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The Effects of Mathematics Anxiety on Academic Performance of Moshood Abiola Polytechnic Students

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Abstract
Mathematics anxiety component is there either in cognitive domain or affective domain or psychomotor domain of affected students. Its negative effects on academic performance; emotional stability and physiological build of those students therein can't be ignored but for us to clinically examine and provide, if possible, solutions. The research work then examines equal; individual; and joint effects of Mathematics anxiety factors on academic performance. It also investigates if indeed these factors have strong association with either the course of study or students' gender. From the results, those factors do not have the same effect on AP (Academic performance) but exert joint significant effect on AP. It is amazing that Mathematics anxiety is associated with the choice of course of study by students but independent of students' gender.

Keywords: Academic, Anxiety, Effects, Mathematics, Performance, Students

I. Introduction

The fear of learning and comprehension of Mathematics by students has gained a remarkable attention from educational researchers over the years. So many responsible factors have been considered by researchers such as:

Obinna, E. and Anne, M. (2011) submitted that anybody who has undergone the study of Mathematics or Statistics in any tertiary institution in Nigeria will agree that the experience is tortuous and often a mere drill and drudgery. Obinna, E. *et al* (2011) further asserted that attitude of Mathematics teachers at the tertiary level of education is also very prevalent at the secondary where Mathematics teachers actually mystify Mathematics and students go with the impression that Mathematics is such a difficult subject which should be left for the exceptional students. Mystification of Mathematics by most teachers (most not qualified to teach Mathematics) is also prevalent at the primary level. Invariably, it creates an erroneous impression (fear; worry) in pupils/students that mathematical contents are very difficult to comprehend. Among these obstacles, the affective component is often overlooked.

The construct of Mathematics anxiety typically refers to the emotional and mental distress that occurs in some students while attempting to understand Mathematics. Though in practice, it is somewhat ill defined. Beginning in 1972, the Mathematics Anxiety Rating Scale (MARS) was developed by Dr. Suinn Richard (Wu, Amin, Malcarne, Menon, 2012). It is unclear how Dr. Richard conceptualized Mathematics anxiety and the intended use of the test. The content specific aspects are geared toward arithmetic and algebra, whereas other subjects are poorly represented. It is also unclear how the MARS scale would differentiate among or be influenced by factors such as dislike of Mathematics, clinical anxiety, social anxiety, and mathematic competency (McMorris, 1988). Since that time, a variety of other methods of measurement have been developed, including Revised Mathematics Anxiety Survey (R-Manx), the Fennema-Sherman Mathematics Attitudes scales, and surveys designed to measure attributes that relate to anxiety. Related to these are the emotional and physiological components.

The negative effects of Mathematics anxiety on students' achievement in Mathematics have gained a remarkable attention from researchers for several years. Richardson and Woolfolk

(1980) discussed how certain features of Mathematics, such as its precision, logic, and emphasis on problem solving, make it particularly anxiety provoking for some individuals. Studies have documented the negative effects of Mathematics anxiety on math performance and achievement (Richardson & Suinn, 1972; Suinn, Edie, Nicoletti, & Spinelli, 1972). Several researchers also have proposed that math anxiety contributes to observed sex differences in Mathematics achievement and course enrolment patterns (e.g., Fennema, 1977; Fox, 1977; Tobias & Weissbrod, 1980).

Various questions concerning math anxiety have received scant research attention. First, the dimensionality of math anxiety has not been explored fully. In the test anxiety area, Liebert and Morris (1967) distinguished two components of test anxiety, worry and emotionality. *Worry* is the cognitive component of anxiety, consisting of self-deprecatory thoughts about one's performance. *Emotionality* is the affective component of anxiety, including feelings of nervousness, tension and unpleasant physiological reactions to testing situations.

Morris and Liebert showed that these two components of anxiety are empirically distinct, though they are correlated, and that worry relates more strongly than emotionality to poor performance (see Morris, Davis, & Hutchings, 1981, for a review of the work on worry and emotionality). Anxiety theorists (e.g., Sarason 1986; Wine, 1971, 1980) believe that the worry or cognitive component of test anxiety interferes most with achievement performance.

II. Statement of the Problem

The decline in performance in Mathematics by students of Moshood Abiola Polytechnic has created anxiety in students and strengthens the perception that they are weak in math. This response will ultimately be a belief that has to change. According to Hadfield and McNeil (1999), most students experience math anxiety since elementary school. This fear is transferred by school teachers through teaching methods. Traditional methods such as lecturing; teaching basic skills without an emphasis on the concept has been identified as a factor that contribute to Mathematics anxiety. Research by Fulya (2008), Marzita (2002), Arem (1993) and Tobias (1980), has shown that Mathematics anxiety had become one of the factors contributing to the decline of the mathematical achievements of the students.

Three major Mathematics anxiety factors (Physical/Emotional, Assessment and Social factors) have been identified to be mainly responsible for Mathematics anxiety among students which in the long run affects academic performance. The problem of this research work is tackling Mathematics anxiety among students of Moshood Abiola Polytechnic in a bid to improve academic performance.

III. Aim and Objectives of the Study

The aim of this study is to statistically investigate the effects of Mathematics anxiety on academic performance of Moshood Abiola Polytechnic students.

