ASSESSMENT OF MATHEMATICS ANXIETY OF UNIVERSITY UNDERGRADUATE STUDENTS

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Abstract

This study examined the influence of programme of study and gender on students' anxiety in mathematics. Descriptive survey research design was adopted. Pre-service teachers from a University of Education in Nigeria were used. A total of 160 second year (200 Level) students (87 male and 73 female) were selected using stratified, proportionate random sampling. A questionnaire, titled items Mathematics Anxiety Rating Scale (MARS) with reliability coefficient of 0.90 was used. One way analysis of variance (ANOVA) was used for the analysis. Results indicated a significant difference in the mathematics anxiety of respondents based on programme of study. $F (6, 153) = 2.58$, $p < 0.05$ and the t-test revealed that mathematics anxiety is gender invariant [$t (160) = 1.266$, $p < 0.05$]. Mathematics anxiety exhibited by male students [$= 58.89$, $S.D = 14.020$] is higher than that exhibited by female students [$= 46.33$, $S.D = 10.537$]. It is recommended that deliberate effort should be made to encourage students and give proper counselling to them on how to develop confidence in mathematics. Also, training of students should be geared towards building students' confidence in mathematics particularly at the foundation level.

Keywords: *Mathematics anxiety, Pre-service, Programme of study,*

Introduction

Various factors have been adduced for poor performance of students in mathematics at all levels particularly at primary and secondary levels. Findings have shown that individual student's characteristics variables such as self-esteem, anxiety and students' concept of mathematics are important factors influencing academic achievement of students (Tella, 2007).

Mathematics anxiety as a construct has received considerable attention among researchers and mathematics educators in recent years. Nolting (2007) defined anxiety to mean stress, tension and strain brought into one's body and mind which involves the loss of control of the body, having sweaty palms, pain in the neck which involves loss of concentration, having negative self-talk, feeling of doubt or mind wanders from test accompanied by feelings of helplessness because the anxious person feels blocked, unable to find a solution to his problem. Anxiety causes an individual to borrow from future problems and therefore, suffers the present fear. Tobias (1993) defines Mathematics anxiety as feelings of tension and anxiety that interfere with the manipulation of numbers. Many scholars have observed that the feeling of tension and anxiety interfere with manipulation and solving the mathematical problems in a wide variety of ordinary life and academic situations (Suinn, 1991).

Mathematics anxiety is one of the major problems University undergraduate face when it comes to solving mathematics problems. A lot of concerns have been raised by mathematics educators and psychologist with regards to mathematics anxiety. A student who has a great ability to solve mathematics problems might not be able to do so if such student suffers from mathematics anxiety. Many like to call Mathematics anxiety a "learned anxiety' (Ashcraft, Krause & Hopko, 2007). Stuart (2000), further explained that this could be why students do not pursue advance courses in mathematics. However, the type of feelings students undergo when they are having mathematics anxiety often leads to panic and panic leads to helplessness, helplessness leads to fear, fear leads to distress, distress leads to shame, shame leads to inability to cope, then sweaty palms, nervous stomach, thinking difficulty, loss of ability to concentrate, and thus diminished their willingness to enrol and be successful in Mathematics courses (Stubblefield, 2006).

Furthermore, it is more critical if the person undergoing or experiencing mathematics anxiety is the teacher. It becomes worse because, teachers who have this anxiety are likely to pass it on to, especially, vulnerable students (Wood, 1988). The participants who reported having mathematics anxiety attributed it to negative elementary or secondary interactions with teachers about mathematics, poor teaching practices while they were in school, and/or negative experiences taking algebra or geometry in high school (McAnallen, 2010).

Students who end up having mathematics anxiety are students who have not in any way prepared for their mathematics test or examination (Stuart, 2000). In other words, from personal experience, the only way to overcome mathematics anxiety is to keep solving mathematics questions or problems daily. Stuart (2000) further pointed out that the problem of Mathematics anxiety is solved once a student on his or her own is able to provide answers to mathematics problems.

Considering the importance of pre-service teachers as future educational leaders that any action taken to solve their mathematics anxiety problem is definitely worthwhile. Mathematics anxiety is prevalent among teachers, elementary and high school students and college students. It has been argued that many elementary school teachers start their studies at the college with a lot of apprehension of and anxiety in mathematics (Harper & Danne, 1998).

