Interactive Effect of Gender, Test Anxiety, and Test Items Sequencing on Academic Performance of SS3 Students in Mathematics in Calabar Education Zone, Cross River State, Nigeria

American Journal of Creative Education
Vol. 3, No. 1, 21-31, 2020
e-ISSN: 2706-6088

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ABSTRACT

The rationale of this study was to examine the interactive effect of gender, test anxiety, and test items sequencing on the academic performance in mathematics among SS3 students in Calabar Education Zone, Cross River State. Two formulated null hypotheses directed the study. The study adopted the quasi-experimental design. Simple random sampling technique was used in drawing a sample of 474 students from a population of 8,549 SS3 students. A Mathematics Achievement Test (MAT) and a Test Anxiety Scale (TAS) were used primarily as the instruments for data collection. The reliability coefficient obtained for both instruments were .88 and .82 respectively. The data collected were analyzed using descriptive statistics such as mean and standard deviation, while the null hypotheses were tested respectively, using Pearson product-moment Correlation, and Analysis of Covariance where applicable. Findings indicated that test anxiety contributes negatively to academic performance in Mathematics; there is a significant interaction effect between item sequencing and gender on academic performance; between item sequencing and test anxiety on academic performance; and between gender and test anxiety on academic performance in Mathematics respectively; The findings also showed that Based on these findings conclusion and recommendations were made.

Keywords: *Interactive effect, Gender, Test anxiety, Test items, Item sequencing, Academic performance, SS3 students.*

DOI: 10.20448/815.31.21.31
Citation | Valentine J. Owan; Bassey A. Bassey; Ini S. Etuk (2020). Interactive Effect of Gender, Test Anxiety, and Test Items Sequencing on Academic Performance of SS3 Students in Mathematics in Calabar Education Zone, Cross River State, Nigeria. American Journal of Creative Education, 3(1): 21-31.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
History: Received: 17 October 2019/ Revised: 21 November 2019/ Accepted: 30 December 2019/ Published: 27 January 2020
Publisher: Online Science Publishing

Highlights of this paper

- The paper contributes to the existing literature by assessing the interactuve the interactive effect of gender, test anxiety, and test items sequencing on the academic performance in mathematics among SS3 students in Calabar Education Zone, Cross River State.
- It was also concluded further that a significant interactive effect exists between gender and test anxiety, but there is no significant interaction effect of gender, test anxiety, and item sequencing on the academic performance of students in mathematics.

1. INTRODUCTION

Over the years, it is unfortunate that statistics and observation have shown that students have not performed well in mathematics. This poor state of affair has troubled the hearts of parents, administrators, government, teachers, and even the students themselves. This is because outside it being a requirement for admission into the tertiary institutions, it involves knowledge and skills that are needed for daily living.

Mathematics as a subject matter area, affects to a varying degree, all aspects of human endeavor (Maliki *et al*., 2009; Owan, 2012). It, therefore, becomes a national problem since the performance of students in school affects the larger society. Efforts made by the government, non-governmental organizations and even researchers seem not to be meaningful or affecting changes in the performance status of the students. For instance, the Cowbell company organizes annual competition in mathematics with tangible prices for schools and individuals that win. This competition was aimed at boosting students' interest in mathematics, supporting parents, and promoting good academic performance amongst students. Through the Science Teachers Association of Nigeria (STAN) secondary school mathematics teachers are given special allowances, workshops, and seminars opportunities as a means of boosting their commitment to work. Different workshops and conferences have been organized with themes focusing on improving the quality of Mathematics teaching and academic performance. Researchers have made several policy recommendations for actions to be taken that will improve the quality of students' academic performance in Mathematics.

Most researchers have suggested a number of factors including students' phobic attitude, teachers' teaching style, students' interest, pseudo-perception transfer from older students, test anxiety about the subject, poor teacher-students' relationship, lack of teachers' supervision of students' work, poor attitude to assessment procedures, inadequate classroom management skills, teachers qualification, overpopulation of students, class size, poor home background (Ogbonnaya and Osiki, 2007; Owan, 2012; Chaman *et al*., 2014; Belhu, 2017; Effiom and Bassey, 2018; Robert and Owan, 2019).

