FUDMA JOURNAL OF SCIENCE AND EDUCATIONAL RESEARCH (FJSER)

A BI-ANNUAL PUBLICATION OF FACULTY OF SCIENCE AND EDUCATION, FEDERAL UNIVERSITY, DUTSIN-MA

ISSN: 2449-0636 Vol. 1. No. 1 JANUARY, 2015

FEDERAL UNIVERSITY, DUTSIN-MA

INTEGRITY & SERVICE

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FUDMA JOURNAL OF SCIENCE AND EDUCATIONAL RESEARCH (FJSER)

VOL.1 NO.1 JANUARY, 2015

ISSN: 2449-0636

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EDITORIAL

FUDMA Journal of Science and Educational Research is a bi-annual Journal Published by the Faculty of Science and Education, Federal University, Dutsin-ma, Katsina State, Nigeria. The Journal was founded for the purpose of providing forum for Scientists, Technologists and Educationists, who are interested in pursuing professionally oriented research and scholarship.

The articles incorporated in this maiden edition are divided into two parts; Science and Educational Research. The Journal consists of blind peer-reviewed articles by experts in the various fields. The articles dwell on topical issues on different aspects of Science and Educational Research. Indeed, the research reports as presented by the contributors will help greatly towards boosting teaching and learning process in schools vis-a-vis solving many problems affecting the Nation's Educational System with the view of having a country with ample opportunities for the younger generation of today and tomorrow.

Every author is solely responsible for the materials published in this Journal. The Editorial Board appreciates the contributions made by the contributors in bringing the Journal to limelight. It is our ardent hope that your original research report will be considered in our subsequent edition.

Finally, I wish to appreciate the Vice-Chancellor and Management of the Federal University, Dutsin-ma for accepting the FUDMA Journal of Science and Educational Research (FJSER) as one of the official Journals of the University and the TETFUND, for their financial support in publishing this Journal.

Editor-in-Chief
Prof. J.O. Fatokun

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ANALYSIS OF FUNCTIONING AND NON-FUNCTIONING DECOYS IN MULTIPLE-CHOICE BIOLOGY ITEMS

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ABSTRACT

This study investigated the functioning and non-functioning decoys of Senior School Certificate Examination (SSCE) multiple -choice biology items. The survey research design was employed for the study. Sample for the study consisted of 1450 Senior Secondary Three (SSIII) students drawn from 20 randomly selected secondary schools in Ekiti State, Nigeria. The instruments used for the study were 2008 SSCE NECO and WAEC multiple-choice Biology test papers. Findings from the study showed that there were 229 (95%) functional options and 11 (5%) non – functional options in 2008 WAEC SSSE Biology multiple choice test; NECO had 280 (93%) functional options and 20 (7%) non – functional options. WAEC and NECO SSCE in Biology had reliability co-efficients of 0.91 and 0.93 respectively (P > 0. 05) and the concurrent validity of 0.90. Four (4) option items especially in Biology was recommended but if 5 options items should be used, more attention should be given to functionality of decoys, validity and reliability.

Key words: *Functioning Decoys, Non-functioning Decoys, Multiple Choice Items, Biology*

Introduction:

In the Nigerian educational system, as it is in the rest of the world prominence has been given to multiple choice tests as a method of assessing students' learning particularly in the different school subjects. Multiple choice tests (MCTs) are becoming more popular particularly in public examinations. MCTs are not only popular in external examinations; they also play a crucial role in assessment processes in the school system. This may be because they ease and objectify the assessment procedures. Multiple choice tests are widely acclaimed as most reliable because of consistency in scoring the test as well as its fairness to all students (Osunde, 2009). Multiple choice tests discourage the learner's tendency to anticipate likely questions but encourage them to cover the whole contents taught in their preparations. They are also useful in assessing learners' mastery of specific facts, concepts, terms, laws and principles (Lawal, 2001 & Kolawole, 2005).

According to Kolawole (2005), multiple choice tests require students to select the answer from a number of plausible alternatives. Its objectivity is both in terms of development and scoring

as items cover wider curriculum contents and objectives of instruction. It is adjudged as having good validity since it has the tendency to cover all aspects of learning content (Alonge, 2003 & Lawal, 2001). The use of multiple choice items/questions in certain educational fields is sometimes contested due to some of the negative aspects whether actual or perceived but the format remains popular due to its reliability, utility and cost effectiveness (Steven, 2004).

