

Influence of Multiple-Choice Item Ordering on Academic Achievement in English Language and Mathematics in Unity Schools in North-East, Nigeria



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ABSTRACT: The study investigated the influence of test item ordering on academic achievement in English language and Mathematics in unity schools in North-East, Nigeria. The study was experimental. The population comprised all the 5403 JSS 3 students in unity schools in North-East, Nigeria. A sample of 600 JSS 3 students was used. Two instruments, each prepared in three different formats were used for the study viz: (1) Mathematics Achievement Test and (2) English Language Achievement each of the test was prepared in three formats following the ways the items were arranged (1) Easy to difficult (ETD), (2) Difficult to easy (DTE), and (3) Mixed difficulty indices (MDI). The instruments were validated by four experts; two in measurement and evaluation, one in mathematics, and one in English language. Test-retest reliability was used to establish reliability indices of the two instruments. The reliability estimates that were obtained for the Mathematics achievement test are as follows: format 0.512, for format ETD, 0.849 for DTE and 0.718 for MDI. The reliability estimates that were obtained for the English Language achievement test are as follows: 0.728 for format ETD, 0.669 for format DTE and 0.877 for format MDI. ANOVA was used to test the null hypotheses. The major finding of the study were: (1) the results showed that JSS 3 students that were exposed to Difficult to easy (DTE) format in Mathematics had the highest mean achievement scores. (2) There was a significant difference between the mean achievement scores in English language of JSS 3 students exposed to different orderings of the items in favour of DTE test item format. Based on the findings, it was recommended that English Language tests items should be ordered from the difficult ones to the easy ones since the highest academic achievement of students was recorded using this method and that Mathematics tests items should be ordered from the easy ones to the difficult ones since the highest academic achievement of students was recorded using this method.

KEYWORDS: Influence of test ordering, Multiple-Choice tests, Item Orderings, Academic Achievement

INTRODUCTION

Tests could be classified into essay and objective tests, but the focus of this study were on the objective tests. An objective test is a type of test administered to a learner with the aim of assessing a particular aspect of the learner's knowledge by using questions which have one correct answer. This is opposed to a subjective test which has the aim of assessing areas of students' performance that are complex or more ways to express it (Manuel Campos, 2023). It therefore follows that in objective test, both the tester and the testee cannot influence the mark given. It is devoid of the feelings and personal interpretations of the scorers. In other words, if different examiners mark the same script of responses obtained from an objective test, using the same scoring key, they will come up with the same score.

Multiple choice questions are fundamental survey question which provide respondents with multiple answers. Primarily, multiple choice question can have single select or multiple select answer options. The multiple-choice format is most frequently used in educational testing. The multiple-choice test item is one in which a problem is presented and the respondent is given three or more alternative answers from which he selects the correct or the most correct answer. The item could be two forms (1) that in which the problem is presented in form of question (2) that in which the problem is presented in form of an incomplete sentence (Okoye, 2015).

Kpolovie (2002). Multiple-choice test is composed of a stem, a key, and distractors. The stem provides the question or problem to be answered. The key and the distractors make up the options. The correct response is the key while the incorrect responses are the distractors. Simply put, a multiple-choice question basically consists of two parts namely the stem and the options. The options are further divided into the key and the distractors.

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There are many factors which may influence the academic achievements of students. Some of these factors could be inherent in the students, some in the teachers, some in the system and some in the nature of the test. Among the factors inherent in the nature of the test may be the ordering of the items of the test.

Test item ordering simply refers to the arrangement of the items that constitute a test. It is a method used to arrange the questions that make up a particular test. There are various methods of ordering test items. These include arranging the test items in increasing order of difficulty; arranging the test items in decreasing order of difficulty; arranging items randomly; and arranging items according to their respective topic sequence in the scheme of work or syllabus. The item difficulty index is a measure of the proportion of examinees who answered the item correctly (Professional Testing, 2015).

Mathematics and English language are subjects that have direct relationship with other subjects particularly art and science related subjects. They are core subjects that are offered virtually at all levels of education and are considered as the bedrock for all scientific and technological development of any nation.

Given the dynamic roles that these core subjects play in any society, it is quite appalling and unfortunate to see students fail English language and Mathematics examinations. That has continued to be a source of worry to all stakeholders in the education sector that are interested in the child is the question of what would have been the causes of this failure? The abysmal performance of JSS 3 students in Basic Educational Certificate Examination (BECE) has not gone unnoticed.

