	134	100%

Table 2 shows the frequency distribution for senior high school students in Science, Technology, Engineering, and Mathematics Strand in San Felipe Neri Catholic School. In regards to their sex. 69 of the students who responded to the survey are male, comprising 51.49% of the total. On the other hand, 65 of the respondents are female, comprising 48.51% of the respondents. As shown in the table, the respondents in regards of male and female are roughly equal showing lack of bias by the researchers when conducting the survey for either gender, which is crucial in ensuring that the influence between differences in male and female remains as low as possible on the results of the rest of the survey.

Table 3

Frequency Distribution for Highest Grade in Mathematics of the Respondents During Senior High School Education

<i>Highest Grade in Mathematics During SHS</i>	<i>Frequency</i>	<i>Percentage (%)</i>
69 below	0	0%
70 - 74	0	0%
75 - 79	1	0.75%
80 - 84	4	2.99%
85 - 89	34	25.37%
90 - 94	85	63.43%
95 - 100	10	7.46%
Grand Total	134	100%

Table 3 shows a frequency distribution table for the respondents' highest grades in mathematics during senior high school education. The majority of respondents attained 90-94 highest grades in mathematics, with a sample number of 85, or 63.43%. Additionally, the distribution also shows that a considerable proportion of respondents, 25.37%, achieved grades in the 85-89 range, indicating a significant number of students performing well in the subject. Lastly, it shows that only a small percentage of respondents attained grades below 85, with less than 2.99% scoring in the 80-84 range and even fewer scoring below 80.

The majority of the respondents achieved grades in the range of 90-94 during their senior high school (SHS) education, comprising 63.43% of the surveyed population. The data indicates that the respondents attained the highest grades in mathematics during their senior high school. According to the study by Rodríguez (2020) found that success in mathematics is linked to better academic wellbeing, with higher perceived competence. In the context of this study, the variable retains significance as it allows students to directly indicate their performance in mathematics.

Table 4
Frequency Distribution for Lowest Grade in Mathematics of the Respondents During Senior High School Education

<i>Lowest Grade in Mathematics During SHS</i>	<i>Frequency</i>	<i>Percentage (%)</i>
69 below	0	0%
70 - 74	0	0%
75 - 79	6	4.48%
80 - 84	53	39.55%
85 - 89	66	49.25%
90 - 94	8	5.97%
95 - 100	1	0.75%
Grand Total	134	100%

Table 4 shows a frequency distribution table of the respondents' lowest grades in mathematics during senior high school education. The majority of the respondents attained lowest grades of 85-89 in mathematics, with a sample number of 66, or 49.25%, which underscores the prevalence of this particular grade range among the surveyed population, indicating a significant pattern among the respondents. Moreover, 53 (39.55%) of the respondents received grades of 80-84, suggesting a comparatively lower level of academic performance in mathematics. Additionally, 8 (5.97%) of respondents received grades of 90-94. Furthermore, a small sample number of 6, or 4.48%, attained grades below 79, and with 1 (0.75%) respondent showing the lowest grades of 95-100. Lastly, with 0% of respondents below 74.

The majority of the respondents, or 49.25% of the sample, achieved their lowest grades in the range of 85-89 during their senior high school (SHS) education. According to the data, the respondents received the lowest grades in mathematics during their senior high school education.

Mendoza-Penarrieta (2022) stresses that a student's coexistence environment significantly affects their academic performance in mathematics, leading to deficiencies in poor academic performance, which affects the cognitive development of students and their training as individuals within the field of mathematics. Consistently, the researchers' assumption that mathematical anxiety may have a negative impact on the academic performance of STEM students at San Felipe Neri Catholic School finds alignment with the theory's discussion on how different students view a certain situation so differently with regards to the unique experiences of they had and the mental framework they have built.

Table 5

Correlation Test between Highest and Lowest Grades in Mathematics versus Mathematical Anxiety, Confidence, and Interest.

