

Comparative Analysis of Psychometric Properties of 2016 WAEC and NECO Mathematics Examination Items in Sabon Tasha Education Zone, Kaduna State, Nigeria

Dairo, Dorcas O. & Maude, Luka K. Department of Educational Psychology and Counselling, Ahmadu Bello University, Zaria, Nigeria Corresponding author: oluwadara17@gmail.com

Abstract

This study investigated the psychometric properties of 2016 WAEC and NECO Mathematics examination items in Sabon Tasha education zone, Kaduna state, Nigeria. The objective was to find out the difficulty, discriminating and distracter indices of WAEC and NECO 2016 mathematics examination questions. The design was cross-sectional survey involving 310 SS3 students as a sample drawn from a population of 7,917. A multistage sampling technique was used for the study. The two instruments used for data collection were objectives past question papers of 2016 SSCE Mathematics examinations developed by the two public examination bodies (WAEC and NECO) which were duly validated by the department of test development in the two examination of difficulty, discrimination and distractor indices. Independent sample t-test was used to test the hypotheses using SPSS version 20. The results indicated that there is no significant difference in the difficulty (t = 0.789, df = 108, p > .05), discrimination (t= -1.947, df = 108, p > .05) and distractive indices (t = 0.551, df =388, p > .05) indices of items in mathematics question papers set by WAEC and NECO in 2016. It was recommended among others that public examination bodies should ensure that difficulty and discrimination of items as well as functionality of mathematics multiple choice test options fall within the acceptable limits for certification at the school certificate level.

Keywords: Psychometric properties, Mathematics, WAEC, NECO, Examination items.

Introduction

Senior School Certificate Examination (SSCE) conducted by the West African Examinations Council (WAEC) and National Examinations Council (NECO) are expected to have comparable psychometric properties of the test items. West African Examination Councils (WAEC), National Examinations Council (NECO) and National Business and Technical Examination Board (NABTEB) are the three examining bodies, saddled with the responsibilities of conducting final assessment and evaluation of the final year students in the Technical Colleges and senior Secondary Schools in Nigeria (Bandele and Adewale, 2013). The set of students that took these examinations are expected to be of comparable ability because the students that took the examinations were exposed to the same course contents and curriculum within the same time frame. Therefore, they are expected to have an equal possibility of success in WAEC and NECO examinations.

Psychometric characteristics of examinations according to James and Olufunke (2020) refers to certain attributes inherent in tests upon which an assessment of candidates is based. Orluwene and Igwe (2016) defined psychometric properties of an examination as the validity, reliability and item characteristics of the examination. These characteristics include the facility or difficulty indices, the discrimination index, the power of distracters, validity and reliability indices. Mathematics is considered as an important subject and is taught at the senior secondary school level. In order to achieve the goals or objectives of mathematics at secondary school, the teaching and learning of Mathematics have to be properly done in the schools and provide students with high academic achievement. An appreciable number of students pass through junior and senior secondary schools during which the curriculum is fully covered and yet cannot score at least a credit pass in mathematics in the SSCE examinations. Over the years a high rate of failure has been recorded in Mathematics of senior secondary school certificate examination conducted by the two examining bodies (WAEC and NECO) in the northern part of Nigeria, Kaduna state. For instance, the reports from the West African Examination Council chief examiners indicated that the general performance of candidates in mathematics examination for the May/June 2011, 2012, 2013, 2014 and 2015 was poor as only 38.93%, 49.00%, 36.00%, 31.30% and 34.18% respectively had a credit pass and above (Wonu & Zalmon, 2017).

There has also been public opinion about the relative superiority of test items of one examination to the other



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and it is quite inappropriate that an important judgment concerning examination bodies should be based on unfounded opinions without reference to psychometric properties and other parameters to establish the difficulty level of the examination, and the indices of the discrimination and distracters. It is therefore necessary to investigate the psychometric properties that is, the process of finding out the quality of the multiple-choice items of mathematics examination papers set by the two major examining bodies in terms of finding out the effectiveness of the distracters, difficulty and discrimination indices of the test items.