The problem of poor result in national examination in Nigeria especially in the North East of the country has become a critical issue. High level of poor performance has been recorded especially in core subjects such as mathematics and English Language in this part of the country. In spite of all efforts put up by government, schools, and other stakeholders, the poor results from students, especially in the Basic Education Certificate Examinations, have persisted. In order to address the issue of poor academic performance, there is need to consider the factors that may cause it. Such factors could be inherent in the school facilities, scheme of work, family, students, or even in the nature of the tests used in assessing the students. An example of the factors inherent in the nature of the test could be the ways tests items are ordered.

Udonsu (2015) investigate salient issue in students' poor performance in Mathematics in public Examination's in Nigeria. A case study of selected secondary schools students in Adamawa State, North-East, Nigeria. Adopted expository research design population of all students in SS2 in Adamawa State, used stultified random sampling with 200 sampled. Finding revealed that from 2000 to 2009 academics session, the performance was not satisfied. In the year 2000, 4,942 students sat for the NECO Examination in Mathematics in Adamawa State and only 1,190 students passed with credit that indicated 24.1% of the students. In 2001, 16,879 students sat for NECO Examination in Adamawa state, North-East Nigeria only 3,540 students passed with credit. In 2002, 7,188 students sat for Mathematics and English Language in NECO Examination only 575 students passed with credit that indicated 8.0%. in 2009, 28,697 students sat for Mathematics in NECO Examination and only 4,171 passed with credits, while in 2014, 36,700 students sat for Mathematics and English Language in NECO Examination only 2,600 candidates passed with credit which indicate 7.1% passed with credits. This showed the level of poor academic achievement of secondary schools' students in North-East, Nigeria. It is therefore, necessary to see if the way items are ordered has influence, hence, the concern of this study is to ascertain if item orderings are factors in academic achievement of the unity school's students in the North-East Nigeria.

OBJECTIVES OF THE STUDY

1. Compare the mean achievement scores in English Language of JSS 3 students exposed to different orderings of the items.
2. Compare the mean achievement scores in Mathematics of JSS 3 students exposed to different orderings of the items.

Hypotheses: The following null hypotheses were tested at 0.05 level of significance.

1. There is no significant difference between the mean achievement scores in English Language of JSS 3 students exposed to different orderings of the items.
2. There is no significant difference between the mean achievement scores in Mathematics of JSS 3 students exposed to different orderings of the items.

METHOD

Design. The experimental research design was adopted for the study. It was experimental because different groups of students were exposed to different experimental conditions.

Area of the Study. The study was carried out in the North-Eastern zone of Nigerian. The zone is made up of Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe States.

Population of the Study. The population of the study comprised all JSS 3 students of 2022/2023 session in all the 15 Unity Schools of the zone. According to records obtained from the Federal Education Quality Assurance Service (FEQAS), there were 5,403 JSS 3 students in the zone, during the 2022/2023 session.

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Sample and Sampling Techniques. The sample used for the experiment consisted of 375 JSS 3 students obtained through a combination of multi-stage and cluster sampling techniques. At the first stage, three out of 15 unity schools were drawn through simple random sampling. At the second stage, three streams of JSS 3 were obtained from each of the three schools, through simple random sampling. All the students in the nine streams were used for the study. This gave rise to 375 students.

Instruments Used for the Study. Two instruments, each prepared in three different formats, were used for the study. They were titled: Mathematics Achievement Test and English Language Achievement Test. A draft of each of the instruments, which contained 80 multiple-choice test items, was first developed by the researchers. Each of these drafts was given to two experts in the corresponding discipline. The experts were requested to go through the items and assess them in terms of clarity of words, appropriateness of items and content coverage. Modifications were made in the items, based on the comments of the experts.

Each of the two drafts of the instruments was then administered on a sample of 150 students who were obtained from a school outside those used for the experiment. Thereafter, the difficulty indices of the items, for each of the tests, were computed using responses from the 150 students. Computations of the indices were done using a statistical software package named Item Analysis Statistical Package (IASP). Fifty items were then selected from the 80 items of each instrument. Only items having their difficulty indices ranging from 0.3 to 0.70 were selected. The fifty items constituted the test for each of the subjects.