The objectives are:

1. To find out if the Mathematics anxiety factors have equal effect on the academic performance of the students.
2. To determine the individual influence and significance of the Mathematics anxiety factors on the academic performance of the students.
3. To investigate the joint effect and significance of the Mathematics anxiety factors on the academic performance of the students.
4. To examine the strength of the relationship (correlation) among the Mathematics anxiety factors, and also between the Mathematics anxiety factors and academic performance of the students.
5. To investigate whether Mathematics anxiety factors is independent of nature of the course of study or gender of students.
6.

Iv. Research Questions

The following research questions shall guide the study and sharpen the course of the investigation:

1. Do the Mathematics anxiety factors have equal effect on the academic performance of the students?
2. What type of influence and significance does the individual Mathematics anxiety factors exerts on the academic performance of the students?
3. What type of effect and significance do the Mathematics anxiety factors jointly have on the academic performance of the students?
4. What is the strength of the relationship (correlation) among the Mathematics anxiety factors, and also between the Mathematics anxiety factors and academic performance of the students?
5. Are Mathematics anxiety factors independent of nature of the course of study or gender of students?

V. Statement of Hypotheses

1. H_{01}: The Mathematics anxiety factors do not have equal effect on the academic performance of the students.
2. H_{02}: Individual Mathematics anxiety factors do not exert significant influence on the academic performance of the students.
3. H_{03}: The Mathematics anxiety factors do not exert joint significant influence on the academic performance of the students.
4. H_{04}: There is no correlation among the Mathematics anxiety factors, and also between the Mathematics anxiety factors and academic performance of the students.
5. H_{05}: Mathematics anxiety factors are not related to the nature of the course of study and gender of students.

Vi. Scope of the Study

This research work covers only "Full Time" students of Moshood Abiola Polytechnic for the 2016/2017 academic session. It covers 5000 randomly selected registered students across all the departments of the institution. The research data is primary in nature.

Vii. Literature Review

Extreme Mathematics anxiety which is left unchecked would have negative consequences for students (Arem, 1993; Marzita, 2002). The studies of Effandi and Norazah (2008) and Marzita (2002) have found that the majority of Malaysian students have a moderate level of Mathematics anxiety. According to Hadfield and McNeil (1994), most of the students begin experiencing Mathematics anxiety from elementary school. Arem (1993) and Marzita (2002), have found that there are many factors that leads to Mathematics anxiety such as curriculum weakness, negative experiences in Mathematics, pressure and family expectations, teacher's personality and teaching style, dreams and expectations of family and peer influences. The study also found that there is an inverse relationship between the level of Mathematics anxiety and Mathematics performance of students. Salwani, T. and A. Salleh (2001), have found that high level of Mathematics anxiety led to decline of student's achievement with the correlation $r = -0.254$ and $p < 0.05$. The finding is consistent with the findings of Effandi and Norazah (2008). A study of two semesters of matriculation students has found that there is a significant negative relationship between Mathematics anxiety and Mathematics performance of students. The finding is also consistent with the findings of Fulya (2008) and Marzita (2002). The results show that if a student has math anxiety problems, then the student's achievement in Mathematics will deteriorate and if the student has less math anxiety level or controlled the anxiety then Mathematics performance is good.

Anxiety according to Freud (1936), is an unpleasant feeling that can cause emotional distress. Mathematics anxiety according to Marzita (2002), is a feeling of being stressed and anxious when faced with numbers and mathematical problem solving in everyday life or when learning Mathematics. Arem (1993) defines math anxiety as a feeling of worry, anxiety, denial, resistance and rejection reactions in Mathematics and problem solving. According to Marzita (2002), Mathematics anxiety exists due to various factors such as classroom climate, mathematical abstraction, past experience, the pressure from the family, the experience of being humiliated in front of the class, teaching techniques and so on. This finding is consistent with the findings of Norwood (1994), Arem (1993) and Greenwood (1984). Extreme anxiety, not controlled, will bring serious consequences to an individual. In terms of Mathematics perception, Arem (1993), Philips (1999), Tobias (1980) and Zaslavsky (1994) found that many students are not able to deliver a good performance in Mathematics when they are feeling worried or anxious in applying their math skills.

Definition and Nature of Mathematics Anxiety

Mathematics anxiety describes the state of mind developed through personal experience, and individual emotional responses to these experiences. Negative feelings towards learning Mathematics arise as a consequence of a range of encounters relating to the way Mathematics is presented, taught and learnt by individuals (Green & Allerton, 1999). According to Sheffield and Hunt (2007), Mathematics anxiety in many ways is easy to describe and define. It is the feelings of anxiety that some individuals experience when facing mathematical problems. Like other forms of anxiety, students may feel their heart beat more quickly or strongly, they may believe they are not capable of completing a Mathematics problem, or they may avoid attempting Mathematics courses. Mathematics anxiety is known as a disabling condition when students struggle with Mathematics. This condition according to Oxford and Vordick 2006 is a specific and real fear of Mathematics that causes students to have an obsessive urge to avoid Mathematics completely. Mathematics anxiety can occur at all the levels of the educational strata from primary school to higher education, and once established, can persist in life, interfering with every day activities involving numeracy experiences in working with teachers, tutors, classmates, parents or siblings (Yenilmez, Girginer, & Uzun, 2007). Many students who suffer from Mathematics anxiety have little confidence in their ability to do Mathematics and tend to take the minimum number of required Mathematics courses, greatly limiting their career choice options. This is unfortunate especially as society becomes more reliant on mathematical literacy (Scarpello, 2005). Barnes (2006) stated that Mathematics anxiety could be caused by a number of things: unpleasant past experiences with Mathematics in the classroom, a parent conveying the message to their child that Mathematics is boring and useless, or from the attitudes of the teachers themselves. Mathematics anxiety is a problem for many college students, not only those in developmental Mathematics courses. If a technique is found to facilitate the alleviation of Mathematics anxiety from students through improved pedagogies, information, and resources, it could remedy students' Mathematics anxiety while helping them acquire the necessary Mathematics skill required for degree completion (Johnson, 2003).