The procedure used by the researcher for analysis of the mathematics multiple choice items conducted by WAEC and NECO 2016 is supported by Anikweze, (2013), Boopathiraj and Chellamani (2013) and Ezugwu (2015) where lower and upper ability groups are considered to determine the difficulty, distracter and discrimination indices of items. The item difficulty, discrimination and distracter indices can be computed as follows:

Difficulty index = $\frac{CR_U + CR_L}{N_U + N_L}$

Where CR_U : number of correct responses from the upper group, CR_L : number of correct responses from the lower group, N_U : number of responses in the upper group, N_L : number of responses in the lower group.

Discrimination index (U) = $\frac{CR_U - CR_L}{N}$

Where CR_U : number of correct responses from the upper group, CR_L : number of correct responses from the lower group, N: number of responses in the upper group/lower group.

Distractive index = $\frac{N_U - N_L}{N}$

Where N_U : number of distracted in the upper group, N_L : number of distracted in the lower group, N: number of responses in the upper group/lower group.

Purpose of the Study

The main purpose of this study was to investigate the psychometric properties of 2016 WAEC and NECO Mathematics examination items in Sabon Tasha education zone, Kaduna state, Nigeria. Specifically, the objectives of the study were to determine the:

- 1. Difficulty index of the test items used by WAEC and NECO in 2016 for SSCE Mathematics.
- 2. Discrimination indices of test item used by WAEC and NECO in 2016 for SSCE Mathematics.

3. Distracter power of the options of Mathematics examination questions conducted by WAEC and NECO in 2016 for SSCE Mathematics.

Research Questions

The following research questions were raised to guide the study:

- 1. What are the difficulty index of the test items used by WAEC and NECO in 2016 for SSCE Mathematics?
- 2. What are the discrimination indices of the test items used by WAEC and NECO in 2016 for SSCE Mathematics?
- 3. What are the distracter power of the options of Mathematics examination questions conducted by WAEC and NECO in 2016 for SSCE Mathematics?

Hypotheses

The following hypotheses were tested at $P \le 0.05$ level of significance:

- 1. There is no significant difference in the mean difficulty index of the test items used by WAEC and NECO in 2016 for SSCE Mathematics.
- 2. There is no significant difference in the mean discrimination indices of the test items used by WAEC and NECO in 2016 for SSCE Mathematics.
- 3. There is no significant difference in the mean distracter power of the options of Mathematics examination questions conducted by WAEC and NECO in 2016 for SSCE Mathematics.

Methods

A survey research design was employed for this study. 310 SS3 students were drawn as sample from a population of 7,917 senior secondary three students who registered for May/June 2019 WAEC and June/July 2019 NECO from the five local government areas in Sabon Tasha education zone, Kaduna state. A cluster sampling technique was used for the study because the population varies between urban and rural areas. Ten (10) schools were selected using purporsive sampling technique, while proportional and random sampling techniques were used to select the students. The instruments used for the study consisted of Mathematics objective test items constructed by WAEC (50 items) and NECO (60 items) for year 2016 examinations. The instruments were administered to 310 SS3 sampled students in ten (10) public secondary schools randomly selected for the study under similar AJSTME, Volume. 9, Issue 2. 79-83, May, 2023. <u>https://www.ajstme.com.ng</u> ISSN: 2251-0141 (Print), 2971-623 (Online)

conditions as given by the examination bodies. The data generated were used to answer the research questions using simple percentages and inferential statistics were used to test the null hypotheses at P < 0.05 level of significance. The formula for computing difficulty index (D), discrimination index and distracter index

were used to analyze data for answering research questions one, two and three while independent sample t-test was used to test all null hypotheses using the SPSS software (version 22.0).

Results

Table 1: Summary of Difficulty Levels of the Examinations Items Conducted by the Two Examination bodies in 2016.

