

## MATH ANXIETY AND ACADEMIC PERFORMANCE IN PRE-CALCULUS OF SELECTED SENIOR HIGH SCHOOL IN SORSOGON STATE COLLEGE

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### ABSTRACT

*Math anxiety is characterized by manifestations of negative behaviors of learners towards mathematical concepts. This study investigated the relationship between math anxiety and the academic performance in Pre-calculus of Senior High School Students taking Science, Technology, Engineering and Mathematics (STEM) Strand at Sorsogon State College- Sorsogon City Campus. The research design utilized was descriptive- correlational. Eighty- eight (88) respondents out of one hundred eighty (180) students or two (2) out of four (4) sections from the Laboratory High School were purposely selected, and took a math anxiety test. Seventy- seven (77) percent are found to have math anxiety. Forty- one (41) percent had low academic performance. Results revealed further that there is a significant relationship between math anxiety and performance of students in Pre- calculus. It is concluded that math anxiety has negative effect on the academic performance of students in Pre-calculus.*

**Keywords:** *math anxiety, academic performance, pre-calculus, senior high school*

### 1.0 Introduction

Mathematics is an indisputably important branch of knowledge that has various applications in different facets of life. It is very important across all disciplines like engineering, sciences, commerce, industries, etc (Reyes & Castillo, 2015). It is not an accident that those races that edged in this discipline also excel in economic aspects. Studies have shown that countries with superior Math Literacy Rate, namely: Singapore, Japan, China and United States are more economically blessed compared to their third world country counterparts (Lee- Chua, 2005). This perhaps supports the assumption that the slow economic growth of the country can be attributed to poor development in sciences, technology and mathematics.

In the Philippines, one cannot deny the fact that yearly the educational institutions across the archipelago are producing mathematically unequipped graduates. Both results in the Trends for International Mathematics & Science Studies (TIMSS) in 1999 and 2003 were unsatisfactory which placed the country in the underachievers in the said examinations (www. eduphil.org, n.d.). The same

educational dilemma is being faced by local educators in Bicol region. The results of the National Achievement Test (NAT) in the last 5 years showed how poor the performance of the Bicolano students in Mathematics as compared to their other subjects such as English and Filipino (www.depedregion5.ph, 2013). This implies how insufficient the pedagogy of Math educators despite the efforts of the government to uplift the quality of education.

Findings of researches conducted unfolded the underachievement of Filipino learners in mathematics can be traced back to difficulty in understanding math concepts, lack of motivation and study habits, strict teachers and failed major examinations, the congested curriculum in Math, fragile foundations of students in the fundamental skills, lack of appropriate school facilities, and negative attitudes and stereotypes of Filipinos toward Math, to cite a few (Laguador, 2013; Lee- Chua, 2005) . Among these, the researcher believes that the latter has profound bearing. Lee-Chua (2005) called these negative attitudes and stereotypes of Filipino learners towards Mathematics *Math Anxiety*.

Curtain-Phillips (2007) insisted that math anxiety is very real and occurs among thousands of people, and much of this anxiety happens in the classroom due to the lack of consideration of different learning styles of students; teachers therefore must re-examine traditional teaching methods which often do not match students' learning styles. This usually result to underachievement in mathematics subjects, she furthered.

Underscoring on the teaching methods and the approaches in mathematical concepts should be introduced to students, Billingsley (2002) generalized that math anxiety is all in the teaching world. She stressed that those students who were reported with lowest math avoidance behavior were also the same students who have teachers offering the most encouragement.

Devlin (2002)of Stanford University, in his insistence that the cause of math anxiety which usually bring about learners' inability to assimilate math schemata, held that everyone has the math's genes. "Newborn babies are actually born mathematician," he asserted. In his perseverance to prove this theory, he later discovered in his extensive studies that those people who manage to switch on their math genes by constant practice and by liking math deliberately find the subject interesting and easy, whereas others who fail to do so lead them to find math difficult. In this theory, it can be said that it is the personal choice of the learners to avoid the mathematical concepts.

In these regards, it can be noted that it was Dr. Suinn Richard (1972) who first developed an instrument and conducted a comprehensive study regarding math anxiety in 1972. He stressed that there was an observable pattern of low performance in mathematics subjects and the cause of which was the negative attitudes or avoidance of children on the subjects.

