Print ISSN 2094-1064
Online ISSN 2244-0437

Liceo Journal of Higher Education Research
doi: http://dx.doi.org/10.7828/ljher.v13i2.1059

Impact of Math Anxiety on Academic Performance in Pre-Calculus of Senior High School

ALDRIN JOHN J. ESTONANTO
ORCID NO. 0000-0001-9678-8100
aldrinestonanto@gmail.com

Sorsogon State College- Sorsogon City Campus
Sorsogon City, Philippines

ABSTRACT

Math anxiety is often associated with poor students' performance in mathematics. This study analyzed the impact of math anxiety and the factors that caused the anxiety in pre-calculus of Senior High School Students taking Science, Technology, Engineering and Mathematics (STEM) Strand at Sorsogon State College, Sorsogon City. 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 randomly selected to take a math anxiety test. Among them, sixty-seven (67) students were found to have math anxiety. Results revealed further that there is a significant relationship between math anxiety and performance of students in pre-calculus. The Nature of the Subject, Student's Factor and Parents Factor were the primary causes of the anxiety of the students. Anxiety-less workbook in pre-calculus was constructed based on the findings.

Keywords: Math anxiety, Performance, Impact, Pre-calculus, Senior high school

INTRODUCTION

People know how significant Mathematics is in their lives. It can be considered as one of the pillars that built the human civilization. It is very important to all disciplines like engineering, sciences, commerce, industries, etc. (Reyes and Castillo, 2015). It is not an accident that those races that edged in this discipline also excel in economic aspects. Studies showed that countries with superior Math Literacy Rate, namely: Singapore, Japan, China and the United States are more economically blessed compared to their third world country counterparts (Lee-Chua, 2005). Nevertheless, this scientific truth sometimes is forgotten and oftentimes ignored not just by ordinary Filipinos, but even by educators and curriculum planners.

In the Philippines, one cannot deny the fact that yearly the educational institutions across the archipelago are producing mathematically unequipped graduates. The 1999 results of the Trends in International Mathematics and Science Studies (TIMSS) showed how far behind the Philippines had been with its other neighboring countries in Asia. While Singapore excelled with its average score of 604 in Mathematics, the Philippines only got 345 performance levels which placed us in the 3rd place from the bottom surpassing only Morocco (337) and South Africa (275). In the 2003 TIMSS, Philippines once again ranked 3rd place from the bottom with a mean score of 358, falling 138 points short of the International Average of 495; surpassing again only two countries, Morocco (347) and Tunisia (339), since South Africa, World's Poorest Performer in Math, did not participate that year (Education in the Phil., 2009).

While the government is struggling to redeem its honor in the international community, the Bicol Region is also in the midst of battle to gain its academic reputation in the national arena. The result of the 2003 TIMSS revealed that Region V only got an average performance of 340.09 which is far lower than the National Average rating obtained. Among the 15 participating regions throughout the country, Region V secured its position in the 9th rank only (www.eduphil.org, n.d.). Furthermore, the results of the National Achievement Test (NAT) in the last five years showed how poor the performance of the Bicolano students in Mathematics as compared to their other subjects such as English and Filipino (Dep. Ed. Region 5, 2013). This implies how insufficient the pedagogy of Math educators despite the efforts of the government to uplift the quality of education.

Some of the factors blamed as possible causes of this phenomenon include: 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; Lee-Chua, 2005). Among these, the researcher believes that the latter has a profound bearing on the mentioned educational dilemma. Lee-Chua (2005) called these negative attitudes and stereotypes of Filipino learners towards Mathematics Math Anxiety.

Underscoring 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.

On these regards, it can be noted that it was Dr. Suinn Richard (Marshall, [n.d.]) 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, the cause of which was the negative attitude 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 could 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 the cause of math anxiety, Hembree (1990) theorized that boys have better performance in mathematics due to the difference in 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 a 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 hold that parental education and teacher factor are still determinants of having a math

anxiety. With these studies and literature, the researcher theorized that if math anxiety of the students were lessened, the performance would be enhanced. Thus, the researcher conceptualized this study.