Examination boules in 2010:								
Examination	Number and %	Total						
Body	of items that	of items that	and % of items					
	are difficult	are moderate	that are simple					
WAEC difficulty	11(22%)	38(76%)	1(2%)	50(100%)				
NECO difficulty	20(33%)	40(67%)	0(0%)	60(100%)				

The result in Table 1 showed that WAEC had 11 items that were difficult representing 22%, 38 items were moderate representing 76%, and 1 item were simple representing 2%. While NECO had 20 items that were

difficult representing 33%, 40 items were moderate representing 67%, and no item was simple representing 0% respectively. This implies that NECO had a higher percentage of difficult items as compared to WAEC.

 Table 2: Summary of Discrimination Levels of the Examinations Items Conducted by the Two

 Examination bodies in 2016.

Examination Body	Number and % of items that	Number and % of items	Number and % of items	Total
	are moderate	that are low	that are poor	
WAEC discrimination	33(66%)	12(24%)	5(10%)	50(100%)
NECO discrimination	45(75%)	12(20%)	3(5%)	60(100%)

The result in Table 2 indicated that WAEC had 33 items with moderate discrimination indices (66%), 12 items with low discrimination indices (24%), and 5 items with poor discrimination indices (10%). While NECO had 45 items or 75% of the items with moderate discrimination indices, 12 items or 20% of the items

with low discrimination indices, and 3 items or 5% of the items with poor discrimination indices. This implies that NECO had a higher percentage of items that discriminate well between the higher and lower achievers in 2016 as compared to WAEC.

 Table 3: Summary of Distractive Indices of the options of Examinations Items Conducted by the Two

 Examination bodies in 2016.

Examination Body	Number and %	Total		
•	of options that	of options that	options that are	
	have ineffective distracters	have effective distracters	non-functioning distracters	
WAEC distracter	29(19%)	113(76%)	8(5%)	150(100%)
NECO distracter	36(15%)	197(82%)	7(3%)	240(100%)

The result in Table 3 indicated that WAEC had 29(19%) options with ineffective distracters, 113(76%) options with effective distracters, and 8(5%) options with non-functioning distracters, while NECO had 36(15%) options with ineffective distracters, 197(82%) options

with effective distracters and 7(3%) options with nonfunctioning distracters respectively. This implies that NECO had a higher percentage of options that had effective distracters in 2016 as compared to WAEC.

 Table 4: Independent Samples t-test for the Mean Difficulty Index of Mathematics Examination Items

 Conducted by WAEC and NECO in 2016.

Examination Body	Ν	Mean	SD	df	t-value	p-value	
WAEC difficulty	50	0.43	0.103	108	.789	.432	
NECO difficulty	60	0.41	0.112				



Table 4 indicated that there is no significant difference in the mean difficulty index of the items of Mathematics multiple choice examinations conducted by WAEC and NECO in 2016 (t = 0.789, df =108, p = 0.432). This clearly shows that both WAEC and NECO were of equal difficulty level. Therefore, the null hypothesis which stated that there is no significant difference in the mean difficulty index of the test items used by WAEC and NECO in 2016 for SSCE Mathematics is hereby retained.

 Table 5: Independent Samples t-test for the Mean Discriminating indices of Mathematics Examination

 Items Conducted by WAEC and NECO in 2016.

Examination Body	Ν	Mean	SD	df	t-value	p-value
WAEC discrimination	50	0.50	0.175	108	-1.947	.054
NECO discrimination	60	0.56	0.169			

Table 5 indicated that there is no significant difference in the mean discrimination indices of the items of Mathematics multiple choice examinations conducted by WAEC and NECO in 2016 (t = -1.947, df = 108, p = 0.054). This clearly shows that WAEC and NECO discriminates well between high and low ability examinees. Therefore, the null hypothesis which stated that there is no significant difference in the mean discrimination indices of the test items used by WAEC and NECO in 2016 for SSCE Mathematics is hereby retained.

 Table 6: Independent Samples t-test for the Mean Distractive Power of the options of Mathematics

 Examinations Questions Conducted by WAEC and NECO in 2016.

