ANXIETY TOWARDS MATHEMATICS AND MATHEMATICS PERFORMANCE OF GRADE 7 LEARNERS

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Abstract:

In this study, we investigated the level of anxiety towards mathematics of grade 7 learners, their mathematics performance and determined if there exists significant difference between male and female learners in their level of mathematics anxiety. We also examined the association between leaners' level of mathematics anxiety and mathematics performance. It utilized descriptive and correlational research designs involving randomly chosen 41 male and 35 grade 7 leaners. Data were obtained through the students' mathematics test scores from their teachers' grade sheets. We also administered a mathematics anxiety scale test of fifteen 15 items, each with 5 possible responses: namely; always, often, sometimes, seldom and never. Findings revealed that grade 7 learners, on average, experience a moderate level of anxiety towards mathematics which was on the same level between male and female learners. On mathematics performance, the leaners manifested below to fairly satisfactory levels. Statistically, there was a significant negative association between learners' level of anxiety towards mathematics and mathematics performance with the strength of association stronger for male learners than their female counterpart. In conclusion, the grade 7 learners manifested moderate level of anxiety towards mathematics, not meeting expected mathematics performance for both male and female groups. Their anxiety level towards mathematics has negative bearing on their mathematics performance, those who manifested high anxiety level towards mathematics tended to perform low in mathematics and vice versa.

Keywords: mathematics anxiety, mathematics performance, gender

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1. Introduction

Mathematics education under the "*K to 12 education program*" of the Philippines aims to inculcate "*critical thinking and problem-solving skills*" among Filipino learners. This is to be achieved by providing a solid curriculum content and mathematical tools, teaching relevant skills (Rodriguez and Abocejo, 2018) and processes, honing values and attitudes (Tiauzon and Malquisto, 2019), and considering the background of the Filipino learners (Department of Education [DepEd], 2013a)

To foster and develop the critical thinking and problem-solving skills of Filipino leaners, the K to 12 curriculum provides mathematical tasks under five content areas: "*number and number sense, measurement, geometry, patterns and algebra, and probability and statistics*" (DepEd, 2013a). At present, this goal remains far from being achieved since there are many factors which hinder students from successfully learning the mathematics subject. One of such hindering factor is mathematics anxiety. Ashcraft (as cited in Thompson, Wylie and Hanna, 2016) defines mathematics anxiety "*as feelings of tension or fear that appear when a person is required to undertake a mathematics performance task.*"

Results from standardized tests and reports from international organizations over the years indicate that developing "*critical thinking and problem-solving skills*" among high school learners is still far from being achieved (Nicolasa and Ematab, 2018; Basri and Abdur, 2018). Many Filipino learners are experiencing difficulty in learning mathematics. In fact, before the "*K to 12 education program*" was implemented in 2013, the results of the National Achievement Test (NAT), a standardized test administered annually by the DepEd, revealed the struggle of many Filipino learners in mathematics in both elementary and high school levels (DepEd, 2013a). The NAT result in mathematics for school year (SY) 2011-2012 showed that learners in grades 3 and 6, and fourth year high school were low of 59.87, 66.47 and 46.37 mean, respectively (The National Achievement Test in the Philippines, 2013b). These were below the standard mean percentage score of at least 75 set by the DepEd.

Moreover, the "*Global Competitiveness Report of the World Economic Forum*" noted that in terms of the quality of math and science education, the Philippines underperformed where the country ranked 67th out of 140 countries during the period 2015-2016; 79th out of 138 countries during the period 2016-2017; and 76th out of 137 countries in 2017-2018 (World Economic Forum, 2016; World Economic Forum, 2017-2018; World Economic Forum, 2018).

The aforementioned facts are strong indicators that Filipino learners are having difficulty in mastering the competencies required of them by the mathematics curriculum, even with the transition from the old Basic Education Program to the K to 12 Education Program. Indicatively, some factors hinder students from successfully learning the mathematics subject (Olteanu, 2018). One of these factors is mathematics anxiety. Ashcraft (as cited in Thompson, Wylie and Hanna, 2016) defines mathematics anxiety "*as feelings of tension or fear that appear when a person is required to undertake a Mathematics performance task.*" A student with mathematics anxiety experiences a certain

level of uneasiness and distress when given a mathematical exercise or problem to accomplish or solve (Mutawah, 2015).

