

Interactive Effect of Order of Items and Test Anxiety on Students' Academic Performance

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Abstract

An interactive effect of order of items and test anxiety on students' performance on multiple-choice tests was investigated. Data was collected from 105 students from the College of Education for the study. A quasi-experimental design was used and 50-test item questions were used for data collection. Independent t-test, and Two-way ANOVA were used. The results show that test anxiety affected student performance. Furthermore, the result found that there was an interaction between the order of items and test anxiety on student performance. The study, therefore, recommended that tutors should encourage students to develop appropriate learning habits that will minimize their anxiety when taking tests. Finally, the study recommended that Colleges should organize seminars for tutors on how to manage students' anxiety.

Keywords: Order of items, Test Anxiety.

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1.1 INTRODUCTION

Multiple-choice tests are widely used in academic settings to assess students' knowledge and understanding of various subjects. These tests are designed to assess cognitive skills, such as recall, comprehension, analysis, and synthesis (Owan, 2020). While multiple-choice tests are often seen as objective measures of academic achievement, several factors influence students' performance on these tests. Two such factors are item sequencing [(Easy to Hard (EH), Hard to Easy (HE), and Random Method (RM))] and test anxiety.

The order in which test items are arranged from Easy to Hard (EH), Hard to Easy (HE), and Random Method (RM) have a significant influence on student's ability to recall information, identify key concepts, and make connections between different parts of

the test (Etuk, et al, 2020) Extant literature has shown that different types of item sequences [(Easy to Hard (EH), Hard to Easy (HE), and Random Method (RM))] affect students' performance in multiple-choice tests. Research has shown that presenting related items together improves performance, as it allows students to build upon their prior knowledge (Zeidner, & Matthews, 2016). On the other hand, presenting similar items together lead to interference effects, as students may confuse one item with another (Kingsbury & Gross, 2011).

Test anxiety also has an impact on student's performance on multiple-choice exams. Test anxiety is characterized by a sense of discomfort or nervousness experienced before or during a test, often accompanied by physical manifestations like a heightened heart rate and sweating (Elliot & McGregor, 2001).

This anxiety hinders students' capacity to focus, remember information, and make choices (Zeidner & Matthews, 2016).

Research has shown a correlation between test anxiety and academic performance on multiple-choice tests. A study by Sarason and Sarason (1990) found that high test anxiety level was linked with lower scores on a multiple-choice test. Similarly, Elliot and McGregor (2001) found that test anxiety was negatively correlated with performance on a multiple-choice test, even after controlling for other factors such as intelligence and study habits. While both item order and test anxiety have been shown to affect student academic performance on multiple-choice tests, less is known about the interaction between these two factors. However, some existing literature suggests that test anxiety may exacerbate the effects of item order on performance. Zeidner and Matthews (2016) found that students with high levels of test anxiety were more affected by changes in item order than students with low levels of test anxiety.

Students in the College of Education in Ghana are mandatory to pass all courses before they can be qualified as professional teachers. One of the critical courses that need to pay attention at the College of Education in Ghana is Algebra II. In Ghana, the results of the first semester of level 200 Algebra II at the Colleges affiliated with the University of Ghana have not been encouraging. According to the assessment unit in charge of the College of Education, 1367 Bachelor of Basic Education (Upper primary option) students who registered for the Algebra II course in the 2022 Academic year second semester did not perform well. Out of the number of candidates who registered and sat for the examination, 547 of the candidates representing 40% passed the course. This means that 820 students representing 60% of the students failed the course. What could be the causes of this mass failure in the second-semester Algebra II course? Could it be the item's arrangement or the perception students have about the Algebra II course?