Other factors outlined by the researchers include problems of school management, quality assurance practice, socio-economic status of parents, parents' education level, instructional factors such as curriculum, institutional strategies and methods, teachers' competence in mathematics education, school context and facilities, individual factors such as self- directed learning, arithmetic ability, motivation, and concentration (Saritas and Akdemir, 2009; Owan, 2012; Belhu, 2017; Owan *et al*., 2018; Bassey *et al*., 2019).

Despite these numerous factors highlighted above, studies have recommended several things that must be followed to improve the performance of students in mathematics. It appears that such recommendations have either not been followed or have not been able to address the menace of students' poor performance in mathematics. The question that arises then is what are the reasons for this continued and sustained poor performance of students in a subject as important as mathematics? After considering earlier studies, the researchers are therefore shifting the paradigm from the main effects of these factors outlined to the interactive effect of gender, test anxiety, and items sequencing on the performance of students in mathematics.

Gender is the state of being either a male or female. Test anxiety is simply the combination of psychological over-arousal, tension, and somatic symptoms, along with worry, dread, fear of failure, that occur in a person before or during test situations. Item sequencing, on the other hand, refers to the determination of order or arrangement in a set of test questions taking into considering the difficulty level associated with each specific question, while following a specific pattern. Studies related to these areas have revealed a form of association with the dependent variable (students' academic performance). Munz and Smouse (1968) found that there is a significant F-ratio ($p< .01$) for reaction type and interaction indicating that item difficult sequencing, achievement anxiety reacts significantly on the academic performance of students.

The study of Ojediran and Oludipe (2016) examined the impact of test anxiety and gender on Nigerian pre-service science education students, and disclosed that at low test anxiety, pre-service science students performed better with CGPAs than their high-test anxiety colleagues; female pre-service science students exhibited lower test anxiety than male pre-service students. It was shown in another study that the females had a higher mean score on test anxiety than the males but the mean difference was not statistically significant. The study showed further that females participants had a higher and significant mean achievement score than males (Timoty, 2015). Sideeg (2015) also found that test anxiety is significantly higher than the critical value that was set. It was discovered further that test anxiety significantly correlates with students' academic achievement. The negative correlation uncovered in the study showed that there is a strong association between these psychological constructs. Further findings indicate a statistically significant effect of gender differences and type of study on the levels of test anxiety.

Josiah and Adejoke (2014) revealed an average performance of students in algebra. The differences in achievement across gender, age, and mathematics anxiety groupings (low, medium & high) were all non-significant. Another study carried out by Iroegbu (2013) showed that the subjects with low anxiety and female gender performed better than the male gender. In addition, there is a significant interaction between anxiety and gender as well as anxiety self-concept, and gender on academic performance.

Barrows *et al.* (2013) provided evidence that showed a strong relationship between each of test anxiety, self-concept, and exam grades. The multiple regression analysis indicated that exam grade could be predicted by test anxiety and self-efficiency level, and that self-efficiency moderates the effects of test anxiety. Farooqi *et al.* (2012) reported that female students demonstrated higher test anxiety level as compared to males. Males students achieved statistically significant higher GPAs as compared to the females, the study also found a significant negative relationship between test anxiety and academic performance.

Syokwaa *et al.* (2014) revealed that there is a significant correlation between anxiety levels and academic achievement and that high anxiety levels had a negative impact on the quality of academic result recorded by students. The study also established that students encountered some high anxiety causing challenges which affect their ability to perform effectively. Karjanto and Yong (2015) also established that students who had a lower score expectation were more anxious than those who had higher score expectations, but that they obtained a better score than the expected score.

Hancock (2001) also discovered that there is a statistically significant result and that students with high anxiety level perform poorly and were less motivated to learn. Similarly, Kassim *et al.* (2009) disclosed that test anxiety was negatively related to students' academic performance. Although the study of Vogel and Collins (2002) found that students with high test anxiety as well as those with moderate anxiety levels showed lower performance. Students with low levels of test anxiety performed the best.