Mathematics Anxiety and Gender

Several studies have been conducted to investigate the level of Mathematics anxiety among male and female students. Some researchers have argued that females have higher Mathematics anxiety than males (Salwani and Salleh, 2001; Yuksel-Sahin, 2008; Karimi and Venkatesan, 2009; Khatoon and Mahmood, 2010). In addition, female students are often labelled as shy and this characteristic can harm their ability to learn. Male students were found to be more active in a wider range of social activities than female students (Khatoon and Mahmood, 2010). Yuksel-Sahin (2008) study on secondary school students in Turkey reported that the stereotypical view of this issue has a powerful impact. Female students believed boys were blessed with the advantage of mastering Mathematics, while the boys thought they were better able to perform in Mathematics when compared with their female counterparts. Such believes negatively affect the ability of female students and their initial assumptions about Mathematics achievement can have a long-term impact on their math achievement. However, other studies do not support this theory. Based on several studies, some researchers have argued that there is no significant difference in Mathematics anxiety between males and females (Marsh and Tapia, 2002; Elenchothy, 2007; Mohamed and Tarmizi, 2010).

Mathematics Anxiety and Achievement

According to Sherman and Wither (2003), a five-year study conducted on students from the age of 6 to the age of 10 revealed that the level of Mathematics anxiety in students is strongly related to their achievement. This is supported by studies by Elenchothy (2007), which showed an inverse relationship between Mathematics anxiety and student's achievement. His findings were based on the results of Lower Secondary Assessments (PMR) for students in the district of Klang, Malaysia. This inverse relationship means that students with high Mathematics anxiety will realize low achievement in Mathematics. The result conform to the findings of Khatoon and Mahmood (2010); Yuksel-Sahin (2008) and Satake and Amato (1995). Students will often feel worried, tired and afraid or feel that Mathematics is not important and will generally refuse to learn Mathematics, even though it is the primary gateway to engineering, science and technology. According to Arem (2009), students with high Mathematics anxiety levels engage in negative thinking about their self-ability. These students will exhibit less confidence in working with numbers and Mathematics concepts through a problem-solving process. Zakaria (1997) also explained that students with high performance levels in Mathematics have a positive attitude toward Mathematics. This is in line with several researchers who reported that students can be encouraged to work and train without being asked by the teacher if they developed interest. Interest and confidence in this aspect are very important in learning to reduce anxiety in Mathematics and eventually being able to obtain good results on examinations.

The Influence of Parents, Teachers, Society and Peer on Mathematics Anxiety

Parental involvement and a parents' role in changing attitudes toward Mathematics are important. Parents need to take a proactive role in the education of their children (Furner & Berman, 2003). Supportive parents contribute to the success of their children while unsupportive ones add to the academic problems (Silva, Tadeo, Reyes, & Dadigan, 2006). Parents should talk with their children about their anxieties. They should discuss the feelings that the child associates with Mathematics and try to pin point when the child started to experience these feelings (Rossnan, 2006). Oxford and Vordick (2006) stated that there are many more influences that are believed to help cause Mathematics anxiety. The teachers' attitude is a major factor since students do not want to learn a subject that the teacher seems uninterested in or uncomfortable with. Other issues include impractical applications, high volumes of assigned problems, and short time spans to complete an assignment. McNaught (2007) indicated that good teachers are able to create a learning environment in which students have high and positive expectations about their learning, co-operative behaviour is pronounced, and the culture encourages learning to occur. Rossnan (2006) suggested that teachers and parents should work together to assure every student that learning Mathematics is important, relevant, and fun so that they can learn the Mathematics skills that they need to succeed. Peer engagement makes a direct contribution to student's learning and success. Peer may provide instrumental aid, by teaching or tutoring their friends, by helping them keep track of assignments, or by studying together. These supports would make their efforts more effective, in terms of both learning and graded performances on homework, projects, and tests (Kindermann & Skinner, 2008). Shields (2006) reported that society plays a large role in the development of Mathematics anxiety.

Viii. Research Methodology

Research Design

This study is set out to investigate the effects of Mathematics anxiety on academic performance of Moshood Abiola Polytechnic students. A number of statistical techniques of analysis have been used by researchers in a bid to investigate Mathematics anxiety among students. However, this study extensively makes use of Multiple regression analysis, Chi-square test, ANOVA test, and Correlation analysis.