Another study which tackled the nature of math anxiety was that of Maloney (2012). This study focused on the cognitive component of math anxiety. The findings of this research stated that increased cortisol which is primarily a product of stress can actually boost performance in a test when physiological stress responses are viewed positively. Thus, it can be interpreted that viewing things positively actually increases academic performance and vice versa.

For genetic factors as cause of math anxiety, Hembree (1990) theorized that boys have better performance in mathematics due to the difference of genetic composition of females and males. It was found out in his study that girls exhibit more math anxiety as compared to boys. Although this was a scientific study, however, some critics questioned the methodology and the number of respondents used by the researcher. These findings might be true to the respondents, but this claim cannot be used to justify that girls are inferior in mathematics in general. In this regard, Tobias (1993) stressed that it was the cultural belief that causes girls to exhibit more math anxiety than boys. The study of this researcher revealed that cultural belief plays significant role in the development of mathematics anxiety among students.

On the other hand, although these studies suggested that factors that cause math anxiety can be attributed to gender issues, Geist (2003) still holds that parental education and teacher factor are still determinants of having a math anxiety. These theorists have different views on the causes of math anxiety. However, all researchers are in consensus that math anxiety has a profound effect on the achievement of students. With these studies and literature, the researcher conceptualized this study.

### **Objectives of the Study**

This study investigated the relationship of Math Anxiety on academic performance in Pre- calculus of Senior High School at Sorsogon State College (SCC). Specifically, this sought to address the following objectives: (1) Determine the level of Math anxiety of the students; (2) Determine the academic performance of the students in Precalculus; (3) Correlate students' academic performance in Pre-calculus to their level of Math Anxiety; (4) Develop an intervention material based on the findings of this study and thereby enhance academic performance.

### **2.0 Methodology**

The study is part of phase 1 of the series of researches conducted by the researcher regarding anxiety of students in Calculus. Other studies focused on impact of math anxiety, causes of math anxiety, lived experiences of students with anxiety, and development of intervention programs for students with math anxiety. It utilized the descriptive- correlational method of research. It is descriptive-correlational study since it was primarily designed to determine the math anxiety level of the senior high school and to correlate it to the academic performance of the

students in Pre- calculus. This study involved 88 respondents. This was 48.89% of the 180 total population of Grade 11 STEM Program of SSC since the remaining two (2) sections were involved during the dry- run. Of the total four sections, only the two most heterogeneous sections of the program were included in this study, while the remaining two sections were involved during the validation and dry run. The researcher purposely selected the two more heterogeneous classes since he believes that the higher the deviation, the more they could represent different kinds of learners . Of the 88, 41 respondents were boys and 47 were girls.

A researcher- modified amplified math anxiety test for students (AMATS) was utilized to determine the math anxiety level of the respondents and the factors that cause it. The instrument was divided into two parts- Part I and Part II determined the anxiety level of the students and the factors that caused the anxiety correspondingly. Part I was adopted from a math anxiety rating scale developed and validated by Yucedag- Uzcan and Brewer(2011). Validity and reliability of this scale registered at the highly valid and reliable categories respectively, with 0.91 average Cronbach alpha reliability score.

For part II of the instrument, a semantic differential continuum was adopted from Zullueta(2010) as rating scale. However, it was modified to address the needs of the respondents. The scale was presented as follows: 7 Certainly a Factor, 5-6 A Factor, 2-4 Not a Factor, 1 Certainly not a Factor. Two professors in mathematics, two in Psychology, and a registered psychometrician and guidance counselor validated the content, practicality and efficacy of the instrument. It can be noted as well that Aquino and Garcia (1994) mentioned that a good research instrument should provide clear, unambiguous, specific and complete directions so that the validity will not be affected. Thus, revisions were made based on the recommendations of the evaluators.

The data were analyzed using frequency counts, rank, percentage, weighted mean and Pearson's correlation. The scale used in determining the level of anxiety of the respondents is the following:

<b><i>Anxiety Score</i></b>	<b><i>Anxiety Level</i></b>
<i>80- 100</i>	<i>Very High Anxiety</i>
<i>60- 79</i>	<i>High Anxiety</i>
<i>40- 59</i>	<i>Low Anxiety</i>
<i>20- 39</i>	<i>Very Low Anxiety</i>

On this scale, the categories high and very high anxiety explicate that the respondents have anxiety in mathematics while the two latter categories, namely low and very low anxiety mean the students have no anxiety or the anxiety are tolerable.