Generally, it was deduced that many students have isolated the independent variables of this study as they connected them to the dependent variable. Just like every other research position, the findings uncovered from the

results of previous studies have shown that there is still an academic debate. The debate is due to the mixed findings established in the literature with some scholars showing that there is an association between the independent and dependent constructs of this study. Only a handful of studies have examined the interactive effect of gender, test anxiety and items sequencing on the academic performance of students in mathematics. Although it seems much has been done, this study contributes to the literature by providing further evidence to revalidate the findings discovered by some earlier studies.

1.1. Purpose of the Study

This study was designed to examine the interactive effect of gender, test anxiety, and items sequencing on the academic performance in mathematics among SS3 students in Calabar Education Zone, Cross River State.

Specifically, this study sight to examine:

(i) The relationship between item sequencing and mathematics test anxiety among SS3 students in Calabar Education Zone.

(ii) The interactive effect of gender, test anxiety and item sequencing on the academic performance of students in mathematics.

1.2. Statement of Hypotheses

The following hypotheses as formulated below offered guidance to the study.

(1) There is no significant relationship between item sequencing and mathematics test anxiety among SS3 students in Calabar Education Zone.

(2) The interactive effect of gender, test anxiety, and items sequencing on the academic performance of SS3 students in mathematics are not statistically significant.

2. MATERIALS AND METHODS

The study adopted the quasi-experimental design. This design was considered suitable to the study since the study used participants from intact classrooms with a repeated measure of three group within-subject where each participant received some form of treatment in the pretest and posttest respectively. The design was also adopted because it affords the opportunity to generalize over the population from which the sample was chosen. The population of the study comprised 8,549 SS3 students distributed across 85 public secondary schools in Calabar Education Zone of Cross River State. The population of this study is presented in Table 1.

Table-1. Population distribution of the study showing the number of schools and students in each Local Government Area of Calabar Education Zone.

S/N	Local Government Area	Number of schools	Number of students
1	Akamkpa	19	1,229
2	Akpabuyo	7	482
3	Bakassi	3	148
4	Biase	17	610
5	Calabar South	17	3,440
6	Calabar Municipality	8	1,710
7	Odukpani	14	930
	Total	85	8,549

Source: Cross River secondary education board (2017).

The sample of this study was randomly drawn using the simple random sampling technique. The technique was employed in selecting three Local Education Authorities (LEAs) through the hat and draw method where the

researchers wrote all the names of LEAs on pieces of papers and place inside a container and blindly drew without replacement. The selected LEAs included Biase, Calabar Municipality, and Odukpani. The simple random technique was employed in selecting three schools from each of the selected LEAs using an intact class approach.

The sample of this study comprised 474 SS3 students randomly selected from the nine selected public secondary schools in Calabar Education Zone out of which 456 of them (212 males and 244 females) were involved in the data collection process as shown in Table 2.

Table-2. Sample distribution of the study showing the selected Local Government Education Authorities and the number of students selected from three public schools in each LEAs.

LGEAs	No. of schools	Number of students sampled		
		Males	Females	Total
Biase	3	65	84	149
Calabar Municipality	3	80	88	168
Odukpani	3	76	81	157
Total	9	221	253	474

Source: Field survey, 2019.

The instruments were used primarily for data collection and included a mathematics achievement test (MAT), and a test anxiety scale. The mathematics achievement test comprised 80 items multiple choice objective test item with four options based on the SS3 mathematics syllabus. The test anxiety scale comprised 5-items questions which were used to measure the test anxiety of students towards mathematics. The 5-items were organized on a modified 4-point Likert scale. The instrument (MAT) was obtained from a standard examination past question. The reliability of both instruments was established through the Cronbach alpha reliability method. The approach was used to ascertain the internal consistency of the instruments. The reliability coefficient obtained for both instruments were .88 and .82 respectively.

The collection of data was carried out by the researchers who visited the selected schools after obtaining permission from the school principals as well as mathematics teachers. A pretest was administered in each school on the first contact with the SS3 students who were intact in their classes. After three weeks the same students who took the pretest were again sorted out using their assigned serial numbers for the posttest.

However, during the posttest, some students were assigned to experimental group I (given easy-to-difficult arranged test items), experimental group II (given difficult-to-easy test arranged items), and control group III (given randomly arranged test items). The completed instruments were retrieved from the respondents without any loss indicating 100 percent return rate of the administered instrument. The data collected were analyzed using descriptive statistics such as mean and standard deviation, while the null hypotheses were tested respectively, using Pearson product-moment Correlation, and Analysis of Covariance where applicable. The result from the analysis of data is presented in the following section.