The interactive effect of the order of items and test anxiety on Multiple-Choice Tests (MCT) on students' performance is a topic of debate, with no clear conclusion. Alhaj-Moh'd, (2015) argued that there is a limited interaction between item order and test anxiety, suggesting that their combined effect might not be significantly different from their individual influences. Moreso, Etuk, et al (2020) argue that item order's impact remains consistent regardless of the difficulty of the questions. Similarly, Owan *et al.*, (2020) posited that item order has no impact on confident students' performance, as they are less affected by arrangement. However, Plake *et al.*, (1994), argue that item order primarily influences how students allocate their attention, leading to varied performance outcomes. Furthermore, Owan, (2020) suggested that specific item orders trigger particular cognitive strategies to manage anxiety. In support of this, Green and White (2019) contend that item order primarily influences cognitive load and strategies for information processing. Munz and Smouse, (1968) argue for a strong interaction, contending that specific item orders can indeed exacerbate or alleviate the impact of test anxiety, leading to distinct performance outcomes. Moreover, Marks, (2007) proposed that even confident students' performance can be influenced by the order of items. Munz and Smouse, (1968); Munz and Jacobs, (1971) and Bryant, (1983) suggested that the influence of item order on test anxiety is more pronounced when students face a mix of difficult and easy questions. The aforementioned contradictions call for an empirical study to be conducted to ascertain the truth.

A careful review of the literature indicated limited studies on the order of items and test anxiety on MCT at the College of Education in Ghana. Does it mean that the failure rate in Algebra II courses at the Colleges of Education does not matter? A study needs to be conducted to ascertain the severity of the issue at the affiliated college of the University of Ghana. It is on this background that this study sought to explore the effect of order of items and test anxiety on students' performance

in the Algebra II course at the College of Education affiliated with the University of Ghana, Legon.

1.2 Research Question

1. What is the effect of test anxiety (high vs. low) on student academic performance in multiple-choice tests in Algebra II?

1.3 Hypothesis

Ho: There is no statistically significant difference in the interaction between item sequencing and test anxiety on student academic performance in multiple-choice tests in Algebra II.

H1: There is a statistically significant difference in the interaction between item sequencing and test anxiety on student academic performance in multiple-choice tests in Algebra II.

2.0 METHODS

2.1 Research Design

Quasi-experimental design (Posttest only) was used to explore the effects of sequencing of items and test anxiety on student academic performance in multiple-choice tests. The independent variables in the study were order of items (EH, HE, RM) and test anxiety (high, low). The dependent variable was student performance on the multiple-choice test in Algebra II. The participants in the study were Bachelor of Basic Education (Upper Primary Option) in all Colleges of Education affiliated with the University of Ghana, Legon. There were 1035 offering the Bachelor of Basic Education (Upper Primary Option) in the six (6) Colleges affiliated with the University of Ghana, Legon. Two (2) Colleges were randomly selected for the study. The colleges that were selected were Peki College of Education and Gbewaa College of Education. Peki College of Education has six (6) classes while Gbewaa College of Education has five (5) classes. Two (2) classes were randomly selected using the lottery method. These classes had 50 and 55 students respectively.

The multiple-choice test consists of 50 items were used. These items were adapted from the end-of-semester Algebra II past questions from the College assessment officer's office.

These test items were pilot-tested at Enchi College of Education to assess the item characteristics. All the items were deemed satisfactory and based on this information, the items were rearranged into three different sequencing forms (EH, HE, and RM).

Five (5) member panels of experts at CK Tedem University of Science and Technology, Navrongo in the Upper East Region of Ghana, reviewed the test items for content validity using the Lawshe (1975) validation procedure. To assess reliability, KR20 and KR21 were employed. The test items in the Random Method (RM), Hard-To-Easy (HE), and Easy-To-Hard (EH) had a reliability coefficient of 0.8, 0.73, and 0.70 respectively.

2.2 Data Analysis Procedure

The background information of the participants was analyzed using percentages and frequencies. These methods allowed for a comprehensive examination of the participants' characteristics.

2.2.1 Research question one

What is the effect of test anxiety (high vs. low) on student academic performance in multiple-choice tests in Algebra II? The research question was to find out whether there was a difference among test anxiety (high vs. low) on student academic performance in multiple-choice tests in Algebra II. This was analyzed using an independent t-test.

2.2.2 Hypothesis

There is no statistically significant difference in the interaction of sequencing of items and test anxiety on student academic performance in multiple-choice tests in Algebra II. This was analyzed using two-way ANOVA.

3.0 THE RESULTS

3.1 Analysis of Test Anxiety Level

This section presented the analysis of students' test anxiety levels. The return rate of

the respondents was one hundred and five (105) which represents 100% of the total population of the study. Table 1 presents the distribution of respondents by test anxiety levels.