A multiple choice item consists of a problem and a list of suggested solutions. The problem which may be a question or an incomplete statement is called the stem of the item. The lists of plausible responses are called alternatives. The correct option to an item is called the key to the item and the remaining options are called decoys/distractors/distracters (Owolabi, 2009 & Onuka, 2009). Many authors have suggested three to five options to be written for each item. (Grier, 1975) and Rodriquez (2005) believe that a 3-option multiple choice test is a reliable and three options are optimal for multiple choice items. Ramons and Stern (1993) explained that the larger the number of plausible decoy/distractors, the larger the reliability of tests and that the four (4) or five (5) option formats are the most difficult to guess the answer correctly.

The usefulness of multiple choice tests for achieving objectives of testing depends on its quality of decoys. The importance of decoys/ distracters/ distractors in multiple choice items cannot be overemphasized.

Decoys/Distractors/Distracters are incorrect options/alternatives in multiple choice test items. The effectiveness of options in multiple choice tests is judged by how plausible or functional the decoys/distractors are. A decoy is considered as effective if at least five percent (5%) of the testees selected it (Tarrant, Ware & Mohammed, 2009 and Theodorsson, Shafil, Wardy, Khan,Mahrezi and Shafaee, 2010).

Distractor analysis is the frequency of selection of each option and the higher the frequency of each option (especially by testees/examinees in the lower group) in relation to the total number of the students in the high and low group, the greater the percentage of the distractor, the higher the degree of the particular option will function as a distractor (Alonge, 2004). A good distractor should be more chosen by the examinees in the lower group, but if otherwise, that particular option should be scrutinized and revised for it will be regarded to be functioning negatively or non-functioning.

In addition, other properties of MCTs are validity and reliability. Bandele (2004) defines validity as the extent to which an instrument measures what it purports to measure. Validity therefore is determined in relation to what particular use for which the instrument is being considered. Validation involves checking the test scores of testee against some other observations that serve as criterion, that is, it examines the relationship between test scores and other empirical data and logical considerations. Many literatures viewed test validity as the degree to which a test measures what it is supposed to measure (Hassan, 1995; Gbaleyi & Akinyemi, 1995; Trimble, 2003 and Lucke, 2005). The following validity procedures are available for educational instruments (like questionnaire, rating scales, opinionnaire and tests): content validity, face validity

criteria-related validity and construct validity. Wuddah (1994) and WAEC (1995) suggest that the reliability of a test is independent of the number of options. According to Bandele (2004), reliability of an instrument is its measure of consistency, stability, dependability, predictability, precision and accuracy. This measure makes it possible to estimate what proportion of the total variance of test scores is error variance. Reliability means the extent to which individual differences in test scores are attributed to the differences in the characteristics under consideration and the extent to which they are attributable to chance errors.

Reliability refers to the degree of consistency between two sets of scores in observations obtained with the same instrument or equivalent form of the instrument (Trimble, 2003). It indicates how much confidence one can place on the test result. Reliability is a very important quality of a test. It means the extent to which the results obtained from the test can be relied upon as the true score. Reliability is a question of degree, that is, it can either be low, moderate or high (Abiri, 2006). The importance of validity and reliability in all the examinations conducted by public examining bodies cannot be overemphasized. MCT is being used by examination bodies like National Examinations Council (NECO) and West African Examinations Council (WAEC) and other public examination bodies. Public Examining Bodies conduct standardized test for both internal and or external examinees in Nigeria. National Examinations Council (NECO) and West African Examinations Council (WAEC) are among the Public Examining Bodies in Nigeria. National Examinations Council (NECO) was one of the last acts of the Abdulsalami Abubakar military administration which was promulgated by a decree, in April 1999 that created the National Examinations Council (NECO). It has its headquarters in Minna, Niger State. NECO took off on 26th April, 1999. The National Examinations Council established in April, 1999 has the sole responsibility of conducting the Senior School Certificate Examination (SSCE), hither-to being conducted by West African Examinations Council (WAEC) (WAEC, 2007). The National Examination Council (NECO) conducted its maiden June/July SSCE in the year 2000 and has since continued to conduct Senior School Certificate Examination (SSCE) twice in a year (June/July and November/December) alongside with the West African Examinations Council (NECO, 2007).