The design adopted for the study is survey design. Primary data was collected using self-administered questionnaire. The questionnaire contained two sections: section A entails respondent's demographic data while section B entails the research parameters: physical and emotional factors, assessment factors, social factors and academic performance. A sample of 5000 respondents were randomly selected from a population of 13993 only full time students of the institution for the 2016/ 2017 academic session across the entire 28 departments using stratified and simple random sampling techniques in order to ensure that every member of the population has an equal chance of being included in the sample. The data collected was modelled as multiple linear regression and analyzed electronically using SPSS 21 (IBM version) and Minitab 17.

The model under consideration is the linear model of the form:

$$AP = b_o + b_1 PEF + b_2 AF + b_3 SF + u_i \qquad (1)$$

where AP = Academic Performance → *Dependent/Explained variable*

PEF = Physical and Emotional Factors

AF = Assessment Factors

SF = Social Factors

} *Independent/Explanatory variables*

b_o = intercept

b_1, b_2, b_3 are regressors' coefficients and u_i = error term

Study Population

The population of this study includes only the full-time 100 level (ND I), 200 level (ND II), 300 level (HND I), and 400 level (HND II) students of Moshood Abiola Polytechnic for the 2016/2017 academic session. The total population is 13993.

Sample and Sampling Techniques

A sample of 5000 students was randomly selected after obtaining the total number of students from the respective school records for each department of each school. A stratified sampling technique was first applied to take care of the heterogeneity of the population by selecting sample proportion across the departments and thereafter across the levels using the formula:

$$n_k = \left(\frac{N_k}{N}\right) n \qquad (2)$$

Where: $n_k =$ desired sample proportion from each strata.

$N_k =$ Population of the kth strata.

$N =$ Total population size.

$n =$ Desired sample size.

A simple random sampling technique using table of random numbers was thereafter applied to select the desired 5000 sample students for the study.

Method of data analysis

For the purpose of this research work, multiple regression analysis technique is majorly used to analyze the joint and individual effects of Mathematics anxiety on the academic performance of students. The Multiple linear regressions (MLR) analysis is a method used to model the linear relationship between a dependent variable and one or more independent variables. The dependent variable is sometimes called the predicted and the independent variables the predictors. MLR is based on least squares: the model is fit such that the sum-of-squares of differences of observed and predicted values is minimized. Several regression statistics are computed as functions of the sum of square terms. The regression equation is estimated such that the total sum–of–squares can be partitioned into components due to regression and residuals.

Coefficient of determination: The explanatory power of the regression is summarized by its R–square value, computed from the sum of square term. R^2, also called the coefficient of determination, is often described as the proportion of variance accounted for, explained or described by regression. It is important to keep in mind that, just as correlation does not imply causation, a high R^2 in regression does not imply causation. The relative sizes of the sums of squares terms indicate how good the regression is in terms of fitting the calibration data. If the regression is perfect all residual are zero. SSE is zero, and R^2 is 1. If the regression is a total failure, the sum of squares of residuals equals the total sum of square. No variance is accounted for by regression, and R^2 is zero.

The sum of squares and related statistics are often summarized in an Analysis of Variance (ANOVA) table**.**

Source of variation	Df	SS	MS
Regression	k	SSR	$MSR = \frac{SSR}{k}$
Residual	$n - k - 1$	SSE	$MSE = \frac{SSE}{n-k-1}$
Total	$n - 1$	SST	

Df = degrees of freedom for SS term, SS = sum of squares term, MS = mean square terms

The mean square terms are the sums of squares terms divided by the degree of freedom.

The explanatory power of a regression is given by the regression R^2, which is computed from sums of squares terms. The F–ratio or overall F, which is computed from the mean square terms in the ANOVA table, estimates the statistical significance of the regression equation. The F–ratio is given by

$$F = \frac{MSR}{MSE} \quad \text{— (3)}$$

The advantage of the F–ratio over R^2 is that the F–ratio takes into account the degrees of freedom, also depends on the sample size and the number of predictors in the model. A model can have a high R^2 and still not be statistically significant if the sample size is not large compared with the number of predictors in the model. The F–ratio incorporates sample size and number of predictors in an assessment of significant of the relationship.

Manually, the significance of the F–ratio is obtained by referring to a table of the F–distribution, using degree of freedom {df_1, df_2}, where df_1 and df_2 are the degrees of freedom for the regression mean square and residual mean square respectively from the ANOVA table. Electronically, the significance of the F–ratio is obtained by comparing its p-value with the level of significance (α) set for the analysis.

One-way Analysis of Variance technique is used to analyse the equality of the effects of Mathematics anxiety factors on the academic performance of the students. One-way analysis of variance is used when the data are divided into groups according to only one factor. We may represent the picture of our hypothetical data by the design below.