<i>Variables</i>	<i>Highest Grade</i>	<i>Lowest Grade</i>	<i>Mathematical Anxiety</i>	<i>Mathematical Confidence</i>	<i>Mathematical Interest</i>
Highest Grade	1				
Lowest Grade	0.615906	1			
Mathematical Anxiety	-0.13062	-0.09928	1		
Mathematical Confidence	0.280484	0.21624	-0.45081	1	
Mathematical Interest	0.12303	0.07541	-0.40164	0.666524	1

The table above shows the correlation among variables where the highest and lowest grades in mathematics are correlated with mathematical anxiety, mathematical confidence, and mathematical interest. The result revealed an overwhelming significance in the area of mathematical confidence versus mathematical interest which resulted in $r = 0.67$ or moderately high correlation. This means that a 67% increase in mathematical interest may be attributed to the confidence of the students in doing mathematics. According to a study by Otoo (2018), the confidence of students directly affects their interest in learning mathematics.

On the other hand, there is an inverse relationship between mathematical anxiety and mathematical confidence ($r = -0.45$ or -45%) which means that the higher anxiety level of the student in mathematics contributes to a decrease in math confidence of almost 45%. According to Quan-Lorey (2017), the development of the students' feelings of anxiety toward mathematics was somehow rooted in an experience in school attributed to teacher attitude, poor instruction, failure, and school track that initiated their mathematics anxieties. Furthermore, having mathematical anxiety can lead to the development of negative perceptions of learning and

tackling mathematics among students, as stated in the study by Supriatna (2021). This may degrade the students' level of confidence whenever they encounter solving or doing math problems. When this worsens, it may lead to developing negative attitudes towards the subject, making it crucial for educators to address and mitigate math anxiety in the classroom (Núñez-Peña, 2013).

Furthermore, there is an inverse relationship between mathematical anxiety and mathematical interest ($r=-0.40$ or -40%) which means that the higher the anxiety level of the student in mathematics contributes to a decrease in mathematical interest of almost 40%. It can be understood through the theory of personal construct by Cherry (2023) which the theory suggests that individual perceptions, shaped by personal experiences and knowledge, influence how students view and engage with mathematics. Anxiety reduces interest because students perceive mathematics as overly challenging and beyond their capabilities. Connecting the study of Anigbo (2016) illustrates how the educational environment, especially teacher qualities and teaching practices, has a significant role in changing these personal constructs. Qualified teachers, by using a variety of effective teaching strategies, may change the students' perceptions of mathematics from challenging to manageable, lowering anxiety and naturally increasing interest. This practical use of Cherry's theory shows how changing students' educational experiences can positively shift their personal constructs about mathematics, effectively validating the inverse relationship between mathematical anxiety and interest through a change in perception assisted by qualified teaching.

Focusing on the correlation between academic performance in mathematics and mathematical anxiety, both the highest grade ($r=-0.13$ or -13%) and lowest grade ($r=-0.10$ or -10%) in mathematics are inversely very weak correlated with mathematical anxiety. This indicates that a higher anxiety level in mathematics contributes to a decrease in grade level by almost 13%, while a lower anxiety level contributes to an increase in grade level by almost 10%. This may occur, particularly in anticipation of tests and while engaged in math-related education. This anxiety, caused by fear and stress, directly correlates to lower mathematical performance (Zanabazar *et al.*, 2023). According to the study of Furner (2022), to lessen the adverse effects of mathematical anxiety, it is recommended that educators implement anxiety-reduction programs that include mindfulness and stress management techniques, promote a supportive and nonjudgmental learning environment, and provide early intervention for students who show signs of anxiety. These elaborate recommendations seek to address the underlying causes of mathematical anxiety, improving students' performance and encouraging a more positive engagement with mathematics.

The next correlation is the correlation between academic performance in mathematics and mathematical confidence; both the highest grade ($r=0.28$ or 28%) and the lowest grade ($r=0.22$ or 22%) in mathematics are positively correlated with mathematical confidence. This means that the higher confidence level of the student in mathematics contributes to an increased grade level in mathematics of almost 28%, and the lower confidence level of the student in mathematics contributes to a decreased grade level in mathematics of almost 22%. According to Espinosa (2016), confidence in mathematics affects academic performance, but the effects are

not constant across quantiles. Expanding on this matter, having high self-confidence in math means being able to meet the stages of understanding problems and solving them, while students with low self-confidence show that they struggle when it comes to problem-solving (Nurkhalipah 2020). Since there is a positive correlation between academic performance in mathematics and mathematical confidence, this suggests that when students have high confidence in math, they are most likely to get higher grades, while on the other hand, those students who suffer from low confidence in math are prone to getting a much lower grade.