Also, the researcher employed unstructured interviews in order to come out with an in- depth analysis of the factors and indicators of the math anxiety of the

respondents. Finally, the identified causes of math anxiety were the factors that were given main consideration in the development of the proposed workbook. This part of the study will not be discussed in this paper since it will be covered in the phase 2 of the research project.

### 3.0 Results and Discussions

This part discusses the analysis and interpretation of the data on the level of mathematics anxiety of students and its causes, the level of performance of students in Pre-calculus, and the correlation of the level of math anxiety of students to their academic performance in the said subject.

*The Math Anxiety Level of the Students.* The anxiety level of a person is a behavioral quality that should be quantified using psychological concepts. Thus, the expertise of two (2) Psychology professors and a psychometrician was asked by the researcher in analyzing the data pertaining to the anxiety of the students. Table 1.1 presents the level of math anxiety of the respondents. Of the 88 respondents, 55 of them or 63% were identified with High Anxiety in Pre- calculus and 12 respondents or 14% were diagnosed with Very High Anxiety. This resulted to a total percentage of 77% or 67 respondents with anxiety in Pre- calculus.

On the other hand, only 5% or 5 respondents and 18% or 16 respondents were diagnosed with Very Low Anxiety and Low Anxiety respectively. As a whole, only 23% of the respondents have lower math anxiety or tolerable anxiety while overwhelmingly 77% have higher anxiety. These findings mean that majority of the senior high school students of SSC, despite the fact that they are taking the STEM strand, were diagnosed with high anxiety in Pre- calculus. This finding is possibly the reason why most of these respondents were hesitant in participating classroom discussions in their Pre- calculus subject. During the interview conducted by the researcher, certain symptoms of math anxiety were observed. Likewise, these symptoms were also been observed during class discussions whereby the researcher was also the teacher of the respondents. The behavioral manifestations that had been observed by the researcher were: (1) lack of confidence to solve mathematical problems when called by the teacher; (2) habitual tardiness and absences in Pre-calculus subject; (3) Non- compliance to the course requirements of the subject ; (4) non- submission of projects in Pre- calculus; (5) sweating palms and shaking voices when asked by the teacher to explain a concept; and (6) Intentionally prioritizing other subjects more than Pre- calculus.

**TABLE 1. 1 MATH ANXIETY LEVEL OF STUDENTS**

<b>Level of Math Anxiety of Students</b>	<b>Anxiety Score</b>	<b>No. of Students</b>	<b>Percentage</b>
Very High Anxiety	80-100	12	14 %
High Anxiety	60- 79	55	63 %
Low Anxiety	40- 59	16	18 %
Very Low Anxiety	20- 39	5	5 %
<b>TOTAL</b>		<b>88</b>	<b>100 %</b>

This means the STEM students of SSC who are expected to be mathematically and scientifically- inclined learners have the same perception towards mathematics subjects as compared to average Filipino learners. It can be mentioned that Lee- Chua (2005) found out in one of her studies regarding the numerical literacy of Filipinos that an average Filipino high school student has anxiety in mathematical concepts particularly in the language of Algebra and abstract mathematics alike. Ironically, STEM students of SSC are found to be afraid also of Pre- calculus which must not supposed to happen because the STEM Program was intentionally designed by the Department of Education to prepare and train future mathematicians and scientists of the country.

*Academic Performance of Senior High School Students in Mathematics.* The researcher theorizes that math anxiety has direct correlation on the academic performance of students in mathematics. Consequently, the researcher made an analysis on the performance level of students in Pre- calculus to assess whether there's a relationship between the two variables. The academic rating was classified using the SSC- adopted scale as indicated in the table below(SSC Laboratory High School Manual, 2011).