Many studies (Erturan and Jansen, 2015; Delgado, Espinoza and Fonseca, 2017; Vakili and Pourrazavy, 2017; Ramirez et al., 2018) indicated that mathematics anxiety negatively impacts mathematics performance among leaners. That is, learners with high mathematics anxiety tend to demonstrate dismal mathematics performance suggesting that more attention must be given to mathematics anxiety and mathematics performance of learners (Widiasih, Permanasari, Riandi and Damayanti, 2018). With this, educators will be guided as to what pedagogical initiatives should be undertaken, and to the kind of strategies, innovations, and interventions to be developed.

This paper contends that exploring the relationships between the "*level of mathematics anxiety and mathematics performance*" among grade 7 leaners will facilitate secondary teachers to deliver mathematics lessons in manner not stressful for the learners creating a positive learning environment and augmenting interest towards mathematics among high school leaners.

1.1 Study Objectives and hypotheses

Our study investigated the level of anxiety towards mathematics among grade 7 leaners, their mathematics performance, gender difference in level of anxiety towards mathematics and the strength of relationship between level of anxiety towards mathematics and mathematics performance. The study tested the null hypotheses of no significant difference between male and female leaners in their level of anxiety towards mathematics and no significant relationship between the level of anxiety towards mathematics and mathematics performance across gender of learners.

2. Literature Review

Mathematics anxiety is "*a state of panic, helplessness, paralysis, and mental disorganization that occurs in some learners when they are required to solve math problems*" (Nolting, 2010). Learners who feel strained and are frightened by being involved in mathematical activities are said to have mathematics anxiety (Beilock and Willingham, 2014).

There are three categories of mathematics anxiety: "*mathematics test anxiety, numerical anxiety, and abstraction anxiety*" (Morada, 2015; Raju, 2018). Mathematics test anxiety (as a form of anxiety) is experienced before, during and after mathematical tasks. Numerical anxiety occurs when performing fundamental operations or a combination of these operations (Raju, 2018). Abstraction anxiety crops up when dealing with algebraic notations or symbols and mathematical principles and properties to work on equations (Nolting, 2010; Morada, 2015).

Arem (2010) identified various reasons why mathematics anxiety develops among learners. These include going through embarrassing events while performing a mathematical task, experiencing unfavourable life events that become associated with mathematics learning, being strained by social demands to perform well (Abocejo and Padua, 2010), perceiving success or failure in mathematics as a gauge of ability level,

being exposed to inappropriate and incorrect teaching methods (Cuñado and Abocejo, 2018), having negative thoughts about mathematics, and labelling male learners as better in mathematics as compared to female learners (Hill et al., 2016; Fernandez and Abocejo, 2014; Vakili and Pourrazavy, 2017).

Rubenstein (2015) stated that learners experiencing mathematics anxiety perceive mathematics subject as a negative stimulus. Their mathematics anxiety tends to build up more as they continue to behave in this manner. Some studies (Hill et al., 2016; Delgado, Espinoza and Fonseca, 2017; Erturan and Jansen, 2015) were conducted to investigate gender difference in Mathematics anxiety. Vakili and Pourrazavy (2017) noted that female leaners manifested significantly higher mathematics anxiety than their male counterparts. Hill et al. (2016) further revealed that secondary and university level female student demonstrate higher mathematics anxiety as compared to male learners.

Moreover, Erturan and Jansen (2015) and Delgado, Espinoza and Fonseca (2017), revealed that "*female learners have higher anxiety towards mathematics*" tests than male learners, but the two groups have no anxiety difference towards the mathematics as a course or subject. In their paper, Delgado, Espinoza and Fonseca (2017) explained that gender difference in mathematics anxiety can be attributed to female leaners being more expressive than their male counterpart. Similarly, Love (2018) found out that "*female learners have significantly higher mathematics anxiety than male learners*". She further reported that, over the past fifty years, this has consistently been observed by many researchers, especially from learners in the secondary and tertiary level of education.