	Treatment 1	Treatment 2	Treatment 3	…	Treatment k	
	y_{11} y_{12} y_{13} ⋮ ⋮ y_{1n}	y_{21} y_{22} y_{13} ⋮ ⋮ y_{2n}	y_{31} y_{32} y_{33} ⋮ ⋮ y_{3n}	⋯ ⋯ ⋯ ⋮ ⋮	y_{k1} y_{k2} y_{k3} ⋮ ⋮ y_{kn}	
Total ($y_{i.}$) Mean ($\bar{y}_{i.}$)	$y_{1.}$ $\bar{y}_{1.}$	$y_{2.}$ $\bar{y}_{2.}$	$y_{3.}$ $\bar{y}_{3.}$	⋯ ⋯	$y_{k.}$ $\bar{y}_{k.}$	$y_{..}$ $\bar{y}_{..}$

The linear statistical model that describes the data of this design is of the form:

$$y_{ij} = \mu + \tau_i + \varepsilon_{ij} \quad \text{— (4)}$$

Where y_{ij} is the j^{th} observation of the i^{th} treatment

μ is the population mean, also denoted $\bar{y}_{..}$

τ_i is the treatment effect of the i^{th} treatment, also denoted $(\bar{y}_{i.} - \bar{y}_{..})$ and

ε_{ij} is the random error, also denoted $(y_{ij} - \bar{y}_{i.})$

The assumption of additivity shows us that the total sum of squares (SS_T) for the model can be divided into two independent parts: sum of squares among treatments (SS_{trt}) and sum of squares error (SS_E). This implies that the deviation of a particular observation from the population mean or grand mean, that is $(y_{ij} - \bar{y}_{..})$, is made up of deviation from the mean of the treatment to which the observation belongs $(y_{ij} - \bar{y}_{i.})$ and deviation of the treatment mean from the population mean $(\bar{y}_{i.} - \bar{y}_{..})$.

That is

$$(y_{ij} - \bar{y}_{..}) = (\bar{y}_{i.} - \bar{y}_{..}) + (y_{ij} - \bar{y}_{i.}) \quad \text{— (5)}$$

Summing for n pairs of observations and summing across the k treatments, we have

$$\sum_{i=1}^{k}\sum_{j=1}^{n}(y_{ij} - \bar{y}_{..})^2 = n_j\sum_{i=1}^{k}(\bar{y}_{i.} - \bar{y}_{..})^2 + \sum_{i=1}^{k}\sum_{j=1}^{n}(y_{ij} - \bar{y}_{i.})^2 \quad \text{—(6)}$$

This implies that

$$SS_T = \sum_{i=1}^{k}\sum_{j=1}^{n}(y_{ij} - \bar{y}_{..})^2 = \sum_{i=1}^{k}\sum_{j=1}^{n} y_{ij}^2 - \frac{(y_{..})^2}{N} \quad \text{—(7)}$$

Where

$$y_{..} = \sum_{i=1}^{k}\sum_{j=1}^{n} y_{ij}$$

$$SS_{trt} = n_j \sum_{i=1}^{k}(\bar{y}_{i.} - \bar{y}_{..})^2 = \sum_{i=1}^{k}\left[\frac{(y_{i.})^2}{n_j}\right] - \frac{(y_{..})^2}{N} \quad \text{—(8)}$$

$$SS_E = SS_T - SS_{trt}$$

$$SS_E = \sum_{i=1}^{k}\sum_{j=1}^{n}(y_{ij} - \bar{y}_{i.})^2 = \sum_{i=1}^{k}\sum_{j=1}^{n} y_{ij}^2 - \sum_{i=1}^{k}\left[\frac{(y_{i.})^2}{n_j}\right] \quad \text{—(9)}$$

We may hence tabulate and analyse our results as follow

Anova Table

Source of variation	SS	Df	MS	F_{ratio}
Treatments	SS_{trt}	$k-1$	$MS_{trt} = \frac{SS_{trt}}{k-1}$	$\frac{MS_{trt}}{MS_E}$
Error	SS_E	$N-k$	$MS_E = \frac{SS_E}{N-k}$	
Total	SS_T	$N-1$		

Df = degrees of freedom for SS term, SS = sum of squares term, MS = mean square terms

Ix. Data Analysis

Table 1: One-Way Analysis of Variance *(Mathematics Anxiety Factors)*

Null hypothesis all means are equal
Alternative hypothesis At least one mean is different
Significance level $\alpha = 0.05$

Equal variances were assumed for the analysis.

Factor Information

Factor Levels Values
Factor 3 1, 2, 3
1 = Physical and Emotional Factor (PEF)
2 = Assessment Factor (AF)
3 = Social Factor (SF)

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	2	50122	25061.0	402.96	0.000
Error	14997	932694	62.2		
Total	14999	982816			

Means

Factor	N	Mean	StDev	95% CI
1	5000	23.376	8.071	(23.158, 23.595)
2	5000	27.493	8.169	(27.274, 27.711)
3	5000	26.960	7.396	(26.742, 27.179)