3. RESULTS

The results of this study were presented based on the hypotheses formulated to guide the study. Before proceeding to the hypotheses test, the results of the descriptive statistics of the study was presented as contained in Table 3.

The result in Table 3 showed that the mean score of 12.59 and 17.38 respectively were obtained in the pre-test and post-test by the 152 subjects in the experimental group one with 63 males in the group having mean scores of 15.56 and 19.70 in the pre-test and post-test respectively while the 89 females in the group had mean scores of 10.48 and 15.73 in the pre-test and post-test respectively. The result further showed that the mean score of subjects

in experimental group one as regards to test anxiety was 11.26 while that of male subjects in the group was 9.21 and the females had a mean score of 12.72.

The result also showed that the mean score of 12.56 10.55 respectively were obtained in the pre-test and post-test by the 152 subjects in the experiment group two with 81 males in the group having mean scores of 14.40 and 12.16 in the pre-test and post-test respectively while 71 females in the group had mean scores of 10.46 and 8.72 in the pre-test and post-test respectively. The result further showed that the mean score of the subjects in experimental group two as regards to test anxiety was 14.61 while that of the male subjects in the group was 13.78 and the females had a mean score of 15.55.

Further examination of the table showed that the mean score of 12.61 and 12.96 respectively were obtained in the pre-test and post-test by the 152 subjects in the control group with the 68 males in the group having mean score o15.07 and 15.12 in the pre-test and post-test respectively while the 84 females in the group had a mean score of 10.61 and 11.21 in the pre-test and post-test respectively. The result further showed that the mean score of the subjects in control group as regarded to test anxiety was 13.38 while that of the male subjects in the group was 12.35 and the females had a mean score of 14.

Finally, the result in the table showed that the mean score of 12,58 and 13.63 respectively were obtained in the pre-test and post-test by the 456 subjects that took part in the study with 212 males having mean score of 14.96 and 15.35 in the pre-test and post-test respectively while the 244 females had mean score of 10.52 and 12.14 in the pre-test and post-test respectively. The result finally showed that the mean score of the subjects that took part in that study as regards to test anxiety was 13.08 while that of the male subjects was 11.96 and the females had a mean score of 14.06.

Table-3. Mean score and standard deviations of subjects in the study variables by group and sex.

Group	Sex	N	Pre-test		Post-test		Test anxiety	
			Mean	SD	Mean	SD	Mean	SD
Experimental group one	Male	63	15.56	5.06	19.70	4.77	9.21	2.77
	Female	89	10.48	3.57	15.73	2.53	12.72	3.34
	Total	152	12.59	4.92	17.38	4.11	11.26	3.56
Experimental group two	Male	81	14.40	5.25	12.16	4.48	13.78	2.72
	Female	71	10.46	3.61	8.72	3.27	15.55	2.79
	Total	152	12.56	4.95	10.55	4.31	14.61	2.88
Control group	Male	68	15.07	5.19	15.12	4.98	12.35	2.20
	Female	84	10.61	3.66	11.21	3.10	14.21	2.45
	Total	152	12.61	4.93	12.96	4.48	13.38	2.51
Overall	Male	212	14.96	5.17	15.35	5.62	11.96	3.19
	Female	244	10.52	3.60	12.14	4.14	14.06	3.11
	Total	256	12.58	4.92	13.63	5.14	13.08	3.31

Source: Field survey, 2019.

3.1. Hypothesis 1

There is no significant relationship between item sequencing and mathematics test anxiety among SS3 students in Calabar Education Zone. To test this hypothesis, the performance of students in the various arrangement and corresponding test anxiety were compared using the Pearson Product Moment Correlation. The result of the analysis is presented in Table 4.

The result of the analysis in Table 4 revealed that the correlation between the performance of the subjects who took the easy to difficult arranged items and their test anxiety produced r-ratio of -.514 with a p-value of .000 which is significant at .05 level of significance. The result also revealed that the correlation between the performance of the subjects who took the difficult to easy arranged items and their test anxiety produced r-ratio of -.722 with a p-

value of .000 which is significant at .05 level of significance. The result also revealed that the correlation between the performance of the subjects who took the randomly arranged items and their test anxiety produced r-ratio of -.603 with a p-value of .000 which is significant at .05 level of significance.