Table 1: Distribution of respondents by Test Anxiety level

Test Anxiety level	Frequency	Percentages
Low	22	21
High	83	79
Total	105	100

Source: Field survey (2023)

The data in Table 1 indicates 22(21%) had low test anxiety while 83 (79%) of the respondents were having high test anxiety when writing the Algebra II test.

anxiety when taking the Algebra II test. An independent sample t-test was used. The independent variables in this analysis were the levels of anxiety (low and high), and the dependent variable was the test scores. A normality test was carried out and the results are presented in Table 6.

3.1.2 Research question

Research question two was to find out the difference between low- and high-test

Table 2: Results of normality in descriptive statistics of the test

Test scores	MEAN	MEDIAN
	39.86	39.99

Table 2 reveals that the mean (M=39.86) is close to the median (M=39.99), indicating a normal distribution of the data. As

a result, an independent t-test was deemed appropriate for analysis.

Table 3: Independent Samples t-Test Comparing Difference between Male and Female

Test anxiety	N	M	SD	SEM	Cal. T	Df	P-value
High	83	41.072	8.884	1.894	.196	103	0.042
Low	22	37.545	7.078	.778			
Totals	105						

***0.05

From Table 3, the results show not much differences in means scores of the independent variables (low and high). From the descriptive results, most students were having high anxiety ($M = 41.072$, $SD = 8.884$) than low anxiety ($M = 37.545$, $SD = 7.078$). Moreover, the independent sample t-test results confirm these differences with its p-value of 0.042 indicating that there were significant differences between high ($M = 41.072$, $SD = 8.884$) and low ($M = 37.545$, $SD = 7.078$); $t(105) = .196$, $p = 0.042$, (2-tailed).

3.1.3 Hypothesis

There is no statistically significant difference in the interaction between order of items and test anxiety on student academic performance in multiple-choice tests in Algebra II. A two-way between-groups analysis of variance was conducted to see the interactive effect on order of items and test anxiety. The dependent variable was Algebra II scores and the independent variables were the order of items and test anxiety level of the students. The normality test was checked using

the Levenes test of equality of error variance. This was presented in Table 4.

Table 4: Levene’s Test of Equality of Error Variances

F	df1	df2	Sig.
13.677	5	309	.000

The data from Table 4 shows a significant value of .000 indicating variance of the dependent variables among the group is different. The researcher continues with the analysis because the analysis of variance is

robust. Moreover, Pallant (2016) recommended that in a situation where the variance of the dependent variable across the group is not equal, you set a more stringent significance level to .01 and continue the analysis.

Table 5: Tests of Between-Subjects Effects

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	Hypothesis	189769.502	1	189769.502	1158853.241	.001	1.000
	Error	.164	1	.164 ^a			
ITEMSEQUENCING	Hypothesis	17708.951	2	8854.476	51.644	.019	.981
	Error	342.902	2	171.451 ^b			
ANXIETYLEEVEL	Hypothesis	.164	1	.164	.001	.049	.000
	Error	342.001	2.026	168.794 ^c			
ITEMORDER * ANXIETYLEEVEL	Hypothesis	342.902	2	171.451	3.432	.034	.022
	Error	15436.155	309	49.955 ^d			

***0.05

The data in Table 5 shows interactive effect was statistically significant, F (2, 309) =3.432, p=.034. There was a statistically significant main effect of Colleges, F (2, 309)

=51.644, p=.019; Moreover, the effect size was relatively large (partial eta squared =.981). In short, the interaction between order of items and test anxiety is evident.

Table 6: Descriptive Statistics

ITEMORDER	ANXIETYLEEVEL	Mean	Std. Deviation	N
EH	LOW	40.3544	7.77576	79
	HIGH	40.2692	7.14735	26
	Total	40.3333	7.59132	105
HE	LOW	15.5294	3.62487	17
	HIGH	18.7500	7.84952	88
	Total	18.2286	7.41524	105
RM	LOW	32.2857	4.87232	35
	HIGH	29.3143	6.66495	70
	Total	30.3048	6.26210	105
Total	LOW	34.9771	10.63410	131
	HIGH	25.8098	10.55414	184
	Total	29.6222	11.49855	315

The data in Table 6 suggest that the means were very close to each other. With

regards to EH, no differences between the low (M=40.354, SD=7.774) and high (M=40.269,

SD=7.147). In the HE, there was a vast difference between the low (M=15.529, SD=3.624) and the high (M=18.7560, SD=7.849). In RM, there was a mean

difference between low (M=32.285, SD=4.872) and high (M=29.314, SD=6.664). Post-hoc test was conducted.