Many studies (Andrews and Brown, 2015; Erturan and Jansen, 2015; Hill et al., 2016; Delgado et al., 2017; Vakili and Pourrazavy, 2017; Ramirez et al., 2018; Gunderson et al., 2018) noted a significantly negative correlation between learners' "*level of mathematics anxiety and mathematics performance*". This indicates that learners with high "*level of mathematics anxiety*" tend to demonstrate a dismal mathematics performance. Mutawah (2015) found out an "*inverse association between mathematics anxiety*" and perceived performance mathematics. Leaners who think their performance in mathematics is low tend to exhibit high "*anxiety level in mathematics*"; conversely, learners who perceive their mathematics performance as high tend to have low "*level of mathematics anxiety*" (Mutawah, 2015).

The anxiety towards mathematics tends to negatively impact on learners' performance in other mathematical tasks (Lai, Zhu, Chen and Li, 2015). Ramirez et al. (2016) indicated a negative correlation between "*mathematics anxiety and the use of advance problem-solving strategies*". That is, learners with high "*level of mathematics anxiety*" prefer not to use advance problem-solving strategies. Oddly, this relationship is stronger when learners have higher working memory.

There are several factors that have bearing on learners' "*level of mathematics anxiety*". Saricam and Ogurlu (2015) revealed that learners with high IQ tend to have low mathematics anxiety; conversely, those with low IQ show high mathematics anxiety. They also found that in turn mathematics anxiety negatively impacts metacognitive awareness among learners.

In another perspective, parents and teachers with mathematics anxiety and of whom the learners regularly communicate with tend to influence the increase of mathematics anxiety among the learners and as their mathematics performance. Learners who have parents with high mathematics anxiety tend to demonstrate a decreased math performance than those who have parents with low math anxiety (Maloney et al., 2015; Smith, 2016). On the other hand, Mizala, Martinez and Martinez (2015) argued that teachers who are highly math anxious impose lesser demands among learners in terms of mathematics performance than do teachers who are less math anxious. In relation to this, Stoehr (2017) found that learners taught by teachers with high math anxiety tend to develop math anxiety, which in turn, results to them having dismal performance in math.

Meanwhile, Santillan, Kramer and Garcia (2017) reported that, at large, mathematics anxiety can be explained by the following determinants: (1) anxiety while taking mathematics test, (2) anxiety towards number-related tasks, (3) anxiety towards mathematics tests, (4) anxiety towards mathematics reading materials, and (5) anxiety towards other mathematical tasks. The findings of their study indicated a coefficient of determination of 65.62 percent which implies that 65.62 percent of the variations in the learners' "*level of mathematics anxiety*" can be attributed to the previously mentioned determinants.

Using Bayesian networks, Smail (2017) discovered a substantial association between mathematics anxiety and any of the variables: gender, personality types, and study habits. Smail (2017) stated that there is a higher chance for female than male learners to experience mathematics anxiety, to experience comfort in learning Mathematics, and to have regular study habits. Understanding aspects of learners' gender (Abocejo et al., 2012), personality types, and study habits is critical in providing for the needs of mathematics anxious learners.

The literature is replete with recommendations concerning interventions to be employed and approaches which schools and teachers should try applying to reduce mathematics anxiety. Geist (2015) explained that teachers who are confident about their mathematics teaching ability tend to employ instructional methods and strategies which are progressive and fit mathematics learning situations. He also recommends providing trainings to teachers that build their confidence in teaching mathematics so as to improve learners' mathematics performance.

Iossi (as cited in Thompson, Wylie and Hanna, 2016) identified three major types of interventions aimed at reducing mathematics anxiety among learners: (1) curricular, (2) instructional, and (3) non-instructional. Curricular interventions involve offering mathematics classes and remediation aimed at re-teaching mathematics. Instructional interventions are teacher-made and require active involvement and participation of learners. Non-instructional interventions are those that directly target specific behavioural and cognitive facets of the learners (Trazo and Abocejo, 2019).

