COMPARATIVE ANALYSIS OF ITEM PARAMETERS OF NECO SSCE AND WASSCE MULTIPLE CHOICE MATHEMATICS EXAMINATIONS FOR PUBLIC SECONDARY SCHOOLS IN OGUN STATE

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Abstract

This study conducts a complete comparative item analysis of the National examinations Council (NECO) and West African Examinations Council (WAEC) Mathematics objective exams, with a focus on public secondary schools in Ogun State, Nigeria. The goal is to evaluate and compare the item specifications for the questions set by these two major examination boards. A simple random sampling technique was used to select two hundred SS III students from ten public secondary schools across five local governments in Ogun State. The instruments used were 2021 mathematics objective past questions of WAEC May/June and NECO, June/July 2021. Three hypotheses were stated and analyzed using the t-test and descriptive analysis. The research employs a descriptive survey design. The mathematics objective questions from NECO SSCE and WASSCE examinations were systematically analyzed by finding the difficulty index, discrimination index and the appropriateness of the items in relation to the prescribed curriculum for secondary education. The study's three null hypotheses were all rejected, according to the results. The study found that the mean scores of students and the level of difficulty of the items in the 2021 WAEC and NECO objective questions in mathematics differed significantly ($t = 19.35$, df = 199, $p < 0.05$) and ($t = 6.17$, df = 108, $p < 0.05$) respectively. In conclusion, students' performance on the 2021 WASSCE and NECO SSCE mathematics objective problems differed significantly. Based on these findings, it is recommended that there should be standardization of assessment items, professional development for educators on effective test construction, regular reviews of examination standards in order to enhance the quality and fairness of mathematics assessments and ultimately improving students learning outcomes.

Keywords: Item analysis, difficulty index, discrimination power, academic performance

Introduction

The essence of public examination is to provide uniform assessment to all candidates who were exposed to a given curriculum. They handle large scale testing programmes of candidates taking the examinations they registered at the same time. The councils use standard scores to report the performance of the candidates. In Nigeria public examinations are taken by candidates in the terminal classes for certification, namely: primary six, junior secondary and senior secondary schools. The National Policy on Education outlines the objectives of secondary school education in Nigeria as preparing each student for (a) meaningful participation in society and (b) further education (Udofia & Udo, 2017). It is at the end of six years tenure in the secondary school that the senior secondary school certificate examinations are taken. The School certificate examinations, which determine the placement of Nigerian students in higher learning and/or employment, are of particular concerned (Udofia & Udo, 2012).

Examination is a generic name for written exercises, oral questions, or practical tasks, set to test a

candidate's knowledge and skill. It involves both quantitative and qualitative description of a pupil's behavior, and the passing of value judgment concerning the desirability of that behavior. According to Udofia & Udo (2017) examination agencies were set up to promote education, to co-ordinate educational programmes, and to control and monitor the quality of education in educational institutions, the essence of which is the organization of public examinations so as to provide uniform standards to all test takers, irrespective of the type or method of instruction they have received. Some of these examination bodies in Nigeria include the West African Examinations Council (WAEC), the National Examinations Council (NECO), the Joint Admission and Matriculation Board (JAMB), and the National Business and Technical Examinations Board (NABTEB). A closer look at the operations of these boards reveals that some of them perform similar functions. For example, secondary school graduate certification is offered by WAEC, NECO, and NABTEB; however, NABTEB is only available to graduates of Nigerian Technical and Vocational Colleges.