In a study that sought to address issues resulting or leading to mathematics anxiety among pre-service teachers, it was reported that negative school experience, lack of family support, and general test anxiety were the main causes of mathematics anxiety (Trujillo & Hadfield, 1999). The teachers however, expressed confidence and optimism that they would overcome their anxiety over time to become effective mathematics teachers.

Furthermore, Garry (2005) pointed out that mathematics anxiety is the outcome of low self-esteem and the fear of failure which causes problems for processing the incoming information as well as the previously learned information for problem-solving. Such students according to Dane, Judy and Tina (1986) tend to avoid mathematics whenever or wherever possible. El-Anzi (2005) reported a negative association between academic achievement in mathematics, anxiety and pessimism. Lower academic achievement in mathematics was related to higher levels of anxiety and pessimism while Creed, Patton and Bartrum (2002) reported high optimism to be associated with higher levels of exploration, career planning, decision-making confidence and career related goals and vice-versa, that is, high pessimism was associated with career indecision, low achievement, low self-esteem and increased psychological distress.

Ashcraft and Kirk (2001) pointed out that correlation between mathematics anxiety and academic performance in mathematics is negatively significant. Moreover Clute (1994) and Hembree (1990), have found that students who have a high level of mathematics anxiety have lower levels of mathematics achievement. They have also noted that math's anxiety seriously constrains performance in mathematical tasks and reduction in anxiety is consistently associated with improvement in achievement.

The teaching and learning of mathematics in Nigeria has been an issue of considerable research especially within the mathematics education community. Therefore it is necessary to investigate the anxiety of students in mathematics.

A lot of issues and concerns have been raised by mathematics educators and psychologist with regards to mathematics anxiety. Mathematics anxiety is one of the factors that is needed to be investigated and when we consider the usefulness of pre-service teachers as the educational leaders of tomorrow then any effort made in solving mathematics anxiety is definitely worthwhile.

Statement of Problem

Effective learning of mathematics can be challenging and has a lot to do with a person's state of mind and views about the subject. Mathematics disabilities, like other learning dis-orders, have the power to keep students from performing up to their potential in school and beyond. Mathematics anxiety has both psychological and physical features whose effects can be counterproductive. Mathematics anxiety is a debilitating emotional reaction to mathematics which ranges from feelings of mild tension to a strong irrational and intense fear of mathematics, overwhelming self-consciousness heightened by a sense of being watched and judged by others and a fear of embarrassment which results to being unnecessarily quiet in class and inability to contribute in the discussions during mathematics lessons.

Mathematics anxiety makes those affected by it to develop a severe avoidance of situations involving any kind of mathematics. For example, they may not choose careers involving the application of mathematics and tend to fear any task or test that relates to mathematics. This anxiety, if not curbed or treated, can negatively impact the quality of life such a student will live as it can result in anxiety disorder evidenced by uneasiness, cold or sweaty hands or feet, shortness of breath, heart palpitation, numbness, muscle tension. A student in such a condition cannot learn effectively.

Students who continue to suffer from mathematics anxiety may develop low self-esteem and social problems related to their lack of academic achievement. Later in life they may be more likely to drop out of school and find themselves shut out of jobs or occupations that require the ability to perform basic mathematical calculations. In view of these problems, the study sought to examine the impact of gender difference and programme of study on mathematics anxiety of mathematics.

Research Questions

i. What is the mathematics anxiety status of undergraduate students

ii. Does programme of study and gender significantly influence mathematics anxiety of undergraduate students in mathematics?

Research Hypotheses

The following hypotheses are postulated to guide the study
1. There is no significant influence of programme of study on mathematics anxiety of undergraduate students.
2. There is no significant difference in the mathematics anxiety of male and female students.