West African Examinations Council as one of the examining bodies in Nigeria was established in 1952 following the acceptance of the Jeffery's Report by the then colonial Governments established by five West African Governments namely Ghana, Liberia, Gambia, Nigeria and Sierra Leone who passed appropriate ordinances in their Legislative Assemblies in 1951 in collaboration with and in succession to, the Cambridge School Certificate Syndicate. It has his headquarters in Accra, Ghana while the Nigeria headquarters is in Yaba, Lagos (WAEC, 2007). It has the sole responsibility of organizing and conducting secondary schools and public examinations in West African countries such as the Gambia, Ghana, Liberia, Nigeria and Sierra Leone.

One of the emphases of the Nigerian

educational policy is that citizens must acquire scientific and technological education. Biology is one of the science subjects that deals with life or the study of living things and their vital processes. According to Parker (1992), Biology embraces those principles of widest application to the origin, growth and development, structure, function, evolution and distribution of plants and animals.

Biology views human beings in their present, past and future lives (Ahmed, 2002). It is a broad subject that has been subdivided into separate branches for convenience of study. For example, Botany is the study of plants; Zoology is the study of animals; Physiology is the study of how living things function; Genetics is the study of how living things inherit characters from their parents; Morphology is the study of external features of living things while Anatomy is the study of internal structures of living things (Eluwa, Soyinbo, Fajembola & Ohazuruike,1991 and Safra, 2003).

In spite of the importance and popularity of Biology among Nigerian students, performance at senior secondary school level has been poor (Ahmed, 2008). The Chief Examiners' reports indicate that students have similar weaknesses in Biology papers which lead to students' poor performance in West African Senior School Certificate Examination (WASSCE) in Biology papers. Nigerian Chief Examiners' Report (WAEC, 2002) for May/June Biology Paper 1 (Practical) shows that students' performance was generally poorer than the previous year. The Mean for the paper was 19 as against 20 for the May/June 2001 WASSCE while the standard deviation (S.D) was 12.04 as against 11.27 for the year 2001. In Biology paper 2 (Essay and Objectives) the performance of the students was generally poorer than that of previous year. The statistics showed that the Mean for the paper was 21 as against 16 for May/June 2001 WASSCE and the standard deviation was 10.54 as against 7.8 for 2001. WASSCE Chief Examiners' Report May/June (2004) shows that the students' performance in Biology paper 1 was slightly poorer than the previous year with a mean score of 20 and a standard deviation of 9.60. In Biology paper 1 and the mean score for the paper 2 was 20 while the standard deviation was 7.48. WASSCE Chief Examiners' Report Nov/Dec. (2004) shows that the mean for Biology paper 2 (Essay) was 22 while the standard deviation was 8.94. Students' performance in this paper was fair compared with previous years. But, the performance of the candidates was poorer than the previous year in paper 3 (alternative to practical).WASSCE Chief Examiners' Report Nov/Dec (2007) indicates that the performance of the students in paper 2 (Essay) was slightly poorer than that of the previous year with a mean score of 17 and a standard deviation of 8.77 compared to a mean of 18 and S.D of 8.94 for Nov/Dec 2006. In addition, students' performance in paper 3 (alternative to practical) was slightly poorer in 2007 with a mean score of 24 and a standard deviation of 12.17 compared with a mean of 28 and standard deviation of 7.64 for Nov/Dec 2006 WASSCE). The desire to know the causes of the poor performance in Biology has been the focus of researchers for some time now. There is therefore need to analyze the functioning and non-functioning decoys in multiple

choice tests of Senior School Certificate Multiple Choice in Biology in order to discover the functionality of decoys/options as well as the validities and reliabilities of WAEC and NECO examinations. Both WAEC and NECO make use of multiple choice Biology items in their examinations. The researchers also examined the extent to which decoys/distractors in senior school certificate multiple choice Biology items are performing.The purpose of the study was to empirically analyze the functioning and non-functioning decoys in Senior School Certificate multiple choice tests in Biology. Specifically, the study sought information on:

1. the functionality of options of each of the NECO and WAEC SSCE multiple choice Biology tests,
2. the reliabilities of NECO and WAEC SSCE multiple choice Biology tests,
3. the validities of NECO and WAEC SSCE multiple choice Biology tests and

Research Questions

The following research questions were formulated to guide the study.

1. To what extent are the options supplied by NECO and WAEC SSCE multiple choice Biology tests functional?

Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance in the study.

1. There is no significant difference in the reliabilities of NECO and WAEC SSCE multiple choice Biology tests.
2. There is no significance relationship in the validities of NECO and WAEC SSCE multiple choice Biology tests.