FRAMEWORK

The study is anchored on the following principles and theories of Psychology and learning: Piaget's Theory of Cognition (Duka, 2011), Maslow's Hierarchy of Needs (Aquino, 1994), Social Learning Theory (Corpuz et al., 2010), and Meaningful Learning Theory of Ausubel (Aquino, 1994).

Piaget viewed learning as a process that happens in accordance with the developmental stages of a person. To this theorist, learning, which is defined as any change in the behavior of an individual, occurs if the new schemata to be learned it can be absorbed by the ability of the individual to understand depending on his own maturity (Duka, 2011). Thus, in order for a child to learn concepts in Pre-calculus, the student must be both mentally and emotionally matured especially in understanding abstract mathematical concepts. The ability to exhibit conservation, reversibility and logical reasoning must be starting to develop gradually. A child with difficulty of understanding concepts would lead to frustrations and later to anxiety.

Additionally, Maslow's theory emphasizes on the importance of satisfying each level of needs of a person in the learning process. A person whose self- esteem has been satisfied due to a sense of success after accomplishing a difficult task becomes his driving force to persevere (Aquino, 1994). In learning pre-calculus, a child experiences increased self-esteem whenever he successfully finished solving a difficult word problem and consequently desire to do more. On the other a hand, a student who always feels the bitterness of failures in answering math tasks subconsciously dislikes the subject until he altogether develops an extreme avoidance of it.

If Piaget and Maslow regard the inner factors or the students themselves as vital in understanding the psychology of an individual, Bandura with his Social Learning theory stressed that it is the environment of person that can explain the why of his behaviors (Corpuz et al., 2010). This means, the culture of the place, the mentality of the people surrounding the student, the philosophies, and ideologies of his family and circle of friends profoundly affect his learning. In other words, math anxiety could also be caused by environmental factors.

Ausubel's theory of Meaningful Learning explained the importance of active

self-motivation in the process of learning. Ausubel argued that when the learning experience is meaningful or important to the child, the concept being taught are just embed naturally in the learner's mind (Aquino, 1994). In other words, if the child is enjoying the subject matter and is innerly motivated because he loves the lesson, then learning is acquired to its optimum without creating artificial interventions. This principle could explain why Filipino learners are left behind as compared to their other Asian counterparts as far as mathematics proficiency is concerned. Other Asian students value mathematics more than Filipino students do. When the learner has positive perception towards the subject matter, the transmission of knowledge from the learning experience to the student becomes natural and spontaneous, and hence pedagogy becomes effective. On the other hand, when the learner has no personal interest and has negative prejudices towards the subject, the whole learning process is forced and artificial.

These theories were utilized by the researcher to establish the connections among mathematical anxiety, the factors that caused it and the performance of the students in the classroom, particularly in the subject pre-calculus. Figure 1 discusses the schema of this study which the researcher adapted from the above cited theories. The schema shows that the factors that caused the anxiety of the students can directly determine the performance of the students in pre-calculus. Thus, if these factors will be considered in the process of instruction, performance in the said subject would be enhanced.

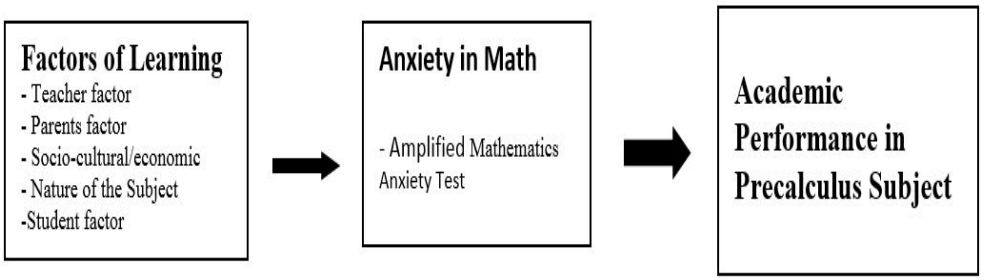

Figure 1. Schema of the Study

OBJECTIVES OF THE STUDY

This study determined the impact of Math Anxiety on academic performance in pre-calculus of Senior High School at Sorsogon State College. Specifically, this sought to address the following objectives: (1) determine the level of Math anxiety of the students; (2) identify the causes of Math Anxiety of the respondents: (3) determine the academic performance of the students in pre-calculus; (4) correlate students' academic performance in pre-calculus to their level of Math Anxiety; (5) develop an anxiety-less workbook based on the findings of this study and thereby enhance academic performance.