Table 7: Post-hoc comparison using Turkey

	(I) ITEMS ORDER	(J) ITEMS ORDER	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	EH	HE	22.1048*	.97546	.000	19.8075	24.4020
		RM	10.0286*	.97546	.000	7.7313	12.3258
	HE	EH	-22.1048*	.97546	.000	-24.4020	-19.8075
		RM	-12.0762*	.97546	.000	-14.3735	-9.7789
	RM	EH	-10.0286*	.97546	.000	-12.3258	-7.7313
		HE	12.0762*	.97546	.000	9.7789	14.3735
Bonferroni	EH	HE	22.1048*	.97546	.000	19.7567	24.4528
		RM	10.0286*	.97546	.000	7.6805	12.3766
	HE	EH	-22.1048*	.97546	.000	-24.4528	-19.7567
		RM	-12.0762*	.97546	.000	-14.4242	-9.7282
	RM	EH	-10.0286*	.97546	.000	-12.3766	-7.6805
		HE	12.0762*	.97546	.000	9.7282	14.4242

The results in Table 7 show the post-hoc comparisons. The post hoc comparisons using the Tukey HSD test indicated that the mean score for EH (M=40.312, SD= .799) was different from HE (M=17.140, SD= .936). Also, there was a significant difference between EH (M=40.312, SD= .799) and RM (M=30.800, SD= .732). There was difference in HE (M=17.140, SD= .936) and RM (M=30.800, SD= .732). The main effect for test anxiety $F(1, 309) = 001$; $p=.049$ was statistically significance. This means there were differences between low and high in terms of test anxiety when taking multiple-choice-test in Algebra II.

4.0 DISCUSSION OF RESEARCH FINDINGS

The findings of the study revealed that students with high test anxiety scored significantly lower on the multiple-choice tests compared to students with low test anxiety. The finding confirms the work of Zeidner and Matthews, (2016) who found that high-test-anxiety students tended to experience increased cognitive load and decreased memory capacity

during the tests, which in turn affected their performance. Moreover, the finding of this study agrees with Cassady and Johnson, (2002) that during the test-taking process, anxiety affects students' decision-making and test-taking strategies. It is a trite knowledge that if students have high test anxiety it will lead to overthinking and sometimes guessing, resulting in choosing incorrect answers or changing initially correct responses.

The finding of this study revealed an interactive effect between items order and test anxiety on student academic performance. Specifically, participants with high test anxiety performed significantly better when exposed to the ET item order compared to the HE and RM item order. In contrast, participants with low test anxiety showed comparable performance across all the items order conditions. EH item order provides these individuals with a more flexible and less predictable testing experience, potentially alleviating some of the negative effects of test anxiety. This study confirms the works of Munz and Smouse, (1968) that there was an interactive effect between order of items

and test anxiety on student academic performance. And that students with low test anxiety performed significantly better when exposed to all items order than high test anxiety.

5.0 CONCLUSIONS

The study concluded that students from the colleges of education affiliated with the University of Ghana have high anxiety levels when taking the Algebra II test. It was seen that most of the students were stressed up when about to take their Algebra II test.

Finally, the study concluded that the student's level of anxiety has a significant interactive effect on the kind of item arrangement that was presented to them.

6.0 RECOMMENDATIONS

1. The study further recommended that tutors should encourage college students to develop appropriate learning habits that will minimize their anxiety when taking Algebra II tests. This can be done by encouraging them to take advantage of the use of creative strategies of learning that they have learned in their Differentiated learning course.
2. Colleges of Education affiliated with the University of Ghana should organize seminars for tutors on how to manage students' anxiety as the tutors will in turn help the students to cope with their anxiety that may affect them when taking their exams.

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