Focusing on the correlation between academic performance in mathematics and mathematical interest, both the highest grade ($r=0.12$ or 12%) and lowest grade ($r=0.08$ or 8%) in mathematics are correlated positively with mathematical interest. This means that the higher mathematical interest level of the student contributes to an increased grade level in mathematics of almost 12% and the lower mathematical interest level of the student contributes to a decreased grade level in mathematics of almost 8%. This implies that there is a very weak relationship between students' interests and academic performance in studying mathematics. These results correspond with Long's (2019) study, which emphasized the importance of stimulating interest among students with lower math proficiency given its close association with academic achievements in mathematics. Since there is a positive correlation between academic performance in mathematics and mathematical interest, this suggests that as students' interest in mathematics increases, their academic performance in the subject is likely to improve. Moreover, Awol *et al.* (2016) examine student factors that contribute to low mathematical performance, such as interest and their backgrounds in mathematics, like lack of effort, and negative attitudes by the students towards it. If one cannot perform well in a subject he or she hates, the interest in the subject will clearly be low.

Summary and Conclusion

The study aims to investigate the relationship between STEM students' academic performance in mathematics and their mathematical interest, confidence, and anxiety. It will be conducted at San Felipe Neri Catholic School with a sample size of 152 STEM students. Using a quantitative research design, data will be collected through survey questionnaires distributed to the students, who will rate their responses on rating scales. The study will employ a descriptive-correlational methodology to analyze the data and assess conclusions about the relationships between the variables. This study has also revealed the correlation between the variables which are mathematical anxiety, interest, confidence, and academic performance among the STEM students through the Correlation Test between Highest and Lowest Grades in Mathematics versus Mathematical Anxiety, Confidence, and Interest which showed that among the investigated factors, mathematical confidence has the strongest positive correlation with mathematical interest ($r=0.67$), suggesting that fostering confidence in students' abilities can significantly increase their interest with the subject.

Furthermore, both mathematical confidence and mathematical interest are positively correlated with academic performance in mathematics, with confidence having a stronger influence ($r=0.28$ vs. $r=0.12$ for the highest grade). Conversely, mathematical anxiety

demonstrates negative correlations with both confidence ($r=-0.45$) and interest ($r=-0.40$), implying that addressing mathematical anxiety is crucial since it can predict students' mathematical interest, confidence, and overall performance in mathematics. Applying Cherry's theory of personal construct could be key to developing more effective teaching strategies. By fostering a learning environment that acknowledges and adapts to the diverse personal construct of students, educators at San Felipe Neri Catholic School and beyond can better support STEM students in overcoming challenges associated with mathematics, ultimately leading to improved academic outcomes and a more positive disposition about the subject.

Recommendation

Based on the results of the surveys, the researchers recommend hiring teachers who are more capable of teaching mathematics efficiently and can establish a good relationship among students. Implementing interventions in the form of fun math activities may also be beneficial, as they believe that this can capture the mathematical interests of the STEM students, which ensures a healthy and pressure-free learning environment that can eliminate the math anxiety that they're experiencing to promote their confidence in tackling math-related problems as well as their overall performance in mathematics. Furthermore, for future researchers on the same topic, it is recommended to broaden the scope of their research, as math anxiety is not limited to STEM students in general. Expanding on this issue over multiple strands and grade levels may help others understand why they avoided the STEM track. This may lead to the root cause of math anxiety, which may aid in better understanding the matter and making additional recommendations to alleviate the issue. Moreover, a challenge that may be encountered during data collection is an insufficient number of respondents. It is advisable to distribute surveys exceeding the target respondent count. This approach allows to select of the most relevant responses for the study, compensating for instances where participants may need to take the survey seriously or return it.

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