The National Council of Teachers of Mathematics ([NCTM], as cited in Furner, 2017) suggests taking the following actions to thwart mathematics anxiety in the classroom: (1) consider learners' learning modalities, (2) use a range of assessment

procedures, (3) promote enjoyment in learning mathematics, (4) eliminate competition among learners, (5) stress that it is just normal to commit errors, (6) show why it is important to learn mathematics, (7) employ cooperative and collaborative approaches in learning mathematics, (8) stress creative and critical thinking, and (9) demonstrate mathematics as undertaking of man.

Similarly, Vakili and Pourrazavy (2017) recommend the following to reduce mathematics anxiety in the classroom: (1) give short and diverse assessments, (2) gradually increase difficulty of mathematics tests and exercises given, (3) integrate optimism in the mathematics lesson, and (4) promote and maintain a friendly mathematics milieu.

According to Furner (2018), using children's literature in mathematics instruction reduces mathematics anxiety among learners and thus creates comfort in the classroom. Additionally, employing children's literature raises learners' interest and confidence in learning mathematics. Technology-based interventions have also been identified as effective in lowering mathematics anxiety among learners. Love (2018) revealed that female learners exposed to online mathematics activities manifested lower mathematics anxiety than those unexposed; however, male learners exhibited the contrary. Hence, this intervention may only be used for female learners. In addition, Berkowitz (2018) recommends the use of mathematical iPad applications for learners who have highly math anxious parents. He found out that such intervention negates the impact of parents' mathematics anxiety on learners' mathematics anxiety, thereby improving their mathematics performance.

2.1 Theoretical and Conceptual Framework

We anchored our study on the following theories as advocated by their forerunners. The Deficit Theory, advocated by Rubinsten and Tannock (as cited in Carey et al., 2016), expounded that learners with low initial mathematics performance, have higher chances of experiencing mathematics anxiety. This notion implies that learners' success or failure in learning mathematics determines whether they will experience or not some degree of mathematics anxiety. The Debilitating Anxiety Model advanced by Lyons and Beilocks (as cited in Carey et al., 2016) puts forward the notion that learners' level of "*mathematics performance*" is a consequence of experiencing a certain "*level of mathematics anxiety*". Meanwhile, Reciprocal Theory of Ma and Xu and Passolunghi (as cited in Carey et al., 2016) combines the two above mentioned previous theories, suggesting that initial mathematics performance has some bearing on the increase of "*mathematics anxiety*" among leaners whose "*mathematics anxiety*" is influenced by the success or failure in learning mathematics course or subject.
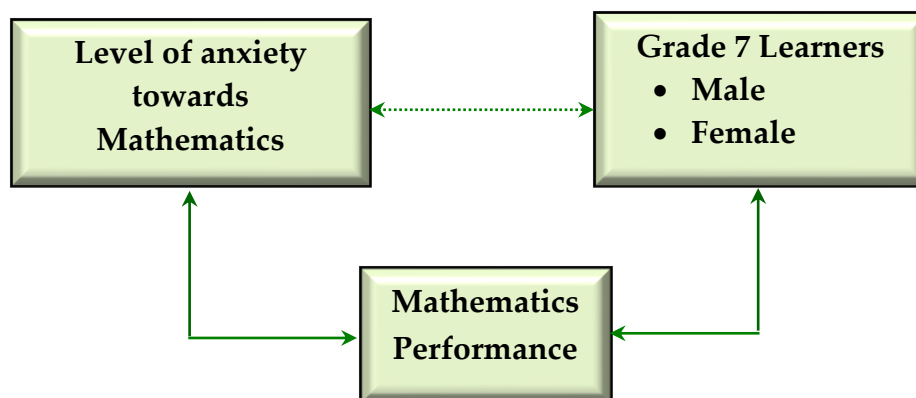
Figure 1: Conceptual Framework of the Study

In figure 1, the grade 7 learners are grouped by gender where their levels of "*mathematics performance*" were measured. The "*levels of mathematics anxiety*" is considered as the dependent variable and was correlated with learners' gender and mathematics performance.

3. Research Methodology

3.1 Research Design
This study used the descriptive-correlational research design. The descriptive research design involved determining the respondents' level of anxiety towards mathematics, their mathematics performance and the difference by gender in "*level of anxiety towards mathematics*". The correlational research design analysed the strength of association between "*level of anxiety towards mathematics and mathematics performance*".