Methodology

A descriptive survey research design was used for the study. The population for the study consisted pre-service teachers from a University of Education in the Southwest Region of Nigeria. One College (College of Science and Information Technology, COSIT) out of four colleges in the University was selected purposely because it is only the students of this College that offered mathematics as one of the required courses. Stratified random sampling was adopted using students' departments as the strata to ensure that all the departments in the College are represented. A total of 160 second year (200L) students made up of 87 male and 73 female students were used for the purpose of this research because their experience in the mathematics courses are still current and are stable. Proportionate random sampling technique was used to select 10 students from Agric, 10 from Biology, 37 from Chemistry, 31 from Computer Science, 41 from Human Kinetics and Health education, 16 from Mathematics and 6 from Physics.

One instrument was used for the study. The revised Mathematics Anxiety Rating Scale (MARS) by Plake and Parker (1982). It consisted of 24 items measuring mathematics anxiety. Each item was rated on a five-point Likert type scale anchored by 1 = No Anxiety, 2 = Slightly Low Anxiety, 3 = Low Anxiety, 4 = Slightly High Anxiety, and 5 = High Anxiety. Cronbach Alpha was computed to ascertain the reliability of scores obtained in this context and it yielded an internal consistency (coefficient alpha) reliability of 0.90. The instruments was administered to the students during their lecture periods and the students were told that the information given would be used mainly for research purpose as there was no right or wrong answers. All instruments were responded to and returned.

The mathematics anxiety score was calculated from 24 items, the minimum score being 24 and maximum 120. A score of 60 and below indicates low anxiety while higher score indicates high anxiety. A one way ANOVA was used to determine the influence of programme of study and gender on the mathematics anxiety of undergraduate students.

Results

Research Question 1: What is the mathematics anxiety status of undergraduate students?

Each item of MARS was rated on a five-point Likert type scale anchored by 1 = No Anxiety and 5 = High Anxiety. The mathematics anxiety score was calculated from 24 items, the minimum score being 24 and maximum 120. A score of 60 and below indicates low anxiety while above 60 indicates high anxiety. The score of respondent on the scale is presented in the Table 1.

Table 1: Mathematics Anxiety Status of the Undergraduate students

Anxiety status	N (Male)	N (Female)	Frequency N (%)	Mean	Minimum	Maximum	Std. Dev
60 and below (low)	22 (50%)	22 (50%)	44* (27.5%)	39.45	26	48	2.634
High above 60 (high)	65 (56%)	51 (44%)	116 (72.5%)	64.09	61	89	9.213
Total	87	73	160 (100%)	57.31	26	89	13.915

*Note. * Percentages appear in parentheses.*

Table 1 revealed that 44 (27.5%) of the respondent had an anxiety score that is equal or below 60 with M =39.45, S.D = 2.634 while 116 (72.5%) of the respondent had an anxiety score higher than 60 with M =64.09, S.D = 9.213. Therefore, majority of the respondents had a high mathematics anxiety among which 56% are male and 44% are female.

Testing of Hypotheses

Hypothesis 1: There is no significant influence of programme of study on mathematics anxiety of undergraduate students.

To establish whether there is significant influence of programme of study on mathematics anxiety of undergraduates students, one way analysis of variance (ANOVA) was computed and presented in table 2.

Table 2: Descriptive Statistics for Math Anxiety by programme of study

	N	Minimum	Maximum	Mean	Std. Deviation
Agric	11	38	85	57.55	15.175
Biology	10	57	84	66.50	8.631
Chemistry	37	27	81	50.76	13.767
Computer Sc.	34	28	83	57.09	13.838
Hum Kin/ Health Ed.	41	26	89	60.24	12.449
Maths	19	31	88	58.53	17.232
Physics	8	46	71	58.88	9.188

Table 2 shows that undergraduate students from Biology possesses the maximum mean anxiety score with M = 66.50, SD = 8.631 and those from Chemistry possesses the minimum mean anxiety score with M = 50.76, SD = 13.767. It is surprising to note that the mean anxiety score of students from Mathematics (M = 58.53, SD = 17.232) is higher than those from Chemistry. Nonetheless, all have high anxiety.

Table 3: Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
MAT_ANX	1.935	6	153	.079

Table4: Analysis of variance for Mathematics Anxiety based on programme of study

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	2836.429	6	472.738	2.588*	020
Within Groups	27949.946	153	182.679		
Total	30786.375	159			

Table 4 shows that there was statistically significant difference in the mathematics anxiety of respondents based on programme of study. $F_{(6, 153)} = 2.588$, $p < 0.05$. Therefore hypothesis 1 is rejected. Test of homogeneity of variance shows equality of variance, Tukey post-hoc test was run and presented in Table 5.