Developed countries, such as the USA, Canada, Ireland and Germany, have highly developed mathematics education programmes at the primary, secondary and post-secondary education system that makes them to record significant success in their countries (Adamu, 2007 inAyanwale, 2018). Thus, for any developing nation such as Nigeria to advance technologically and improve its social and economic status, mathematics education at the primary, secondary and post-secondary levels should be well managed. Students need to develop more interest in mathematics and have a fair grasp of the basic concepts and fundamental principles because numeracy, reasoning, thinking and problem solving skills can be demonstrated through learning and application of mathematics (Adegoke, 2013). However, the current trends in the performance of students in mathematics at senior secondary school certificate examination administered by bothWest African Examinations Certificate, (WAEC) and National Examinations Council of Nigeria (NECO) show that examinees' performance is consistently fluctuating over the years. More importantly, Asikhia, (2010) in Ayanwale, (2018) isolated various factors that could mar examinees' performances in Mathematics. Prominent among these factors are the nature of the test items and the examinees' characteristics. The performance of an examinee on a test item can be explained by the characteristics of the item.

School exams are activities that are routinely held every year at school. Examination is one of the important parts of the education system Schwerdt and Woessmann (2017). Exams are activities that cannot be separated from measurements. The measurement results will be the basis or reference in making the assessment. School examinations are held as an effort to evaluate whether students have reached the standards of learning competency and academic knowledge. This is very important because it is considered as a basis for followers to a higher class. In addition, examinations can maintain motivation for students to learn better and base predictions about the future education and talents of students(Suleman, Gul, Ambrin, & Kamran, 2015 and Zanon, Hutz, Hanwook, &Hambleton, 2016).Examination is carried out to measure the successes and weaknesses of students obtained during the education process. The accuracy of the results of the examination can be influenced by various things such as: instrument quality, scoring accuracy, good supervision, and other factors. School exams are very closely related to assessment activities.

Assessment is a very important activity in the implementation of education (Rahman & Majumder 2014). In order to make a good assessment and measurement, a good instrument is needed. Quality test instruments will provide accurate measurement results about student success. If the instrument used is not good, it will produce a measurement error (Ramadhan, Mardapi, Sahabuddin and Sumiharsono 2019) Tests as a tool to measure the ability of students to become very important. The test is a way of assessment that is designed and carried out to students at a certain time and place and in conditions that meet certain conditions. The test is usually given to students after participating in educational activities

during a certain time interval. Assessment must be supported by good measuring instruments. The measuring instrument commonly used in assessment activities in schools is a test. Therefore, a test instrument must be of quality to support the implementation of a quality assessment.

Item analysis is a process in which responses to test items are examined in order to test the quality of those items. Statistical methods are routinely used to identify any test items that do not belong on the test. Items are removed when they do not show the same kind of patterns of association with other items that is observed among retained test items. In addition, an item analysis will reveal if an item is too easy, too difficult, and/or will show a difference between different types of test-takers. Item analysis can be a useful method in confirming the value of test items for discriminating test-takers with ASD from test-takers without ASD when both groups are administered the same test (Baron-Cohen, Wheelwright, Skinner, Martin &Clubley, 2001 in Soto, 2013).

Item analysis is the practice of examining student responses to individual test items (questions) in order to assess their quality and the overall usefulness of the test. This method is especially useful for revising questions that will be used in future assessments, as well as removing unclear or misleading items in a single test administration (Hambleton & Jones, 1993). Item analysis also helps instructors improve their test construction abilities and is a crucial technique for assuring test efficacy and fairness (Zhao et al., 2019).Educators are likely to use item analysis both consciously and unconsciously on a daily basis. For example, grading entails examining student responses and discovering patterns in errors, whether they are related to specific questions or types of questions. When codified, item analysis becomes a scientific tool for improving examinations while maintaining academic integrity (Hambleton and Jones, 1993).The process of item analysis specifically evaluates student responses to individual test items, such as multiple-choice questions (MCQs). An MCQ typically consists of a stem followed by response options, which include one correct answer and three or four incorrect options, known as distractors (Harris, 2018). Item analysis employs statistical tests to determine whether an item should be included in the test, thereby improving the quality of tests and the items within an item bank (Zhao et al., 2019).