Methodology

This study adopted a descriptive survey research design. The population for this study consists of all senior secondary school students in Ekiti State. Survey research design was chosen for this study because the data were collected through the tests and no variable was manipulated during the conduct of the study. Since, the study is not experimental in nature.

The target population for this study consists of senior secondary school three (SS3) students in Ekiti State. Stratified random sampling technique was adopted for the study. The schools were stratified along three Senatorial Districts in Ekiti State. In Ekiti Central and Ekiti North Senatorial Districts 7 (35%) senior secondary schools each were selected while in Ekiti South 6 (30%) senior secondary schools were selected. Ekiti Central had the highest number of respondents with 576 (40%) students, followed by Ekiti South, with 466 (32%), while Ekiti North had the lowest with 408 (28%) respondents.

Thus, a total of twenty senior (20) senior secondary schools were selected. One thousand four hundred and fifty (1450) students were randomly selected to take part in the study. The researchers used item-analysis data, to assess the proportion of non-functioning decoys on a sample of WAEC and NECO papers administered to Biology students in Ekiti State, Nigeria. The 2008 WAEC SSCE multiple choice Biology items have 240 options (180) decoys/ distractors and (60) correct responses while 2008 NECO SSCE multiple choice Biology items have 300 options (240) decoys/ distractors and (60) correct responses. Thus, a total of 120 items were reviewed, including 540 options (420 decoys or distractors and 120 correct responses). Non-functioning options were defined as ones that were

chosen by fewer than 5% of examinees. The instruments for this study are 2008 NECO and WAEC multiple choice Biology papers. The instruments were standardized tests used by these examination bodies in Nigeria and West Africa. These instruments were considered to be accurate and reliable by the public examination bodies.

Frequency and percentage were used to determine options' functionality of the test items in order to answer research question 1 while z-test and Pearson Product Moment Co-efficient were used to test hypotheses 1 and 2.

RESULTS

Research Question One: To what extent are the options supplied by NECO and WAEC SSCE multiple choice Biology tests functional?

Non-functioning options or poorly performing distractors were defined as those that were chosen by fewer than five percent (5%) of examinees (Tarrant, Ware and Mohammed, (2009) and Theodorsson, Shafil, Wardy, Khan,Mahrezi and Shafaee, 2010). In other words, five percent (5%) of the students that selected distractors was used as yardstick to judge option functionality. The options functionality obtained was then summarized and presented in grouped frequency distribution table 1.

Table 1: Functional and Non- functional Options of 2008 NECO and WAEC SSCE Multiple Choice Biology Tests

Variable	NECO Frequency	%	WAEC Frequency	%
Functional Options	280	93	229	95
Non-functional Options	20	7	11	5
Total	300	100	240	100

Table 1 reveals that there were 280 (93%) functional options and 20 (7%) non-functional options in 2008 NECO SSCE multiple choice Biology test while 2008 WAEC SSCE multiple choice Biology test had 229 (95%) functional options and 11 (5%) non-functional options. The researchers compared functionality of options in NECO and WAEC SSCE multiple

choice Biology test by using 5% of the students that selected distractors as shown in the table 2 below.

Table 2: Comparison of the 2008 NECO and WAEC SSCE Multiple Choice Biology tests according to Number of Functioning Options.

Variable	No of Functional Options	Percentage %
NECO	280	93
WAEC	229	95

chosen by fewer than 5% of examinees. The instruments for this study are 2008 NECO and WAEC multiple choice Biology papers. The instruments were standardized tests used by these examination bodies in Nigeria and West Africa. These instruments were considered to be accurate and reliable by the public examination bodies.

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Table 2 shows the comparative analysis of 2008 NECO and WAEC multiple choice Biology test according to number of functioning options. Thus, NECO had 280 (93%) functional options while WAEC had 229 (95%) functional options. This shows that 2008 WAEC SSCE multiple choice Biology test have more functional options than 2008 NECO SSCE multiple choice Biology test.

Hypothesis One: There is no significant difference in the reliabilities of NECO and WAEC SSCE multiple choice Biology tests.

The reliabilities of NECO and WAEC SSCE multiple choice Biology tests were compared using z- test.

Table 3: Mean, K-R21 and z-test (Transformation) of Reliability Co-efficient of NECO and WAEC SSCE Multiple Choice Biology Tests.