Pooled StDev = 7.88619

Table 2: Tukey Pairwise Comparisons

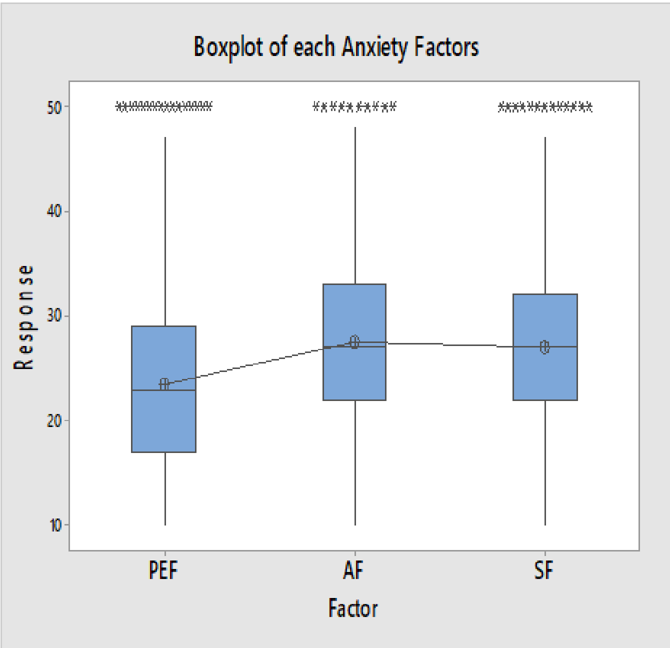
Grouping Information Using the Tukey Method and 95% Confidence

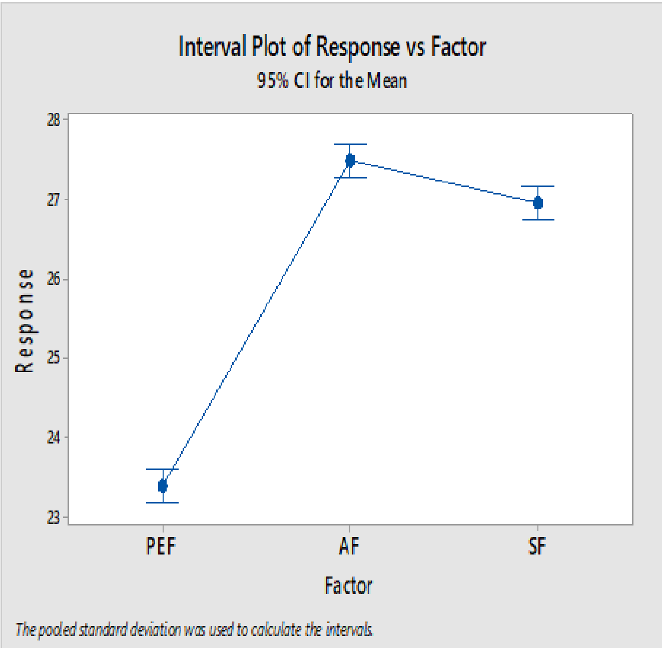
Factor	N	Mean	Grouping
2	5000	27.493	A
3	5000	26.960	B
1	5000	23.376	C

Means that do not share a letter are significantly different.
Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
2 - 1	4.116	0.158	(3.747, 4.486)	26.10	0.000
3 - 1	3.584	0.158	(3.215, 3.953)	22.72	0.000
3 - 2	-0.532	0.158	(-0.902, -0.163)	-3.38	0.002

Individual confidence level = 98.07%





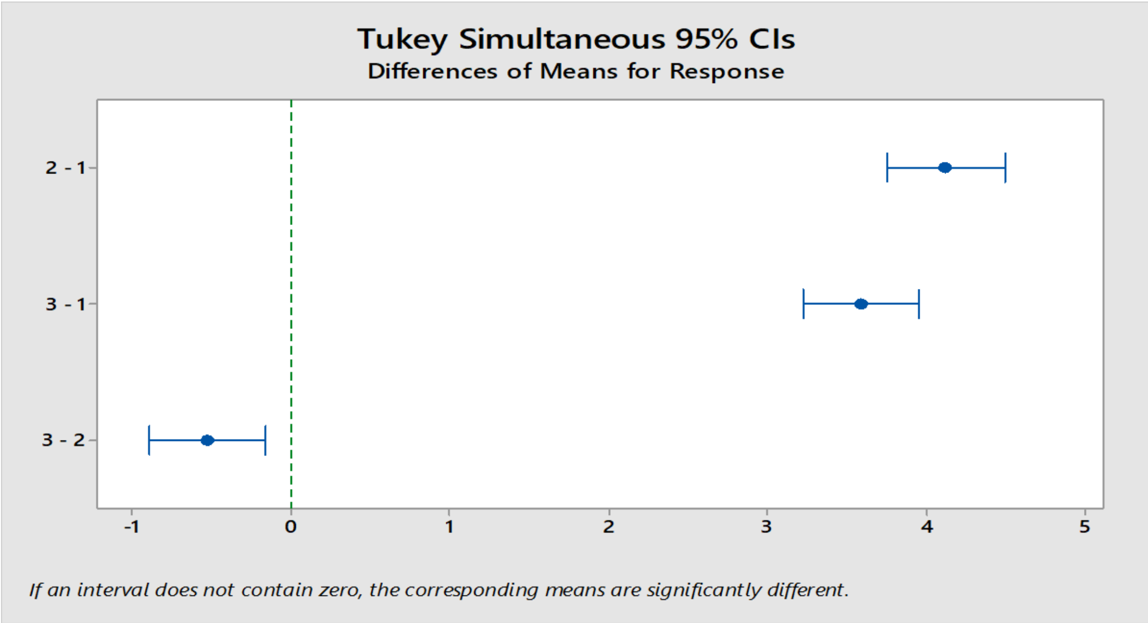


Table 3: Regression Model Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	37.784	0.442	85.52	0.000	
PEF	0.0075	0.0106	0.71	0.477	1.02
AF	0.0159	0.0105	1.52	0.128	1.03
SF	0.0377	0.0116	3.26	0.001	1.03