Table 5: Multiple Comparisons
Tukey HSD

Dependent Variable	(I) PROGRAMME	(J) PROGRAMME	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
		BIOLOGY	-8.955	5.906	.735	-26.60	8.69
		CHEMISTRY	6.789	4.642	.766	-7.08	20.66
		COMPUTER SCIENCE	.457	4.688	1.000	-13.55	14.47
	AGRIC	HUMAN KINETICS AND HEALTH EDU	-2.698	4.589	.997	-16.41	11.01
		MATHEMATICS	-.981	5.121	1.000	-16.28	14.32
		PHYSICS	-1.330	6.280	1.000	-20.09	17.44
		AGRIC	8.955	5.906	.735	-8.69	26.60
		CHEMISTRY	15.743*	4.817	.022	1.35	30.14
		COMPUTER SCIENCE	9.412	4.862	.460	-5.12	23.94
MAT_ANX	BIOLOGY	HUMAN KINETICS AND HEALTH EDU	6.256	4.767	.845	-7.99	20.50
		MATHEMATICS	7.974	5.280	.738	-7.80	23.75
		PHYSICS	7.625	6.411	.897	-11.53	26.78
		AGRIC	-6.789	4.642	.766	-20.66	7.08
		BIOLOGY	-15.743*	4.817	.022	-30.14	-1.35
		COMPUTER SCIENCE	-6.331	3.211	.437	-15.93	3.26

CHEMISTRY	PHYSICS	7.625	6.411	.897	-11.53	26.78
	AGRIC	-6.789	4.642	.766	-20.66	7.08
	BIOLOGY	-15.743*	4.817	.022	-30.14	-1.35
	COMPUTER SCIENCE	-6.331	3.211	.437	-15.93	3.26
	HUMAN KINETICS AND HEALTH EDU	-9.487*	3.065	.037	-18.64	-.33
	MATHEMATICS	-7.770	3.815	.396	-19.17	3.63
COMPUTER SCIENCE	PHYSICS	-8.118	5.270	.720	-23.86	7.63
	AGRIC	-.457	4.688	1.000	-14.47	13.55
	BIOLOGY	-9.412	4.862	.460	-23.94	5.12
	CHEMISTRY	6.331	3.211	.437	-3.26	15.93
	HUMAN KINETICS AND HEALTH EDU	-3.156	3.135	.952	-12.52	6.21
	MATHEMATICS	-1.438	3.871	1.000	-13.01	10.13
HUMAN KINETICS AND HEALTH EDU	PHYSICS	-1.787	5.311	1.000	-17.66	14.08
	AGRIC	2.698	4.589	.997	-11.01	16.41
	BIOLOGY	-6.256	4.767	.845	-20.50	7.99
	CHEMISTRY	9.487*	3.065	.037	.33	18.64
	COMPUTER SCIENCE	3.156	3.135	.952	-6.21	12.52
	MATHEMATICS	1.718	3.751	.999	-9.49	12.93
MATHEMATICS	PHYSICS	1.369	5.224	1.000	-14.24	16.98
	AGRIC	.981	5.121	1.000	-14.32	16.28
	BIOLOGY	-7.974	5.280	.738	-23.75	7.80
	CHEMISTRY	7.770	3.815	.396	-3.63	19.17
	COMPUTER SCIENCE	1.438	3.871	1.000	-10.13	13.01
	HUMAN KINETICS AND HEALTH EDU	-1.718	3.751	.999	-12.93	9.49

		Mean Difference	Std. Error	Sig.	Lower Bound	Upper Bound
	PHYSICS	-.349	5.696	1.000	-17.37	16.67
	AGRIC	1.330	6.280	1.000	-17.44	20.09
	BIOLOGY	-7.625	6.411	.897	-26.78	11.53
	CHEMISTRY	8.118	5.270	.720	-7.63	23.86
PHYSICS	COMPUTER SCIENCE	1.787	5.311	1.000	-14.08	17.66
	HUMAN KINETICS AND HEALTH EDU	-1.369	5.224	1.000	-16.98	14.24
	MATHEMATICS	.349	5.696	1.000	-16.67	17.37

*The mean difference is significant at the 0.05 level.