METHODOLOGY

This study 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. The involved 88 respondents. This was 48. 89% of the 180 total population of Grade 11 STEM Program of SSC. Of the total four sections, only the two most heterogeneous sections of the program were included for 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 believed 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 adapted 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 a rating scale. However, it was modified to address the factors it was intended to measure. 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 count, rank, percentage, weighted mean and Pearson's correlation. The scale used in determining the level of anxiety of the respondents is the ff:

Anxiety Score	Anxiety Level
80- 100	Very High Anxiety
60- 79	High Anxiety
40- 59	Low Anxiety
20- 39	Very Low Anxiety

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.

RESULTS AND DISCUSSION

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. Math Anxiety Level of Students

Level of Math Anxiety of Students	Anxiety Score	No. of Students	Percentage
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 %
TOTAL		88	100 %

Table 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 in a total percentage of 77%, or 67 respondents had 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 no math anxiety while overwhelmingly 77% have math anxiety. These findings mean the majority of the senior high school students of SSC, despite the fact that they are taking the STEM strand, were diagnosed with 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. The behavioral manifestations of math anxiety 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.

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 perception of 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 suppose 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.

Table 2. Factors That Cause Math Anxiety Among Senior High School Students

Cause of Anxiety	No. of Students	Percentage	Rank
Teacher Factor	9	10 %	4
Parents Factor	16	18 %	3
Socio- cultural/ economic Factor	3	4 %	5
Nature of Subject	39	44 %	1
Student Factor	21	24 %	2
TOTAL	88	100 %	

Factors that Caused the Math Anxiety of the Respondents. This portion shows the different factors that caused the anxiety of senior high school students in pre-calculus. Table 2 presents the five main factors that caused math anxiety as identified by the respondents. The table shows that the number 1 factor that caused their anxiety was the Nature of the Subject itself. Of the 88 total student respondents, 39 of them or 44 % were diagnosed with math anxiety and the cause of which was the difficult nature of the subject Precalculus. This results are similar to the findings of Shannon (2008) in her study about math anxiety and its correlation to the course preference of students in college. The paper mentioned that the very first reason why students were afraid of mathematics subjects was the very fact that mathematical concepts are hard to understand, and thus there is a need for educators to devise a strategy to make these abstract concepts simple and relevant to students. In other words, students are afraid of mathematics because they have this preconceived mentality that mathematics is a hard subject.

Furthermore, next to the factor mentioned was Student Factor. twenty-one respondents or 24 % determined Student Factor as the second primary cause of their anxiety. This means, students with anxiety were afraid of mathematics not because of any external factors that because they deliberately choose to avoid the subject. Thus, it can be deduced that these students do not see the significance and relevance of mathematics in their life. An unstructured interview was done by the researcher to verify these findings and it was found that there are students who were from the Laboratory Junior High School that were given the privilege to be admitted to STEM Program without taking the admission test. This explains why there are STEM students who have very high math anxiety since they were admitted to the program regardless of their aptitude and interest.

Additionally, 16 respondents or 18 % said that the cause of their anxiety was Parents Factor. This 18% represents the set of students whose parents were not that actively involved in monitoring their child's academic needs, especially in mathematics subjects. Consequently, these students were doubtful of their ability to perform well in Precalculus since they lack assurance and security that their parents' support and assistance on them would be a maximum. These findings may be attributed to a large number of parents of students who are Overseas Filipino Workers (OFWs). Some students interviewed said that they feel pressured to have higher grades in mathematics subjects because their parents are working abroad as engineers.