Regression Equation

AP = 37.784 + 0.0075 PEF + 0.0159 AF + 0.0377 SF

Table 4: Regression ANOVA for Joint Effect

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	3	572	190.74	5.37	0.001
Error	4996	177430	35.51		
Total	4999	178002			

Table 5: Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
5.95940	0.32%	0.26%	0.15%

Table 6: Correlation Matrix

	PEF	AF	SF
AF	0.120 0.000		
SF	0.114 0.000	0.139 0.000	
AP	0.018 0.199	0.030 0.037	0.051 0.000

Cell Contents: Pearson correlation
P-Value

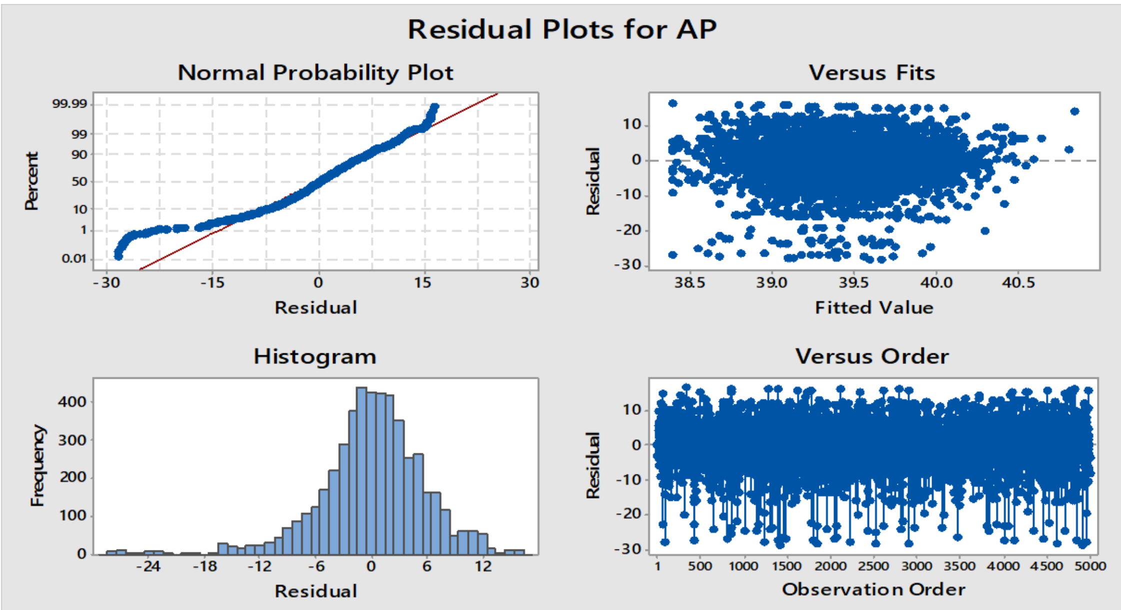


Table 7: Chi-Square Tests *(Course of Study * Anxiety)*

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	112.136[a]	54	.000
Likelihood Ratio	111.720	54	.000
Linear-by-Linear Association	.461	1	.497
N of Valid Cases	389145		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 151.38.			

Table 8: Chi-Square Tests *(Gender * Anxiety)*

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.816[a]	2	.245
Likelihood Ratio	2.817	2	.245
Linear-by-Linear Association	1.485	1	.223
N of Valid Cases	389145		

X. Discussion of Results

Table 9: Summary of Results

Tukey HSD multiple comparisons of means			
V*ariable*	Physical and Emotional factor	Assessment Factor	Social Factor
Physical and Emotional factor	-	Significant (0.000)	Significant (0.000)
Assessment Factor	Significant (0.000)	-	Significant (0.002)
Social Factor	Significant (0.000)	Significant (0.002)	-
Coefficients (α =0.05)			
Variable	Effect	Sig. value	Remark
Physical and Emotional factor	Positive	0.477	Insignificant
Assessment Factor	Positive	0.128	Insignificant
Social Factor	Positive	0.001	Significant

Discussion of results

The One-way ANOVA table (Table 1) gives a *Sig. value* of 0.000 which is less than the conventional level of significance (α = 0.05). This implies that the null hypothesis of equal effect is rejected. In other words, the Mathematics anxiety factors under study do not have equal effect on the academic performance of the students.

The Tukey pairwise comparison test (Table 2) above shows that the significant effects exist between all the possible pairs of factors.

From the coefficient table (Table 3) the regression model can be deduced as:

$$AP = 37.784 + 0.0075PEF + 0.0159AF + 0.0377SF$$

where *AP* = Academic Performance → *Dependent/Explained variable*

PEF = Physical and Emotional Factors
AF = Assessment Factors
SF = Social Factors
} *Independent/Explanatory variables*

b_o = 37.784

$b_1 = 0.0075, b_2 = 0.0159, \text{and } b_3 = 0.0377$

The intercept (b_0) value of 37.784 implies that in the absence of all the Mathematics anxiety factors under study, the academic performance of a student is expected to be 37.784 (approximately 85.9%).