Olutola (2015) when analyzing Item Difficulty and Discrimination Indices of Senior School Certificate Multiple Choice Biology Tests, it was found that WAEC SSCE multiple-choice Biology test have more difficult items than NECO SSCE multiple choice Biology test. WAEC SSCE multiple choice Biology test have mean difficulty of 0.42 while NECO SSCE multiple choice Biology test have mean difficulty of 0.40. This shows that WAEC SSCE multiple choice Biology test have more difficulty items than NECO SSCE multiple choice Biology test. The findings disagree with the studies of Thomas (2016) which says that, the fiveoption formats have better difficulty indices. The study contradicts the findings of Abiri (2006) which say difficulty indices of multiple choice tests with fewer numbers of options say four is better than anyone with larger number of options. The higher mean difficulty index discovered in WAEC may be caused by the Number of options in WAEC SSCE multiple choices Biology test. Four option formats in WAEC have higher difficulty than five option formats in NECO.

The findings of this study contradicted the findings of Kolawole (2007) which says that there is no significant difference between the difficult levels of WAEC and NECO multiple choice items in mathematics. Therefore, both WAEC and NECO multiple choice tests in mathematics have the same difficulty levels. It was found that WAEC 2008 SSCE multiple choice Biology test have more discriminating items than NECO 2008 SSCE multiple choice Biology test. WAEC SSCE multiple choice Biology test have mean discrimination of 0.43 while the mean discrimination for the WAEC SSCE multiple-choice Biology test is 0.43, whereas the mean discrimination for the NECO SSCE Biology test is 0.39. This indicates that there are more discriminating items in the WAEC SSCE multiple-choice Biology test than in the NECO SSCE multiple-choice Biology test. Olatunji's (2007) discovered that the four-option formats of the WAEC SSCE multiple-choice exams have superior

discriminating indices than the NECO SSCE multiple-choice test in economics lends credence to this conclusion.

Statement of the Problem

In a developing country such as Nigeria, performance of student in Mathematics which is the bedrock of nation's technological advancement should be given complete attention. There are several views about the quality of items constructed by the two major examination bodies in Nigeria namely West African Examinations Council WAEC and National Examinations Council NECO. According to Bulus and Chukwuma (2021), certain schools of thought believe that NECO has more challenging item questions in terms of discriminating level and effectiveness, while others believe that WAEC is easier. Failure on the math test, may jeopardize the admission of any students that doesn't pass at credit level to any higher institution, as Mathematics is a major subject to be passed and considered for admission purpose. And this would cause delay as there's no job opportunities for students in this category and this will likely make them to become liabilities to their parents. The failure in Mathematics may be due to the quality of items constructed by the two examination bodies (WAEC & NECO).

The research was based on finding out the position of these major examination bodies by juxtaposing the performance of public school students in Mathematics in five LGAs in Ogun State and the best way to achieve this inquisitiveness is to carry out item analysis using the multiple choice question. This research aims to conduct a detailed comparative item analysis of WASSCE and NECO SSCE Mathematics objective examinations for public secondary schools in Ogun State by systematically scrutinizing the characteristics of examination n items. This study seeks to provide valuable insights into the pedagogical and evaluative practices of these examinations.

Purpose of the Study

The study carried out a comparative analytical study of WAEC and NECO SSCE mathematics objective questions with a view to examine the psychometric properties (difficulty levels, discriminating powers) of the 2021 WAEC and NECO SSCE mathematics objective test. Specifically, within the context of this purpose, the following purposes were generated:

1. Compare the mean scores of students in 2021 WAEC and NECO SSCE in mathematics
2. Determine the item difficulty level of WAEC and NECO mathematics objective questions.
3. Determine the discriminating power of WAEC and NECO mathematics objective questions.

Hypotheses

H01: There is no significant difference in the mean scores of students' performance in 2021 WASSCE and NECO SSCE objective questions in mathematics

H02: There is no significant difference between difficulty level of items in 2021 WASSCE and 2021 NECO SSCE mathematics multiple choice questions

H03: There is no significant difference between discriminating power of effective items in 2021 WASSCE and NECO SSCE mathematics objective questions.