The result finally revealed that the correlation between the overall performance of the subjects and their test anxiety produced r-ratio of -.685 with a p-value of .000 which is significant at .05 level of significance. Based on these results, the null hypothesis that is no significant relationship between item sequencing and mathematics test anxiety among SS3 students in Calabar Education Zone was rejected for all the different item sequencing and the overall. With the obtained r-ratio -.514, -.722, -.603 and -.685, it is indicated that test anxiety had a significant negative relationship with both items' arrangement and overall academic performance in Mathematics among SS3 students in Calabar Education Zone.

Table-4. Pearson Product Moment Correlation analysis of item arrangement and test anxiety among SS3 students in Calabar Education Zone.

Variable	N	Mean	SD	r	p-value
Easy-Difficult (X)	152	17.38	4.11		
				-.514*	.000
Test anxiety (Y)		11.26	3.53		
Difficult-Easy (X)	152	10.55	4.31		
				-.722*	.000
Test anxiety		14.61	2.88		
Random (X)	152	12.96	4.48		
				-.603*	.000
Test anxiety (Y)		13.38	2.51		
Overall performance (X)	456	13.63	5.14		
				-.685*	.000
Test anxiety		13.08	3.31		

Noted: *Significant at .05 p<.05.

3.2. Hypothesis 2

The interactive effect of gender, test anxiety, and items sequencing on the academic performance of SS3 students in mathematics are not statistically significant. The independent variable in this hypothesis is gender, test anxiety, and item sequencing while the dependent variable is post-test scores of academic performance in Mathematics among SS3 students in Calabar Education Zone. In order to test this hypothesis Analysis of Covariance (ANCOVA) test statistic was used with a pre-test as the Covariance. Results of the analysis are presented in Table 5.

Table-5. Summary of ANCOVA for interactive effective gender, test anxiety and item sequencing on academic performance in Mathematics among SS3 students in Calabar Education Zone.

Source of variation	SS	df	MS	F	p-value
Corrected model	10501.767[a]	67	156.743	39.786*	.000
Intercept	1283.472	1	1283.472	325.780*	.000
Pre-Test	1642.630	1	1642.630	416.944*	.000
Group	945.230	2	472.615	119.963*	.000
Gender	5.657	1	5.657	1.436	.232
Test anxiety	428.987	14	30.642	7.778*	.000
Group*gender	11.844	2	5.922	1.503	.224
Group*test anxiety	298.949	21	14.236	3.613*	.000
Gender*test anxiety	141.245	13	10.865	2.758*	.001
Group*gender*test anxiety	137.934	13	10.610	2.693*	.001
Error	1528.599	388	3.940		
Total	96737.000	456			
Corrected total	12030.366	455			

Note: *Significant at .05 level; a R Squared = .873 (adjusted R Squared = .851).

When these means were compared using ANCOVA, the results in Table 5 were obtained. The results showed that there is no significant interaction effect of item sequencing and gender (F=5.922; p>.05) on academic performance in Mathematics among SS3 students in Calabar Education Zone. The result further revealed that there is a significant interaction effect of item sequencing and test anxiety (F=14.236; p<.05) on academic performance in Mathematics among SS3 students in Calabar Education Zone.

The result also revealed that there is a significant interaction effect of gender and test anxiety (F=10.865; p<.05) on academic performance in Mathematics among SS3 students in Calabar Education Zone. The result finally revealed that there is a significant effect of gender, test anxiety and item sequencing (F=10.610; p<.05) on academic performance in Mathematics among SS3 students in Calabar Education Zone. Based on these results, the null hypothesis which states that the interactive effect of gender, test anxiety, and items sequencing on the academic performance of SS3 students in mathematics is not statistically significant was rejected.