3.2 Research Locale
The study was implemented at Macalpi-ay National High School and San Jose National High School, Leyte, Philippines during the second quarter of school year 2017–2018. Both schools are government own high school education institutions, operating under the supervision of the DepEd of the Philippine government.

3.3 Research Respondents
The respondents included seventy-six (76) grade 7 intact-group learners sampled from two population groups, one from Macalpi-ay National High School and the other from San Jose National High School in Leyte, Philippines. Simple random sampling was employed to select the identified respondents from each secondary learning institution.

3.4 Ethical Considerations
Prior to the implementation of the study, written permission was sought from the school heads of the two schools. Voluntary participation of identified research respondents was assured. Full consent from the parents of the learners in the participating grade 7 leaners classes was also obtained. The study objectives were

clearly explained to the research respondents, measures were undertaken to ensure that the respondent learners were any way not coerced nor harmed along the conduct of the study. All the generated information were dealt with utmost confidentiality and were solely be used for the study.

3.4 Research Instrument

To measure the "*anxiety level towards mathematics*", the "*Mathematics Anxiety Scale*", adopted from May (2019) with fifteen (15) items and five (5) possible responses for each item: usually, often, sometimes, seldom, and never. Meanwhile, the second periodical test scores in mathematics of the respondents were culled from the grade sheets of the teacher advisers to obtain the learners' performance in mathematics.

3.5 Data Gathering Procedures

Prior to data gathering, administering the research questionnaire and culling of test scores from teachers' grade sheets, the researchers asked permission from the principals of the respective schools to conduct the study assuring them that we observe and follow all needed protocols and ethical considerations.

Upon getting the approval, questionnaires were administered to all the grade 7 learner-respondents. Retrieval was done after the learners completed answering the questionnaires. We double checked and ensured that all items were answered. The grades of the grade 7 learners were obtained from their respective teacher advisers. The generated data underwent validation, processing, organising and summarising into tables and scatter plot for analysis and interpretation. Descriptive and inferential statistical analysis as were carried with the latter testes at 0.05 level of significance.

3.7 Treatment of Data

This study employed both descriptive and inferential statistics to analyse the gathered data. The mean and standard deviation (SD) were used to describe the "*level of anxiety towards mathematics and the mathematics performance*" of the learners. Frequencies and percentages were also computed and presented in tabular form to describe the respondents across levels of anxiety towards mathematics and mathematics performance. To examine, if there exists or not, differences in the "*level of anxiety towards mathematics*" and gender, the "*T-test for independent samples*" was used at 0.05 level of significance. To determine the association between "*level of anxiety towards mathematics and mathematics performance*", scatterplots were generated and the Pearson product moment correlation coefficients were computed at 0.01 level of significance.

3. Discussion of Results

Table 1 shows the frequency and proportion of respondents with particular "*level of anxiety towards mathematics*" and the mean anxiety score of the two respondent groups. The analysis was based on a 6 level scaling of responses generated from the survey questionnaire. Majority of the grade 7 learners (52.40 percent) have moderate "*level of*

anxiety towards mathematics", while 22.95 percent have high level of anxiety. About one-fifth (19.86 percent) of grade 7 learners manifested low "*level of anxiety*". On the extreme, two percent of the learners exhibited very high "*level of anxiety*" while 2.74 percent displayed very low "*level of anxiety towards mathematics*".

Table 1: Grade 7 leaners' level of anxiety towards mathematics

Anxiety Score Range	Level of Anxiety	Frequency	Percent (%)
4.51 – 5.00	Very High	6	2.05
3.51 – 4.50	High	67	22.95
2.51 – 3.50	Moderate	153	52.40
1.51 – 2.50	Low	58	19.86
1.00 – 1.50	Very Low	8	2.74
Mean Anxiety Score = 3.06 (Moderate)		n = 292	100.00

The grade 7 learners' "*level of anxiety*" was relatively normally distributed with mean and mode falling under the same moderate level of anxiety. Of concern are those learners manifesting high level (22.95 percent) and very high level of anxiety (2.05 percent) which, altogether accounted one-fourth of the entire learners covered in the study.