On the other hand, only three respondents or 4% and nine respondents or 10% were identified as students whose causes of math anxiety were Sociocultural/economic Factor and Teacher Factor respectively? These figures mean that Sociocultural/economic factor had no direct effect on the anxiety of students in mathematics. Similarly, it can be said that the economic status, cultural background and other factors in the society where the students belong do not affect that much the level of anxiety of students in mathematics. Also, the results further reveal that the teacher's traits and personality, in this case, have no profound impact on the perception and attitude of the students towards the subject. This is contrary to the results of research conducted by Marshall (n.d.) which stated that the major cause that contributes to math anxiety is teacher factor. Accordingly, it may be inferred that in this study, the result is different as compared to that of Marshall because the student respondents, in this case, do not see their teacher as the cause of their anxiety.

Analysis of the Factors that Caused the Anxiety of the Students.The findings revealed that the major causes of the anxiety of the senior high school students in pre-calculus are the Nature of the Subject, Students Factor and Parents Factor respectively.

Table 3. Indicators of Nature of the Subject as Cause of Anxiety

Indicators	Mean Score	Description
Mathematics is the most difficult and "brain-cracking" subject.	2.74	Agree
Mathematics is very challenging but it is an interesting subject.	1.01	Disagree
The language of algebra and mathematics is extremely abstract.	2.50	Agree
The language of algebra and mathematics is not that difficult to be evaded.	1.11	Disagree
The use of English as medium of instruction in teaching makes mathematical concepts harder to understand.	1.89	Moderately Agree
Using the English language does not contribute to the difficulty of the subject.	1.92	Moderately Agree
The complexity of solving mathematical equations causes students to dislike math.	2.03	Moderately Agree
Solving mathematical equations makes the subject very challenging and interesting to students.	1.04	Disagree
Endless memorization of formulas, graphs and tables, and substitution of numbers with variables bring "terror" to most students.	2.87	Agree
Memorization of formulas, graphs and tables, and the use of variables other than mere numbers make mathematics more challenging.	1.02	Disagree

It can be gleaned from table 3 that the primary cause of the anxiety of the students is the Nature of the Subject. The findings suggest that most of the students view the difficulty of the subject Precalculus as the cause of their anxiety. At the scale of 3.0, the majority of the indicators of a student who has math anxiety scored above 2.0 which means the respondents unanimously agreed that the subject indeed is very difficult for them to understand. Moreover, it can also be observed that the reason why the respondents consider the nature of the subject as the cause is due to their strong opposition to the integration of extremely abstract mathematical concepts in the subject and the memorization of formulas as well as solving equations. On the other hand, only the indicator about the use of English language as a medium of instruction does not reach 2.0 score. This means the use of English in teaching Precalculus was not a contributory factor which increases the difficulty of the subject. To supplement these findings, the researcher conducted an unstructured interview with the respondents. It was revealed in the conversations that, although the respondents are STEM students, there are students who have been admitted to the program

whose field of interest was not mathematics; rather, they were just forced by their parents to take this strand. Consequently, the researcher also conducted an interview with the officers- in- charge of the admission process for STEM students. It was found out that, 67 out of 180 or 37.22 % of the enrollees who were from the institution's Junior High School, though they took the entrance examination to qualify for STEM Program, however, they were given a special privilege to be admitted regardless of the results of the admission test. As opposed to the principle that only those whose field of interest is STEM must be admitted to the program, total absorption of Grade 10 completers from JHS was done which was possibly the reason why the majority of the respondents have been diagnosed with math anxiety and thus these findings. Furthermore, it was also found out in this study that another cause of the anxiety of the respondents was the respondents themselves.