4. DISCUSSION OF FINDINGS

The first result of this study revealed that test anxiety had a significant negative relationship with both item arrangement and overall academic performance in mathematics among SS3 students in Calabar Education Zone. This was observed in the obtained r-ratios of -.514, -.722, -.603 and -.685 which indicated that test anxiety contributes negatively to academic performance in Mathematics in such a way that the more the test anxiety, the lower the academic performance in mathematics among SS3 students in Calabar Education Zone. The result indicates that the anxiety level was more among the subjects who took the difficult to easy arranged items followed by those that took the randomly arranged items while those that took the easy to difficult arranged items had the least test anxiety level considering the items they believed the answered correctly.

This study is in consonance with the findings of Hancock (2001) and Barrows *et al.* (2013) which provided evidence that showed a strong relationship between each of test anxiety, self-concept, and exam grades. The multiple regression analysis indicated that exam grade could be predicted by test anxiety and self-efficiency level, and that self-efficiency moderates the effects of test anxiety.

The finding also agrees with the studies of Kassim *et al.* (2009); Farooqi *et al.* (2012); Syokwaa *et al.* (2014); Karjanto and Yong (2015) which revealed that there is a significant correlation between anxiety levels and academic achievement and that high anxiety levels had a negative impact on the quality of academic result recorded by students. also established that students who had a lower score expectation were more anxious than those who had higher score expectations, but that they obtained a better score than the expected score. In agreement with the finding of this study, the study of Vogel and Collins (2002) found that students with high test anxiety as well as those with moderate anxiety levels showed lower performance. Students with low levels of test anxiety performed the best.

The result of the second analysis revealed that there is a significant interaction effect between item sequencing and gender on academic performance in Mathematics as well as item sequencing and test anxiety on academic performance in Mathematics. The result also revealed that there is significant interaction effect of gender and test anxiety on academic performance in Mathematics but there was no significant interaction effect of gender, test anxiety and item sequencing on academic performance in mathematics. The result is a bit surprising that interactive effect existed between item sequencing and gender, sequencing and test anxiety, gender and test anxiety but the interactive effects of gender, test anxiety and item sequencing was not statistically significant. This might be attributed to variables extraneous to the study which was not considered in this study such as ability level and family background.

The second finding of this study corroborates the finding of Munz and Smouse (1968) which found that there is a significant F-ratio ($p < .01$) for reaction type and interaction indicating that item difficult sequencing, achievement anxiety reacts significantly on the academic performance of students. The finding also agrees with the study of Ojediran and Oludipe (2016) which disclosed that at low test anxiety, pre-service science students performed better with CGPAs than their high test anxiety colleagues; female pre-service science students exhibited lower test anxiety than male pre-service students.

It was shown in another study that the females had a higher mean score on test anxiety than the males but the mean difference was not statistically significant. The study showed further that females participants had a higher and significant mean achievement score than males (Timoty, 2015). Sideeg (2015) also found that test anxiety is significantly higher than the critical value that was set. It was discovered further that test anxiety significantly correlates with students' academic achievement. The negative correlation uncovered in the study showed that there is a strong association between these psychological constructs. Further findings indicate a statistically significant effect of gender differences and type of study on the levels of test anxiety.

This finding agrees with the studies of Iroegbu (2013) and Josiah and Adejoke (2014) which indicates that there is a significant interaction between anxiety and gender as well as anxiety self-concept, and gender on academic performance. The differences in achievement across gender, age, and mathematics anxiety groupings (low, medium & high) were all non-significant.

5. CONCLUSION

It was concluded based on the result of this study that there is a significant negative relationship between test anxiety and students' academic performance in mathematics. It was also concluded further that a significant interactive effect exists between gender and test anxiety, but there is no significant interaction effect of gender, test anxiety, and item sequencing on the academic performance of students in mathematics.

6. RECOMMENDATIONS

Based on the finding of this study, it was recommended that:

(1) The government should ensure that adequate professional counsellors are employed and as well posted to assist in improving the test anxiety levels of the students.

(2) Mathematics teachers should also ensure that lessons in mathematics are made concrete through the use of supportive materials in instructional delivery. This will help make mathematics appealing to students and reduce consequently, the incidences of test anxiety among learners.

(3) Test items in both classroom and standard examination should be arranged following a logical flow of easy items coming up first before proceeding to more daunting items.

(4) Students irrespective of gender should learn and appreciate mathematics as an interesting subject. Just like every other subject, taking mathematics examinations or other mathematics-related subjects.

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