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Examination Body	Ν	Mean	SD	df	t-value	p-value	
WAEC distracter	150	0.02	0.065	388	.551	.582	•
NECO distracter	240	0.03	0.051				

Table 6 indicated that there is no significant difference in the mean distractive power of the options of Mathematics multiple-choice examination items conducted by WAEC and NECO in 2016 (t = 0.551, df = 388, p = 0.582). This clearly shows that majority of the items for both WAEC and NECO were fall within the accepted level. Therefore, the null hypothesis which stated that there is no significant difference in the mean distracter power of the options of Mathematics examination questions conducted by WAEC and NECO in 2016 for SSCE Mathematics is hereby retained.

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Discussion

The result of hypothesis one showed that there was no significant difference between the mean item difficulty levels of WAEC and NECO Mathematics multiple-choice examination items conducted by WAEC and NECO in 2016. Also, in WAEC 2016; 22% of the items were difficult, 76% of the items were moderate and 2% of the items were easy/simple, while in NECO 2016 examination; 33% of the items were difficult, 67% of the items were moderate and no item was easy/simple. This finding lay credence to the findings of studies carried out by Alfred (2013); Metibemu (2016); James and Olufunke (2020) which says that there was no significant difference between the difficulty level of WAEC and NECO multiple-choice items in mathematics. However, the study disagrees with the submission of Bandele and Adewale (2013) that NECO examinations are more difficult than WAEC test items.

The result of hypothesis two showed that there was no significant difference between the mean item discrimination indices of WAEC and NECO Mathematics multiple-choice examination items conducted by WAEC and NECO in 2016. Also, in WAEC 2016; 66% of the items had moderate discrimination indices, 24% of the items had low discrimination indices and 10% of the items were poor discrimination indices, while in NECO 2016 examination; 75% of the items had moderate discrimination indices, 20% of the items had low discrimination indices and 5% of items had poor discrimination indices. This finding agrees with Boopathiraj and Chellamani (2013); Hingorjo and Jaleel (2012) and Anikweze (2013) that discrimination index is the statistics that indicates the degree to which an item separates the students who performed well from those who performed poorly. This result disagrees with the findings of Ogunbamowo, Adediwura and Diyan (2019) which showed that the discrimination indices of NECO and WAEC Economics items were different from one another significantly.

The result of hypothesis three showed that there was no significant difference between the mean distractive power of the options of Mathematics multiple-choice examination items conducted by WAEC and NECO in 2016. Also, in WAEC 2016; 19% of the options were ineffective distracters, 76% of the options were effective distracters, and 5% of the options were non-functioning distracters, while in NECO 2016 examination; 15% of the options were ineffective distracters, 82% of the options





were effective distracters and 3% of the options were nonfunctioning distracters. This finding agrees with the findings of James and Olufunke (2020) who revealed that there is no significant difference between guessing index of the examination items constructed by WAEC and NECO. They further revealed that the overall, the guessing index of WAEC and that of NECO mathematics test items are comparable. However, Hingorjo and Jaleel (2012) also explained that 'ideal questions' could be affected by nonfunctioning distracters.

Conclusion

The result of the study shows that there is no significant difference between 2016 WAEC and NECO difficulty, discriminating and distracter indices which implies that there is no superiority of the test items of WAEC examinations over NECO examinations. However, 76% and 82% of the item's distracter indices of WAEC and NECO 2016 mathematics past questions were effective. Therefore, the reasons for the poor performance of students of Sabon Tasha educational zone, Kaduna state in mathematics examinations conducted by WAEC and NECO in 2016 can be attributed to poor items psychometric properties.

Recommendations

Based on the findings of the study, the following recommendations were made:

- 1. Public examination bodies should continue to ensure that the difficulty and discrimination of items as well as the functionality of mathematics multiple choice test options fall within the acceptable limits for certification at the school certificate level both within the urban and the rural areas.
- 2. Items of WAEC and NECO should always be constructed to have optimum sensitivity and ability to distinguish between bright and less bright testees.
- 3. WAEC and NECO as a large-scale assessment responsible for the awarding of senior school certificates should improve the mathematics items standard of the examination by involving measurement connoisseur in the examination items development process to enhance its psychometric properties to a tolerant level.
- 4. Government should establish a joint examination evaluation team to ensure that examination items constructed by different examination bodies are of the same standard.

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