Table 4. Indicators Of Student Factor As Cause Of Anxiety

Indicator	Mean Score	Description
My field of interest is not math.	2.04	Moderately Agree
My field of interest is mathematics.	1.11	Disagree
I just do not like numbers and figures.	2.82	Agree
I love computations, solving and numbers.	1.31	Disagree
I rather watch TV and play video than do my math homeworks.	1.90	Moderately Agree
Doing my mathematics homeworks is my priority before watching TV, etc.	2.02	Moderately Agree
I was born with a fate not meant to learn mathematical concepts.	2.53	Agree
I believe everybody has the innate capacity to be mathematicians.	1.84	Moderately Agree
Students fear mathematics because they "think" they will always fail.	2.04	Moderately Agree
Students' pre- formed mentality about the subject has nothing to do with their fear in math.	1.05	Disagree

Table 4 presents the indicators of Student Factor as the cause of the anxiety of the respondents. As shown in this table, the majority of the respondents have a negative perception of the subject pre-calculus. Of 3.0 scale, the dominant scores are above 2.0 also similar to the previous findings of the Nature of the Subject as the cause of the anxiety of the respondents. This means the problem is not only that the subject pre-calculus is difficult, but that the students themselves have no interest in the subject at all. The indicators in the table mentioned earlier reveal that the respondents have problems in their study habits and that their interest is in other activities other than doing things relevant to mathematics. These are

manifestations that these students have already reached a high level of math anxiety which is mainly characterized by extreme math avoidance. In this regard, their misconception about mathematics as a subject should have been corrected during the early years of their high school life. During the interview conducted by the researcher, most respondents mentioned that they started avoiding mathematics during their high school years particularly when they were in Grade 7. It can be noted that in this grade level, the abstract concept of variables and the language of algebra were gradually introduced in the curriculum. Thus, it can be inferred that the change from elementary arithmetic concepts into algebraic concepts in the topics in high school mathematics could be the cause of the start of math avoidance of most respondents. It was found out further that the cause of the anxiety of the respondents was not only the nature of the subject and the respondents themselves but also influenced by external forces particularly the parents of the respondents.

Table 5. Indicators of Parents Factor as Cause of Anxiety

Indicator	Mean Score	Description
The inattentive parenting style (unmindful of the child's academic needs) contributes to student's poor study habits in mathematics.	2.70	Agree
The parenting style of parents study mathematics as a subject.	1.12	Disagree
Parents' pressure to excel in mathematics above other subjects gives burden to me as student.	2.55	Agree
Parents' pressure to excel in mathematics above other subjects motivates me to study more in math.	1.13	Disagree
The encouragement and support of parents to their child causes him to be intrinsically motivated.	2.09	Moderately Agree
The encouragement and support of parents to their child does not result to motivation to study math.	1.90	Moderately Agree
The passiveness and negligence of parents to extend academic help (e.g. making homeworks) leaves the child hopeless and fearful to face the difficulty of the subject.	2.33	Moderately Agree
The passiveness and negligence of parents to extend academic help does not directly result to fear of the mathematics subject.	1.24	Disagree
Parent's negative approach in dealing with failures of their child in math causes fear on the part of the child to the subject.	2.80	Agree
Parent's negative approach in dealing with failures of their child in mathematics does not cause fear on the part of the child to the subject.	1.92	Moderately Agree

Table 5 reveals that the support and attention of parents to school activities of their children could have lessened the anxiety of the respondents in pre-calculus. The data are shown in the table mentioned above present inattentive parenting style, parents' pressure to their children to excel in class, and the failure of parents to extend assistance to their children in their homework contributed to the development of the anxiety of the students. During the interview, some

of the respondents shared that they came from a broken family, some said they were raised by a single parent and others were children of OFWs. With this information, it can be inferred that the above mentioned reasons could have caused the anxiety of the respondents.

Academic Performance of Senior High School Students in Mathematics. The researcher theorizes that math anxiety has a direct correlation on the academic performance of students in mathematics. Consequently, the researcher made an analysis of 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 6. Performance Level Of Students In Pre-Calculus

Performance Level in Pre- calculus	Grade	No. of Students	Percentage
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 %
TOTAL		88	100 %

Table 6 presents the performance level in pre-calculus of senior high school students during the 1st Grading Period. It can be observed that among the total 88 respondents, majority of the students are in 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 the 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 researchers consider 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. This interested the researcher to determine whether there exists a significant relationship between math anxiety and academic performance of students in pre-calculus. 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 a moderate inverse relationship between the math anxiety level and the performance level of the students. The computed Pearson r is shown in table 7 below.