The selected items for each instrument were then arranged in three ways, to give rise to three formats of the test. Format ETD had the items arranged in increasing order of difficulty indices (Easy to Difficult- ETD), format DTE had items arranged in decreasing order of difficulty indices (Difficult to Easy- DTE), while format MDI had items arranged in random order of the indices (Mixed Difficulty- MDI). There were thus three formats of the test for each subject- DTE, ETD and MDI.

Experimental procedure: The class teacher administered the three different formats of test to JSS 3 students in the sampled schools. The three formats were administered during normal class period, just like the normal formative assessment. Each of the examination took sixty minutes for the students to finish. The scripts were collected by the class teacher. Three formats of each test were arranged alternately and the papers distributed following that order while students were seated. Alternate arrangement implied that the formats were arranged for examples as follow: ETD, DTE, MDI, ETD, DTE, MDI, ETD, DTE, MDI etc. With that arrangement no students had the same format with the person sitting on his/her right or left. This served as a random assignment of the participants to the formats. All the students took the examination the same day and time. The mathematics test was administered the first day and the English Language test, administered the next day. At the end of each examination the scripts were separated into the three respective formats, giving rise to six groups. The scripts, for each group and for each subject were then be marked, scored, and the scores used for analysis.

Method of Data Analyses: The research questions were answered by arithmetic mean and standard deviations. The null hypothesis were tested using one-way analysis of variance (ANOVA). If p-value was smaller than level of significance, null hypotheses was rejected.

RESULT AND DISCUSSION

HYPOTHESIS 1: There is no significant difference between the mean achievement scores in English Language of JSS 3 students exposed to different orderings of the items.

Item Ordering Formats	Type III Sum of Squares	Df	Mean of square	F	Sig.
All the Item Ordering Formats	21020.874	2	10510.437	44.714	.000

Table 1 shows the Analysis of Variance (ANOVA) summary for the test of difference in the achievement scores in English Language of the three groups of JSS 3 students that were exposed to the three different item ordering formats. Their achievement scores had a Type III Sum of Squares = 21020.874, df = 2, Mean of Square = 10510.437, F ratio = 44.714 and sig = 0.001. The F value of 44.714 is significant at 0.05 α -level, since probability 0.001 < 0.05.

Table 2: Mean Achievement Scores in English Language of the Students Exposed to Different Items Orderings

Item Ordering Formats	Mean	Std. Deviation	N
ETD	47.870	14.743	200
DTE	61.585	13.636	200
MDI	53.455	17.586	200
Total	54.303	16.386	600

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Table 2 shows the descriptive statistics of the mean achievement scores in English Language of the JSS 3 students exposed to different orderings of the items. The students that were exposed to Easy to Difficult (ETD) item ordering were 200 and they had a mean score of 47.870 and a standard deviation of 14.744. Similarly, the students that were exposed to Difficult to Easy (DTE) item ordering were 200 and had a mean score of 61.580 and a standard deviation of 13.636. Lastly, the students that were exposed to items with Mixed Difficult Indices (MDI) were 200, had a mean score of 53.455 and a standard deviation of 17.586. These results show that the students that were exposed DTE had the highest mean achievement score followed by those that were exposed to MDI and lastly, those that were exposed to ETD.

These results show that the students that were exposed to Difficult-to-Easy (DTE) method of item ordering had the highest mean achievement score followed by those that were exposed to Mixed Difficulty Index (MDI) method and lastly, those that were exposed to Easy-to-Difficult (ETD) method. The result also revealed that there was a significant difference between the mean achievement scores in English Language of JSS 3 students exposed to different orderings of the items.

The significant difference observed between the mean achievement scores in English Language of JSS 3 students exposed to different orderings of the items is expected and not surprising. The student was used to the format DTE in their examination from primary school, since most of the teachers are not exposed to different item ordering format. Some are easily put-off when they encounter difficult questions while some maintain strong level of internal control and motivation to continue irrespective of how challenging the questions may be. However, it is surprising that students that were exposed to Difficult-to-Easy (DTE) method of item ordering had the highest mean achievement score followed by those that were exposed to MDI then ETD. This result was contrary to expectation. One had expected the performance would be highest when arranged in ascending order considering the fact that tasks are easier to accomplish when one moves from simple to complex.