Table 2 reveals that about one-third (32.53 percent) of grade 7 learners did not meet the expected performance, indicating that they have failed in the mathematics test. Almost one third (33.22 percent) just attained satisfactory performance. The remaining one-third of the learners' learners under study exhibited either satisfactory (12.67 percent), very satisfactory 8.56 percent) and outstanding (13.01 percent) performances. As indicated by the grand mean, the grade 7 learners were not able to meet the expected performance in mathematics (grand mean= 66), suggesting that their overall performance in math was really poor.

Table 2: Grade 7 learners' mathematics performance

Score Range	Description	Frequency	Percent (%)
90 – 100	Outstanding	38	13.01
85 – 89	Very Satisfactory	25	8.56
80 – 84	Satisfactory	37	12.67
75 – 79	Fairly Satisfactory	97	33.22
Below 75	Did Not Meet Expectation	95	32.53
Mean Score = 66 (Did Not Meet Expectation)		n = 292	100.00

The T-test of two independent samples was employed to examine the significant difference (or otherwise) in "*level of anxiety towards mathem*atics" between male and female grade 7 learners. As reflected in Table 3, the T-test yielded a p-value greater than the level of significance of 0.05 indicating not to reject the null hypothesis (Ho). This suggests that both male and female have statistically the same "*level of anxiety towards mathematics*". In other words, gender has no influence on the "*anxiety level towards mathematics*". In this study, it does not matter whether a student is male or female, he or she can have either low or high "*level of anxiety towards mathematics*".

Table 3: Difference in the level of anxiety towards mathematics by gender

Gender	n	Mean	SD	T-value	P-value
Males	143	3.01	0.54	-1.45ns	0.148
Females	149	3.11	0.53		

ns - not significant

Using scatterplots, the relationship between "*mathematics performance and level of anxiety towards mathematics*" was explored. Figure 2 reflects a seemingly inverse relationship between "*level of mathematics anxiety and academic performance*" indicated by the learners' test scores of the male group. There is also an inverse association of data points from left to right which indicates a rather negative linear relationship between the two variables. This somehow suggests that the higher the "*level of anxiety towards mathematics*" among male grade 7 learners, their corresponding mathematics performance tend to go lower. There is really a need to bring down the "*anxiety level towards mathematics*" of male grade 7 learners if their "*mathematics performance*" is to be improved.
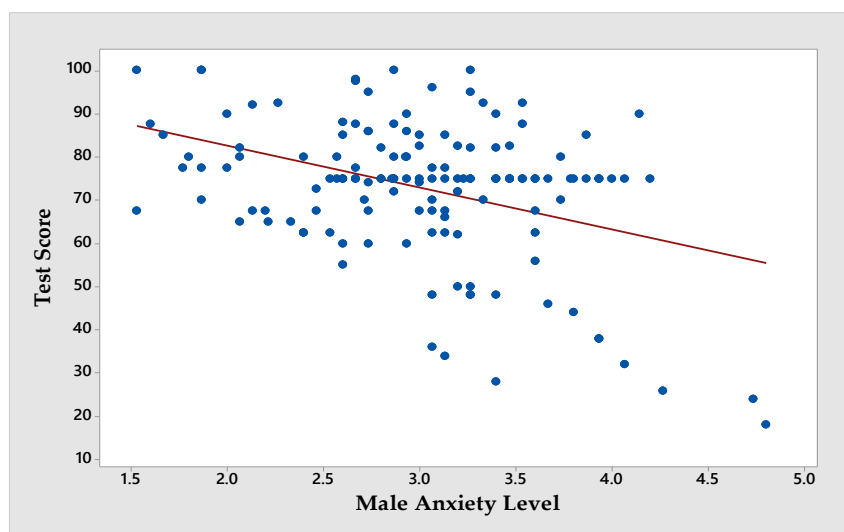