$b_1 = 0.0075$ implies that for every unit increase in Physical and Emotional factor while other anxiety factors (Assessment factor and Social factor) are kept constant, a student's academic performance is expected to improve by 0.0075 (0.017%). The positive sign indicates that Physical and Emotional factor has a positive effect on academic performance of students. The *Sig. value* of 0.477 which is greater than the conventional level of significance (α = 0.05) implies that the observed positive effect of Physical and Emotional factor on academic performance of students is insignificant.

$b_2 = 0.0159$ implies that for every unit increase in Assessment factor while other anxiety factors (Physical & Emotional factor and Social factor) are kept constant, a student's academic performance is expected to improve by 0.0159 (0.036%). The positive sign also indicates that Assessment factor has a positive effect on academic performance of students. However, the *Sig. value* of 0.128 which is greater than the conventional level of significance (α = 0.05) implies that the observed positive effect of Assessment factor on academic performance of students is insignificant.

$b_3 = 0.0377$ implies that for every unit increase in Social factor while other anxiety factors (Physical & Emotional and Assessment factors) are kept constant, a student's academic performance is expected to improve by 0.0377 (0.086%). The positive sign indicates that Social factor has a positive effect on academic performance of students. The Sig. value of 0.001 which is less than the conventional level of significance (α = 0.05) however indicates that the observed positive effect of Social factor on academic performance of students is significant.

The regression ANOVA table (Table 4) gives a *Sig value* of 0.001, which is less than the set conventional level of significance (α = 0.05) implies that the Mathematics anxiety factors under study exert joint significant influence on the academic performance of the students.

The model summary table (Table 5) gives the coefficient of determination (R^2) of 0.32% (0.0032), which implies that approximately 0.32% of the variation in a student's academic performance is being explained by the Mathematics anxiety factors (Physical and emotional factor, Assessment factor and Social factor).

The bivariate correlation table (Table 6) indicates that there is a weak positive but imperfect association (0.120) between Physical & Emotional factor and Assessment factor. The correlation value of 0.114 between Physical and Emotional factor and Social factor implies that the degree of association is a weak positive and imperfect one. Also, the correlation value of 0.018 between Physical and Emotional factor and Academic performance implies that the degree of association is a very weak positive and imperfect one. Similarly, the correlation value of 0.139 between Assessment factor and Social factor implies that the degree of association is a weak positive and imperfect one. In addition, the correlation value of 0.030 between Assessment factor and Academic performance implies that the degree of association is very weak positive and imperfect one. More also, the correlation coefficient of 0.051 between Social factor and Academic performance implies that the degree of association is a very weak positive and imperfect one.

Pearson chi-square test of independence between Course of study and Mathematics anxiety factors was given in Table 7. The *Asymp. Sig. value* of 0.000 which is less than the conventional level of significance (α = 0.05) implies that Mathematics anxiety factors and Course of study are related.

Table 8 shows the Pearson chi-Square test of independence between Gender and Mathematics anxiety factors. The *Asymp. Sig. value* of 0.245 which is greater than the conventional level of significance (α = 0.05) implies that Mathematics anxiety factors are independent of students' gender.

Xi. Conclusions

From the results of this study, it can be concluded that the three Mathematics anxiety factors under study do not have the same effect on the academic performance of the students but exert joint significant effect on the academic performance of the students. Of the three Mathematics anxiety factors under study, only the social factor individually exerts significant positive effect on the academic performance of students. Approximately 0.32% is being contributed by Mathematics anxiety factors to students' academic performance. While Mathematics anxiety factors are related to students' course of study, but independent of students' gender.

Xii. Recommendations

1. Parents, from school age of a child, should endeavour to jointly educate their wards on "importance of Mathematics" to a good and meaningful life later in the future (Academic and social wise).
2. Parents should, as a matter of compulsion, disabuse the impression that Mathematics is both difficult to learn and comprehend. They should, as much as possible, try to encourage and motivate their children to have positive interest and constant persistence in knowing and comprehending mathematical contents.
3. Teachers' attitude as it relates to mystification of teaching of Mathematics should be discouraged at all levels of education. Only highly qualified (trained to teach the subject; tested; and experienced mathematicians) should be allowed to teach Mathematics at all levels of education (it is a profession). Particularly at primary level, the idea of Jack of all subjects should be seriously discouraged where a teacher that studied social studies in a college is allowed to teach all subjects in primary school.
4. Every institution (Secondary to Tertiary) should organise seminars and workshops for all students periodically where the need to know Mathematics are stressed and emphasized in order for the students to live a meaningful life later in the future. Mathematics competitions could also assist students to have right perception on an erroneous impression that Mathematics is difficult.
5. Negative influence (as per re-echoing the nature of the subject) by peer groups should be minimized if not totally discouraged by parents and Mathematics teachers.
6. Enhancement of Mathematics teachers via seminars; workshops and any other reasonable mean, in all ramification (pedagogical practice; train the trainers; salary incentives; promotion as at when due; etc) should be done by respective employers, government or private.

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