The finding of the present study is in agreement with that of Opara and Uwah (2017) who investigated the effect of test item arrangement on performance in Mathematics among Junior Secondary School Students in Obio-Akpor L.G.A of Rivers State. The findings of the study were that item arrangement based on ascending order of difficulty had a positive and significant effect on students' performance in mathematics. Item arrangement based on no particular order of difficulty had a positive and significant effect on students' performance. The present study is also in consonance with the findings of Chen (2010) who carried out a study on the moderating effects of item order arranged by difficulty on the relationship between test anxiety and test performance. The investigations revealed that item order adjusted according to individual examinee's perceived item difficulty have a more significant moderating effect than item order arranged according to item bank calibration.

A finding which the present study is discordant with is that of Plake, et al (1982) that conducted a study using three-item orderings (easy-to-hard, spiral cyclical, and random) and two levels of knowledge of ordering (informed and non-informed) to ascertain the differences in test results, student's perception of the test's fairness and difficulty, and student's estimation of test performance. The study found no significant difference in test scores when different orderings are used. This divergent result from the present study may be attributed to the fact that while the present study had item difficulty established by calculations, the reviewed study had its item difficulty based on the students' perceptions.

Table 3: Table of Means for English Language

	ETD	DTE	MDI	Total
Male	43.876	63.756	54.359	54.424
Female	49.792	60.309	52.877	54.235
	47.870	61.585	53.455	

Having found that there is interaction between gender and item ordering, there is need to look at the table of means. This is shown in table 4.2. Looking at the table, it would be observed that the result of comparison of males and females depends on the item ordering. In format ETD, females did better. However, in format DTE and MDI males did better.

Therefore, ETD is best for female JSS 3 students in Unity Schools in the North-East Nigeria for English language. DTE is best for male JSS 3 students in Unity Schools in North-East Nigeria for English language and MDI, male JSS 3 students in Unity Schools in North-East, Nigeria.

This result is expected and not surprising because males and females generally react differently to situations. Males generally possess more innate ability process complex tasks than females. Therefore, it is expected that the male students would do better in answering tests items that are arranged in various ways, even the complicated ones, than the female students.

Kassaw and Astatke (2017) who conducted a study to assess the relationships between gender, level of goal orientation, academic self-efficacy and academic performance in Woldia College of Teachers' Education. The result of the study showed significant gender difference in students' general self-efficacy and academic achievement. The present study is also in agreement with the findings of Dania (2014) who investigated the effect of gender on students' academic achievement in secondary school Social Studies. Results revealed that there was significant interaction effect of type of school (public or private) and gender on

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students' academic performance in Social Studies. A finding which the present study is discordant with is that of Plake, et al (1982) who conducted a study on the effects of item ordering and two levels of knowledge of ordering (informed and non-informed) academic performance. No significant effects were found for the interaction of knowledge of arrangement and item order. These divergent results may be due to the variations in the objectives of the two studies, whereas the present study was on the interaction of gender and item ordering, the previous study was on knowledge of item ordering and item ordering.

HYPOTHESIS 2: There is no significant difference between the mean achievement scores in Mathematics of JSS 3 students exposed to different orderings of the items.

Item Ordering Formats	Type III Squares	Sum ofdf	Mean of square	F	Sig.
All the Item Ordering Formats	35685.738	2	17842.869	73.251	.000

Table 4 shows the Analysis of Variance (ANOVA) summary for the test of difference in the achievement scores in Mathematics of the three groups of JSS 3 students that were exposed to the three different item ordering formats. Their achievement scores had a Type III Sum of Squares = 35685.738, df = 2, Mean of Square = 17842.869, F ratio = 73.251 and sig = 0.001. The F value of 73.251 is significant at 0.05 α -level, since probability 0.001 > 0.05.

Table 5: Mean Achievement Scores in Mathematics of the Students Exposed to Different Items Orderings

Item Ordering Formats	Mean	Std. Deviation	N
ETD	63.900	17.536	200
DTE	47.480	14.596	200
MDI	53.505	16.655	200
Total	54.961	17.644	600

Table 4 shows the descriptive statistics of the mean achievement scores in Mathematics of the JSS 3 students exposed to different orderings of the items. The students that were exposed to Easy to Difficult (ETD) item ordering were 200 with a mean score 63.900 and a standard deviation of 17. 551. Similarly, the students that were exposed to Difficult to Easy (DTE) item ordering were 200 and they had a mean score of 47.480 and a standard deviation of 14.592. Lastly, the students that were exposed to items with Mixed Difficult Indices (MDI) were 200; they had a mean score of 53.050 and a standard deviation of 16.655. These results show that the students that were exposed ETD had the highest mean achievement score followed by those that were exposed to MDI and lastly, those that were exposed to DTE.