Figure 2: Male learners Mathematics mean anxiety and test scores

Similar scatterplot was constructed for the female group. The same trend of data points are observed in Figure 3, indicating a negative association between the anxiety levels of female grade 7 learners and their mathematics performance. In like manner with their male counterparts, the female grade 7 learners tend to have lower mathematics performance when their corresponding "*anxiety level towards mathematics*" gets higher. The two variable go on the opposite direction.
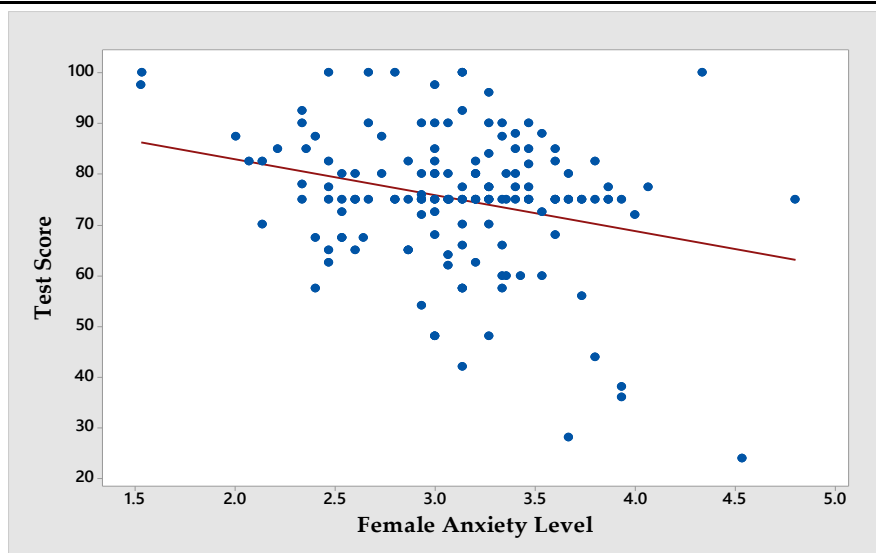
Figure 3: Female learners Mathematics mean anxiety level and test scores

As shown in Table 4, all test of bivariate correlational test yielded highly significant but inverse association of the study variables. Findings revealed that anxiety level is inversely and highly correlated with mathematics performance suggesting to the fact that when grade 7 learners manifest high level of anxiety, their mathematics performance is correspondingly low. In terms of magnitude, for every unit change in the anxiety level, will bring about 0.389 unit corresponding decline in mathematics performance among the grade 7 leaners. A similar finding is revealed in the relationship of the same paired variables for the female group with about 0.277 unit corresponding decline in mathematics performance per unit change in anxiety level.

Table 4: Correlation between level of anxiety
towards mathematics and mathematics performance

Group	n	Mean	SD	r-value	P-Value
Male learners anxiety level	143	3.01	0.64	-0.389**	0.000
Male learners' Mathematics Performance	143	72.76	16.11		
Female learners anxiety level	149	3.11	0.53	-0.277**	0.001
Female learners' mathematics performance	149	75.16	13.56		
Total learners anxiety level	292	3.06	0.59	-0.333**	0.000
Total learners' mathematics performance	292	73.98	14.88		

*** - highly significant at $\alpha \leq 0.01$*

Table 4 also reveals the existence of an inverse linear relationship between "*level of anxiety towards mathematics and mathematics performance*", arguably however, the relationship is higher in magnitude stronger for male learners than their female learners' counterpart.

5. Conclusion and Recommendations

In the light of the study findings, it is concluded that learners' mathematics anxiety has negative bearing on leaners' mathematics performance. Learners with higher

"*mathematics anxiety level*" tend to have lower mathematics performance. Conversely, learners with lower "*mathematics anxiety level*" tend to demonstrate higher performance in mathematics. The study variables did not go hand in hand, instead to opposite direction. Notwithstanding the same level of anxiety towards mathematics by gender, the inverse association between learners' "*anxiety level towards mathematics*" and mathematics performance is higher for male than their female counterpart. Overall, gender has no bearing on anxiety level and the learners' mathematics performance. Indeed, "*anxiety towards mathematics*" need be tamed down to low level if the desire is to boast mathematics performance among grade 7 learners. Indeed, mathematics anxiety is a crucial factor which can determine the level of mathematics performance among high school learners. There is a need to bring down anxiety level and any of its contributing attributes if, to realise commendable performance in mathematics. Future research may be conducted considering more variables other than gender, "*level of anxiety towards mathematics and mathematics performance*" at various levels among high school learners.

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