Methodology

A descriptive survey research design was adopted for the study. Simple random sampling techniques was used to select sample size of two hundred (200) SS III students from ten (10) public secondary schools across five local governments in Ogun State. Two research instruments were used for the study. The first instrument was 2021 May/June WAEC questions in mathematics which consist of 50 multiple choice items with four options and the second was the 2021June/July NECO questions which consist of 60 multiple choice items with five options. Three hypotheses were raised and analyzed using the t-test and descriptive analysis.

As part of the data collecting process, the researcher first visited the chosen schools to request permission

from the principal to gather the participants' informed consent. Students who consented to participate in the study were given copies of the WASSCE and NECO SSCE 2021 mathematics objective questions. Optical Mark Recognition (OMR) answer sheets were given to the students for the test, which lasted 60 minutes for the WAEC objective questions and 50 minutes for the NECO SSCE objectives questions. Thereafter, students' answer sheets were promptly collected, and the data collected was then compiled and profiled for analysis using the SPSS, (Statistical Package for the Social Sciences) version 21.

Results
Hypotheses Testing

H01: There is no significant difference in the mean scores of students' performance in 2021 WASSCE and NECO SSCE objective questions in mathematics.

To test this hypothesis, the data collected were summarized and analyzed using inferential statistics of student t-test.

Table 1: t-test summary table showing the mean difference in the performance of students in the WASSCE and NECO SSCE tests

Variable	N	Mean	S.D	Df	Cal.t-value	Sig. of t-value	Decision
Students' Performance (WASSCE)	200	24.82	7.39				
				198	19.345	.000	Significant
Students' Performance (NECO SSCE)	200	13.90	3.84				

Source: Field survey 2022; Mean Difficulty Level = M. Diff. Level

Table 1 revealed the test of group mean difference in the students' performance in mathematics conducted by WAEC and NECO using paired samples t-test. The results show that there is significant difference in the students' performance in mathematics conducted by WAEC and NECO (t=19.345, p<0.05). Therefore, the null hypothesis is rejected while the alternative hypothesis is retained. The mean score of WAEC $\bar{X}$=24.82; SD=7.39) and NECO ($\bar{X}$ =13.90; SD= 3.84) can be used to interpret the academic performance of students in a test by providing insight into the overall performance level and the distribution of scores. A higher standard deviation indicate a wider range of scores, suggesting greater variability in performance, hence students' performance in WAEC spreads more than NECO with a lesser variability.

H02: There is no significant difference between difficulty level of items in 2021 WASCE mathematics objective questions and 2021 NECO objective questions.

Table 2: t-test summary table showing the mean difference in the difficulty level of items in 2021 WASSCE and NECO SSCE objective questions in mathematics

Variable	N	M. Diff. Level	S.D	Df	Cal.t-value	Sig. of t-value	Decision
Difficulty level (WASSCE)	50	.528	.289				
				108	6.168	.000	Significant
Difficulty level (NECO SSCE)	60	.278	.113				

Source: Field survey 2022; Mean Difficulty Level = M. Diff. Level

Table 2 shows that WASCE has a mean index of difficulty (p=0.528) while NECO SSCE has an index (p=0.278). The 2021 WASSCE mathematics objective questions and the 2021 NECO SSCE

mathematics objective questions have a statistically significant mean difference in item difficulty (t = 6.168, df = 108, p = 0.000). Thus, the hypothesis which states that there is no significant difference between difficulty level of items in 2021 WASSCE mathematics objectives questions and 2021 NECO SSCE mathematics objective questions was rejected so retains the alternative hypothesis. This implies that NECO SSCE items were more difficult than WASSCE items. The mean index of difficulty of WASSCE (p=0.528; SD=0.289) suggests that, on average, a majority of students answered the test item correctly. This could indicate that the test item was relatively easier for the students, as the score is significantly above the midpoint of the possible score range. This might imply that the test item assessed a concept or skill that the students were well-prepared for or familiar with.