Table 7. 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_0
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 critical value 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.

CONCLUSION

The findings of this study clearly show that math anxiety had an impact on the academic performance of the respondents in pre-calculus subject. Furthermore, the difficult nature of the subject, student factor and parents factor caused the anxiety of the students and thus must be given attention by teachers. Instruction should not only focus on a cognitive aspect of the lesson but psychological as well by enhancing performance by eliminating anxiety among students. Anxiety-less worktext in pre-calculus was developed based on the results of the study.

RECOMMENDATIONS

Based on the foregoing findings and conclusions, the following are recommended by the researcher:

1. A 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 the 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.

LITERATURE CITED

Aquino, G. V., and Garcia, L. B. (1994). Fundamentals of measurements and evaluation.National Bookstore, Philippines.

Aquino, G. V. (1994). The P-L-E instructional model, A Guide to Systematic Teaching. Quezon City: R. M. Garcia, Publishing Home, p.50

Billingsley, J. N. (2002) Health Today, p. 13.

Corpuz et al. (2010). Child and adolescent development: Looking at learners at different life. Quezon City, Lorimar Pub., Inc. ISBN 971-685-721-4.

Duka, C. D. (2011). Reviewer for licensure examination for teachers. Manila, Manila Review Institute, Inc. ISBN 978-971- 8590-16- 4.

Geist, E. (2003). The anti-anxiety curriculum: Combating math anxiety in the classroom. Journal Of Instructional Psychology, 37(1), 24-31.

Hembree, R. (1990). The nature, effects, and relief of math anxiety, Journal for Research in Mathematics Education, Vol. 21, No. 1, p.33-46. Retrieved from:http://www.jstor.org.proxyremote.galib.uga.edu/stable/749455

Laguador, J. M. (2013). Academic problems and negative atittude of engineering students towards engineering program, International Journal of Management, IT and Engineering, 3(7): 495-505.

Lee–Chua, Q. (1994). "Are Math Teachers Competent?", Foundation for upgrading the standard of education (FUSION), Inc., Ateneo de Manila University, p. 145.

Lee-Chua, Q. N. (2005). The Philippine Journal of Education (MilleniumNotes) Volume LXXXIV, no.1., p.12.

Lee-Chua, Q. N. (2005). Developing a problem-solving culture in the Philippines. Ateneo de Manila University.

Maloney, E., Beilock, S. (2012). Math anxiety: Who has it, why it develops, and how to guard against it. Trends in Cognitive Science, Volume 16, Issue 10, p. 404-406. Marshall, Ellen, et.al.n.d. Maths Anxiety. University of Sheffield.

National Achievement Test Results. (2017). Retrieved February (2017), from http: //depedregion5.ph/nationalachievement test--nat-.html

Reyes, M. D. and Castillo, A. C. (2015). Test anxiety and college students' performance on mathematics departmental examination: Basis for mathematics achievement

Shannon, C. E. (2008). A comprehensive study of mathematics anxiety, State University of New York.

Sorsogon State College Laboratory High School Academic Manual. (2011). Approved by virtue of BOT Resolution No. 59, S. 2011.

Trends in International Mathematics & Science Studies. (2017). Retrieved January 2017 from http://eduphil.org/timss-results-for the philippines.html

Tobias, S. (1993). Overcoming math anxiety (Revised and Expanded). United States of America: Haddon Craftsmen Inc.

Yucedag-Uzcan A., and Brewer, S. (2011). Adaptation of mathematics anxiety Rating Scale-Revised (MRS- R)for Online Students, University of Phoenix

Zulueta, F. M. and Perez, J. R. (2010). Methods of Research, Thesis Writing and Applied Statistics. Navotas Press, Navotas City.