Variable	(N)	X(Mean)	K-R21	z- Cal.	z- Critical
NECO	1450	29.00	0.93	0.500	0.209
WAEC	1450	25.12	0.91		

As shown in table 3, the calculated z-value of 0.500 and critical z-value of 0.209 at 0.05 alpha level. Since the calculated z-value is greater than the critical z-value, therefore hypothesis one was rejected. Thus, there is a significant difference in the reliability of NECO and WAEC SSCE multiple choice Biology tests. In addition, NECO SSCE multiple choice Biology test have higher reliability co-efficient of 0.93 with mean of 29.00 than WAEC SSCE multiple choice Biology test with reliability co-efficient of 0.91 with mean of 25.12.

Hypothesis Two: There is no significant relationship in the validities of NECO and WAEC SSCE multiple choice Biology tests.

The concurrent validities of NECO and WAEC multiple choice Biology tests were analyzed using Pearson Product Moment Correlation Coefficient (PPMC) to show the relationship between the two tests.

Table 4: Pearson Product Moment Correlation Coefficient (PPMC) of Validity of NECO and WAEC SSCE Multiple Choice Biology Tests.

Variable	N	X	SD	DF	Cal. r-value	Sig. of r- value
NECO	1450	22.61	11.75	1448	0.90	.000 (S)
WAEC	1450	22.21	13.42			

As shown in table 4, the calculated r-value of 0.90 and his was significant at 0.05 alpha level. Hence, the null hypothesis two was rejected meaning that there is a significant relationship in the validities of NECO and WAEC SSCE multiple choice Biology tests. Thus, NECO is valid when WAEC is used as the standard test and WAEC is also valid if we take NECO as the standard test. The concurrent validity shows that there is a very high relationship between NECO and WAEC SSCE multiple choice Biology tests.

Discussion of Findings

Based on work done on the analysis of result, the findings of the study, it was revealed that WAEC 2008 SSCE multiple choice Biology test have more functional options than NECO SSCE multiple choice Biology test. This shows that WAEC SSCE multiple choice Biology test functions better with 95% functionality than NECO SSCE multiple choice Biology test with 93% functionality. This finding is supported by the finding of Olatunji (2007) and Abiri (2006) which asserted that four-options multiple –choice test has the best functional options in NECO and WAEC multiple choice test items in Economics.

Findings from this study revealed that both the reliabilities of 2008 NECO and WAEC were high but NECO SSCE multiple choice Biology test have higher reliability coefficient of 0.93 and mean of 29.00 than WAEC with reliability coefficient of 0.91and mean of 25.12. This finding is supported by the submission of Wuddah (1994) which asserted that the reliability of a test is independent of the format typ- based on the number of options. According to Thorndike and Hagen (1978), the larger the number of plausible distractors, the larger the reliability of tests. It is possible to infer that the significant difference observed may be accounted for by the format of multiple choice Biology test in NECO. The findings of this study contradicted the findings of Kolawole (2007), which says that there is no significant difference in the reliabilies of NECO and WAEC multiple choice items in mathematics. He discovered very high reliability in NECO and WAEC multiple choice test in mathematics.

Findings from this study showed that, there is a significant relationship in the validities of NECO and WAEC SSCE multiple choice Biology tests. Thus, NECO is valid when WAEC is using as the standard test and WAEC is also valid if we take NECO as the standard test. The concurrent validity shows that there is a very high relationship between NECO and WAEC SSCE multiple choice Biology tests. This study is supported by the findings of Kolawole (2007), which say that there is a very high relationship in the concurrent validities of NECO and WAEC SSCE multiple choice mathematics test items, and there is no significant difference between the two papers. The significant relationship discovered in this study may be accounted for by the standard of NECO and WAEC SSCE Biology tests. Both examinations were prepared and standardized by test experts.

Recommendations

Based on the findings of this study, the following recommendations are made to relevant education authorities and examination bodies and other stakeholders in education.

1.Teachers must be given proper orientations on how to confirm functionality of options, validity and the reliability of their multiple choice items. Governments should periodically organize in-service training programme for teachers on regular basis.

2. Four (4) option test formats should be adopted in the Biology subjects that have a multiple choice tests component in future examinations because they have more functional options. Those examination bodies and teachers that want to go for five option formats should put functionality of options, reliability and validity into considerations.

3. The two examining bodies should meet and agree on the same number of distractors of the test items to avoid unnecessary standard comparability.

4. The use of four (4) numbers of options for multiple choice tests should not be limited to senior secondary school but it should start from the grassroots level of education, that is primary school level.

5. Both WAEC and NECO should reduce the number of non-functional options of their test items to barest minimum since they are standardized tests.

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