Conversely, a mean difficulty level (p=0.278; SD=0.113) of NECO SSCE indicates that, on average, students had more difficulty with this test item. The score is significantly below the midpoint of the possible score range, suggesting that a considerable portion of the students struggled to answer the item correctly. This might imply that the test item was challenging, either due to its complexity, the way it was formulated, or the content it assessed.

H03: There is no significant difference between discrimination power of items in 2021 WASSCE mathematics objective questions and 2021 NECO SSCE objective questions.

Table 3: t-test summary table showing themean difference in the discrimination power in the WASSCE and NECO SSCE mathematics objective tests

Variable	N	M. Discr. Index	S.D	Df	Cal t-value	Sig. of t-value	Decision
Discrimination power (WASSCE)	50	.30	.300				
				108	2.107	.037	Significant
Discrimination power (NECO SSCE)	60	.21	.086				

Source: Field survey 2022; Mean Difficulty Level = M. Diff. Level; Mean Discriminating Index= M. Discr. Index

Given the results of paired samples t-test (t = 2.11; p<0.05) on Table III, there is significant difference in discrimination of items in mathematics conducted by WAEC and NECO. Therefore, the null hypothesis that there is no significant difference in the discrimination power of items in mathematics conducted by WAEC and NECO SSCE is rejected while the alternative hypothesis is retained.
From the table, the relative high standard deviation (SD=0.30) of WASSCE, suggests a wide spread of scores, indicating significant variability in student performance while the mean score ($\overline{X}$=0.30), being around the middle of the possible score range, suggests that a substantial portion of students performed both above and below this average.
This combination of high variability and an average mean score might indicate that the test item had moderately good discrimination power. It means that while some students performed well and others poorly, the item was not extremely effective at distinguishing between those with high and low levels of knowledge or ability.

Further, the mean score of NECO SSCE ($\overline{X}$=0.21) indicates that students, on average, scored below the middle of the possible score range on this test item. The slightly high standard deviation (SD=0.086) suggests a small improvement in performance for this second test item.
In both cases, a high standard deviation indicates that the scores were spread out over a wide range, which can affect the item's ability to discriminate effectively.

Discussion of Findings

The first hypothesis examined if the mean scores of students on the 2021 WAEC and NECO SSCE mathematics objective questions differed significantly. The alternative hypothesis (t=19.345; p<0.05) was kept after the null hypothesis was rejected. This suggests that students' performance on the 2021 WAEC and NECO maths objective questions differs significantly. Studies by Ajayi and Awogbemi (2012), who examined the correlation between WAEC and NECO SSCE examination scores in mathematics in Osun State and found a statistically significant link, confirm this conclusion.

Hypothesis two tested if there is difference in the difficulty level of WAEC and NECO SSCE tests. The results of the sample t-test (t=6.168; p<0.05) indicated that there is significant difference between difficulty level of items in mathematics conducted by WAEC and NECO SSCE. Thus the null hypothesis was rejected and the alternative hypothesis was retained.

According to Bandele and Adewale's (2013) submissions on a comparative analysis of the item difficulty levels of the mathematics achievement examinations administered by the WAEC, NECO, and NABTEB, the study determined the order in which the three Nigerian examination bodies construct the mathematics achievement tests. The findings demonstrated that the item difficulty levels of the WAEC, NECO SSCE, and NABTEB Mathematics Achievement Examinations did not differ significantly. Therefore, it was advised that no one of these tests be regarded as being of a lower calibre than the others, and that the WAEC, NECO SSCE, and NABTEB certifications be recognized equally. Similarly, Udofia and Udo (2017), Alfred (2013), Metibemu (2016), and Ogbebor (2017) thought there was little difference in the level of difficulty between the WAEC and NECO SSCE multiple-choice mathematics questions.