The results revealed that the students that were exposed to Easy-to-Difficult (ETD) method of item ordering had the highest mean achievement score in Mathematics followed by those that were exposed to Mixed Difficulty Index (MDI) method and lastly, those that were exposed to Difficult-to-Easy (DTE) method. Also, the result showed that there was a significant difference between the mean achievement scores in Mathematics of JSS 3 students exposed to different orderings of the items.

The result shows that performance in the test was highest when the items were arranged in ascending order of difficulty. This result differs from that of English Language. It is not surprising that the result turned out as shown. Again this finding went according to expectation, that the performance was highest when the items are arranged from easy to difficult.

This is because students are expected to attempt more questions when arranged from easy-to-difficult than when arranged vice versa. This owes to the fact that the very difficult questions will not hinder the students from attempting the easier ones; hence, higher scores are expected especially when all the questions attract equal marks. Also, students are motivated to attempt more questions when they get the first few items correctly, the reverse should be the case when they fail the initial items of a test.

The finding of the present study is in consonance with that of Opara and Uwah (2017) who conducted a study on the effect of test item arrangement on performance in Mathematics among Junior Secondary School Students in Obio-Akpor L.G.A of Rivers State. The findings of the study were that item arrangement based on ascending order of difficulty had a positive and significant effect on students' performance in Mathematics. Item arrangement based on no particular order of difficulty had a positive and significant effect on students' performance. The present study is also in consonance with the findings of Chen (2010) who carried out a study on the moderating effects of item order arranged by difficulty on the relationship between test anxiety and test performance. The investigations revealed that item order adjusted according to individual examinee's perceived item difficulty may have a more significant moderating effect than item order arranged according to item bank calibration.

A Finding which the present study is not in agreement with is that of Monk and Stallings (1970) who worked on the relationship between scores obtained from equivalent tests with variations in item ordering. They discovered no significant linear

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relationships between equivalent test forms on the ordering of item difficulties. These variant results may be attributed to differences in area of study and methods adopted in conducting the study.

Table 6: Table of Means for Mathematics

	ETD	DTE	MDI	Total
Male	73.000	41.194	53.522	56.640
Female	58.082	50.641	53.492	54.014
	63.900	47.480	53.505	

Having found that there is interaction between gender and item ordering, there is need to look at the table of means. This is shown in table 4.4. Looking at the table, it would be observed that the results of comparison of males and females depends on the item ordering. In format ETD, males performed better. However, in format DTE, females performed better than the males, and format MDI, while male was better (superior) in format MDI. This result is expected and not surprising because males and females generally react differently to situations. Males generally possess more innate ability process complex tasks than females. Therefore, it is expected that the male students would do better in answering tests items that are arranged in various ways than the female students. To the best of the knowledge of the researcher, no previous study has been conducted on the interaction of gender and item ordering in determining academic achievements. However, a finding with which this present study is in agreement with is that of Kassaw and Astatke (2017) who conducted a study to assess the relationships between gender, level of goal orientation, academic self-efficacy and academic performance in Woldia College of Teachers' Education. The result of the study showed significant gender difference in students' general self-efficacy and academic achievement with the mean scores of male students' academic self-efficacy and CGPA higher than those of their female counterparts. However, a finding which the present study is in agreement with is that of Dania (2014) who investigated on the effect of gender on students' academic achievement in secondary school Social Studies. Results revealed that there was significant interaction effect of type of school (public or private) and gender on students' academic performance in Social Studies. A finding which the present study is discordant with is that of Plake, et al (1982) who conducted a study on the effects of item ordering and two levels of knowledge of ordering (informed and non-informed) academic performance. No significant effects were found for the interaction of knowledge of arrangement and item order. These divergent results may be due to the variations in the objectives of the two studies, whereas the present studied the interaction of gender and item ordering

CONCLUSION

From the results obtained in this study, conclusion is drawn that item ordering has influence on achievement scores obtained by students in multiple-choice tests in both English Language and Mathematics.

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