Post-hoc test computed (Table 5) revealed that the significant difference existed between biology and chemistry respondents; chemistry and human kinetics/health education respondents. Biology undergraduate students possess higher level of mathematics anxiety, followed by students from Human Kinetics/ Health Education.

Hypothesis 2: There is no significant difference in the mathematics anxiety of male and female students.

To deduce whether there is significant difference in the mathematics anxiety of male and female students, t-t test was computed.

Table 6: Group Statistics

	GENDER	N	Mean	Std. Deviation	Std. Error Mean
MAT_ANX	MALE	87	58.59	14.020	1.503
	FEMALE	73	55.79	13.729	1.607

Table 6 shows that male undergraduate students exhibited slightly higher mean mathematics anxiety score than [= 58.59, SD = 14.020] female students [= 55.79, SD = 13.729].

Table 7: Independent sample test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
MAT_ANX Equal variances assumed.	.001	.974	1.266	158.	207	2.792	2.204	-1.562	7.146
Equal variances not assumed			1.269	154.252	206	2.792	2.200	-1.555	7.138

Table 7 shows that mathematics anxiety is not affected by respondents' gender t (160) = 1.266, at p < 0.005. Therefore, hypothesis 2 is not rejected

Discussion

Mathematics anxiety is a serious and pervasive problem especially in a school setting. It can be a disabling condition causing humiliation, resentment and even panic. Students often develop mathematical anxiety in schools often as a result of learning from teachers who are themselves anxious about their mathematical abilities in certain areas. Students may experience mathematics anxiety in many forms and degrees, from "freezing up" during a mathematics examination to attempting to avoid anything having to do with numbers. The samples used for this study are the pre-service teachers whose peculiarity was the fact that all of them must compulsorily offer mathematics courses at 100 level irrespective of their departments. Incidentally, the result of this study indicated that majority of the respondents (72.5%) had very high mean mathematics anxiety score which may consequently affect their achievement in mathematics.

As pointed out by Trujilo and Hadfield (1999), negative school experience, lack of family support and general test anxiety may be responsible as there are economic hardships experienced by many students where many of them had to

struggle to pay their school fees. However, this result is contrary to Arigbabu (2006) who reported that mathematics anxiety is not well pronounced among pre-service teachers, in the sample data, however this may be due to the fact that respondents varied in their characteristics from time to time and place to place based on their environmental and social background. It is however compatible with what the study reported for the non-mathematics majors which exhibited statistically significant higher level of anxiety than the mathematics majors. This result is also in accordance with the view of Harper and Daane, (1998) and Hembree (1990) that mathematics anxiety was prevalent amongst pre-service teachers.

Furthermore, another difference in mathematics abilities often explored in research concerns gender disparities. It is thought that women experience more anxiety in mathematics as a group than men. However, the results of this study indicated that mathematics anxiety is not influenced by gender. This result corroborates the finding of Arigbabu (2007) who reported no gender difference in mathematics anxiety in Nigerian sample of prospective teachers, indicating that mathematics anxiety is gender invariant, that is, mathematics anxiety is not influenced by gender among respondents This result is in line with (Arigbabu & Mji, 2005) who reported no gender influence on mathematics anxieties of pre-service teachers. Considering the male and female respondents as the educational leaders of tomorrow, the findings of this study is indeed a pleasant development in the mathematics environment as it shows that mathematics anxieties of pre-service teachers is gender invariant.

Recommendation

It is noticed from the results that majority of pre-service teachers had high mathematics anxiety, it is therefore recommended that deliberate effort should be made to encourage students and give proper counselling to them on how to develop confidence towards mathematics particularly at the foundation level. Consequently, one of the easiest ways to reduce mathematics anxiety is for the parent to be more involved in their child's education. Also, teaching programmes should be geared towards accommodating different learning styles and allowing training of students in such a way that it could build students' confidence in mathematics

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