**TABLE 2. 1 PERFORMANCE LEVEL OF STUDENTS IN PRE- CALCULUS**

<b>Performance Level in Pre-calculus</b>	<b>Grade</b>	<b>No. of Students</b>	<b>Percentage</b>
Very High	95-100	4	4 %
High	90- 94	8	9 %
Average	85- 89	19	22 %
Low	80- 84	36	41 %
Very Low	65- 79	21	24 %
<b>TOTAL</b>		<b>88</b>	<b>100 %</b>

Table 2.1 presents the performance level in Pre- calculus of senior high school students during the 1<sup>st</sup> Grading Period. It can be observed that among the total 88 respondents, majority of the students are at the low performance level category. Of these, 41 % or 36 respondents registered at low a performance level in Pre- calculus and 24 % or 21 respondents are identified under the very low performance level category. These findings could be overwhelmingly surprising since students under the STEM strand are expected to be mathematics enthusiasts.

On the contrary, only 4 % or 4 respondents, 9 % or 8 respondents, and 22% or 19 respondents are identified with very high, high and average performance level in Pre- calculus respectively. Since majority of the respondents registered low academic performance in Pre- calculus, this suggests that a critical analysis of the factors that contributed to these results must be done on the part of the teacher. Thus, the researcher considered math anxiety as a possible factor to this low academic performance of students.

*Correlation of Math Anxiety and Performance in Pre- calculus.* It can be noted that 63 % and 41 % of the respondents registered high math anxiety and low academic performance in Pre- calculus accordingly. To correlate the two variables, the researcher compared the individual math anxiety score and the academic rating of each respondent using Pearson's correlation showing the relationship at 0. 05 level of significance. The computed value of Pearson r was-0.6657 (negative) which means there is moderate inverse relationship between the math anxiety level and the performance level of the students. The computed Pearson r is shown in table 3. 1 below.

**TABLE 3. 1**  
**COMPUTED PEARSON R OF MATH ANXIETY AND ACADEMIC**  
**PERFORMANCE OF STUDENTS**

STATISTICAL ANALYSIS	STATISTICAL DATA	INTERPRETATION
Df	86	--
Level of significance	0.05	--
Computed r- value	- 0.6657	Moderate, Inverse
Critical t- value	2.0211	-
Computed t- value	5. 8998	Reject H <sub>0</sub>
Conclusion	*Significant	

The inverse relationship means as the anxiety level of students in Pre-calculus increases, the performance level goes down. Moreover, the computed T-value 5. 8998 is also beyond the area of rejection 2. 0211 at 0. 05 level of significance which means the null hypothesis is rejected. Considering this result, it can be deduced that the math anxiety level of the STEM students is significantly

related to their performance level in Pre- calculus subject. Thus, the math anxiety level is inversely proportional to their academic performance in Pre- calculus.

*Proposed Amplified Workbook in Pre- calculus.* Based on the results of this study, the researcher conceptualized a workbook in Pre- calculus that is amplified, math anxiety- less and responsive to the present needs and interests of the students. The factors that were considered by the researcher along the conceptualization of this instructional material was the outcome of this study, specifically, the three (3) primary factors that caused the anxiety of the students. The details of the workbook will not be discussed in this paper. The development and validation process of this research output will not be discussed in this paper.



Figure 1. Front & Back Cover of Developed Worktext in Pre-calculus

#### 4.0 Conclusions and Recommendations

Based on the findings drawn, the following conclusions were formulated: (1) Majority of the students have high anxiety in Pre- calculus; (2) Majority of the students registered low academic performance in mathematics; (3) There is a significant relationship between the students' academic performance and the level of anxiety; (4) To lessen the anxiety of students in Pre- calculus, an amplified, math anxiety- less and student- friendly workbook may be proposed.

Based on the foregoing findings and conclusions, the following are recommended by the researcher: (1) Series of math anxiety- awareness programs, seminars and symposia be conducted to advance the significance of mathematics in the society; (2) A separate remedial instruction program be held catering the special needs of students suffering from math anxiety and low academic performance in mathematics; (3) For more significant results in the performance level of students in Pre-calculus, the utilization of positive approach to lessen math anxiety be employed to the maximum in every mathematics classroom; (4) The proposed workbook be utilized classroom instructional material; (5) For further advancement of this study, a parallel research both in the elementary and junior high school levels under the same variables but of greater scope is highly recommended.



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