The results of the current study were not supported by the findings of Bandele and Adewale (2013), Udofia and Udo (2017), Alfred (2013), Metibemu (2016), and Ogbebor (2017). The current study found a significant difficulty level of mathematics items administered by WAEC and NECO SSCE, despite the claims of Bandele and Adewale (2013), Udofia and Udo (2017), Alfred (2013), Metibemu (2016), and Ogbebor (2017) that there was no significant difference in the item difficulty levels of WAEC, NECO SSCE, and NABTEB.

The study's findings are comparable to those of Bulus and Chukwuma (2021). They reaffirmed that the three tests are similar and that the recent overwhelming failure in the NECO exams may have been caused in part by the difficulty of the NECO SSCE exams compared to the WAEC and NABTEB exams. This result confirms the study's conclusion that the item difficulty level of the WASSCE and NECO SSCE is similar.

The third hypothesis examined the items' ability to discriminate between 2021 WASCE mathematics objectives and 2021 NECO objective questions. There is a substantial difference between the discrimination powers of the mathematics items conducted by WAEC and NECO, according to the t-test (t=2.107; p<0.05). The null hypothesis was thus disproved. This result is different from that of Aborisade and Fajobi (2021), who claimed that the discrimination index was the only factor that showed a significant difference between the WAEC and NECO item parameters. The results of this investigation aligned with previous research by Olatunji (2007) in Aborisade and Fajobi (2021); Olutola (2015); Thomas et al. (2016), which found that items created using WAEC had more discriminating items than those from NECO tests.

Four options for WAEC multiple choice tests offer superior discriminating indices than NECO multiple choice tests in Economics, according to Olatunji (2007), referenced in Aborisade&Fajobi (2020). The discrimination indices of the WAEC and NECO SSCE mathematics examination instruments differ significantly, according to Thomas, Uchegbe, and Ugbe (2014). This indicates that the two examination

instruments differ significantly in their ability to distinguish between students who are bright and those who are not. The outcome also demonstrates that WAEC instruments separate the bright students from the dull ones more effectively than NECO instruments. The results are consistent with previous research by Abel and Frisbre (1991), who contend that a test with a high discrimination index is by definition superior, and that sucha test would produce a more reliable zone than the other.

Conclusion

The results of this investigation show that students' performance on the 2021 WAEC and NECO SSCE mathematics objective problems differed significantly. The findings support the notion that students' performance varied on these tests, with the WAEC showing a greater degree of item discrimination. Furthermore, the analysis indicates a significant discrepancy in the degree of difficulty between the mathematics items given by the WAEC and NECO SSCE, which runs counter to earlier studies that claimed they were equivalent. These findings underline the necessity of more research on the efficacy and calibre of the assessment items utilized in these tests, especially with regard to their capacity to reliably gauge student accomplishment.

Recommendations

Standardization of Assessment Items: In order to standardize the degree of difficulty of their mathematics assessment items, WAEC and NECO should work together. To make sure that both tests offer a fair and comparable assessment of student performance, this may entail a collaborative review of item construction procedures.

Professional Development for Teachers: Educational institutions ought to provide continuous professional development for teachers that emphasize item analysis and exam design. Exam item design can be enhanced by teaching teachers good assessment techniques, which will increase student ability measurement.

Regular Review of Examination Standards: It is essential for examination bodies to conduct regular reviews of their test items and overall assessment strategies. This should include analyses of item discrimination and difficulty, ensuring that all assessments are aligned with current educational standards and effectively differentiate between varying levels of student performance.

Research on Examination Outcomes: Further research should be conducted to explore the factors contributing to the differences in student performance between WAEC and NECO SSCE. Longitudinal studies could provide insights into how these examinations impact student learning outcomes and inform potential reforms to enhance their effectiveness and fairness.

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