ASSESSMENT OF PSYCHOMETRIC PROPERTIES OF ONDO STATE MATHEMATICS UNIFIED PROMOTION EXAMINATION USING ITEM RESPONSE THEORY

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Abstract
This study established the unidimensionality of Ondo State Unified Promotion Examination in Mathematics, it examined the difficulty and discrimination indices of the Mathematics examination items and also, determined the reliability and validity of the Mathematics Examination items. The study adopted descriptive survey research design. The population of the study consisted of all public Senior Secondary School two (SS II) students in Ondo State for the year 2019/2020 session. The sample consisted of 609 students which were selected using multi-stage sampling procedure. The instrument for data collection was 2019 Ondo State Unified promotion Examination questions in Mathematics which comprised 34 multiple choice test items. The Stout's test of essential unidimesional, 2 parameter model, and reliability tests were used for the analysis of research questions one, two and three respectively. The findings revealed that Ondo State promotion examination Mathematics items violated the assumption of unidimensionality because $p<0.05$; hence it was multidimensional in nature which implies that the items measured more than a single trait. It was observed that, out of 34 items of Ondo State unified promotion Mathematics examination, 28 items representing 82% were moderately difficult and they discriminated correctly, six items, representing 18%, functioned poorly in terms of discrimination and difficulty indices.The study recommended that teachers should organize more standardized internal examinations such as Mock examinations for their students to adequately prepare them for external examination and the Ondo state government should invest in conferences where examination experts are updated on areas of improvement in item construction.

Keywords: Unified promotion examination, Item Response Theory, Unidimensionality, Local item dependence, Discrimination index, Difficulty *index*

Introduction

Assessment is the process of determining the status or performance of a student or a group in relation to expected outcome. When students' performance are compared with an already established standard, an assessment has taken place.

Examination is the most comprehensive form of assessment typically given at the end of the term to evaluate students' performances in schools. It has been used to motivate teachers to teach and students to learn in the school system, thereby contributing to the enhancement of the quality of education in schools (Asuru, 2010). The objectives of most schools' examinations are to: measure the effectiveness of the teaching and learning process; measure students' present levels of achievement; evaluate the relevance of the curriculum; measure progress towards the accomplishment of national goals and so on (Wasanga&Ramani, 2010). There are majorly two types of examination in education and they are the formative and summative examination or test. Formative tests are the types of tests in education that are used or given to learners throughout the teaching process to demonstrate that the students have understood what they have been taught whereas summative examination aims at evaluating the overall students learning and compare it against some benchmarks or standards. They are usually high stakes with a high point value examples includes midterm or end of term tests and exams, final projects and standardized tests to demonstrate institutional accountability like the admission and progressive tests that takes students to the next class or level of education.

There are examination bodies that are charged with the responsibility of conducting standardized examinations in Nigeria for certification and transition from senior secondary schools to Universities, Polytechnics and Colleges of Education in Nigeria for further studies. The bodies are West African Examinations Council (WAEC), the National Examinations Council (NECO), National Business and Technical Examinations Board (NABTEB), Basic Education Certificate Examination (BECE) among others. There are standard required points students have to make to proceed to the next level of education in these external examinations. Due to the importance of these external examinations to educational advancement, adequate preparation must therefore be made to help students achieve highly in them. In a bid to prepare students for these external examinations several measures have been made by Ondo State Government. The prominent among these measures was the introduction of Unified Joint Promotion Examination for SSII students which is also known as Joint examination, borne out of the government's interest in looking for a reliable ground in preparing for students to perform better in the external examinations. The Examination is used to decide those students that will be promoted from SSII to SSIII and used as a yardstick of paying students WAEC fees, as well as veritable tool to prepare and equip students for external examinations. For examinations to achieve their goals, they must have some desirable qualities such as reliability, validity, adequate discriminatory and appropriate difficulty level. A test that does not have these characteristics may lead to failure of testee due to poor quality of such tests rather than the students' academics ability. This Unified Promotion Examination have been faulted and criticized by many scholars and the general public. The criticism ranges from unknown psychometric properties of the items, items been biased and that the examination is subject to teachers manipulations which tend to confirm the insinuation by general public that the items

might not have been properly standardized before been administered on students and also items might not been parallel when compare with that of external examinations that are developed in standard form by the experts. The standardization ensures the psychometrics properties like; the difficulty index, discriminating index, reliability, validity etc. It is therefore necessary to assess the psychometric properties of the unified examinations in Ondo State so as to find out the extent to which the qualities of the test items are standard.

The specific objectives of this study were to:

a) establish the unidimensionality of Ondo State unified promotion examination in Mathematics;
b) examine the item difficulty and discrimination indices of the Mathematics examination; and
c) Determine the reliability and validity of the Mathematics unified promotion examination in Ondo state.

The study provided answers to the following research questions

1. To what extent do the unified promotion examination item (Mathematics) satisfy the essential IRT Assumption of unidimensionality?
2. What are the item parameter estimates for the Ondo State unified promotion examination Mathematics item?
3. To what extent is the Ondo State Unified Promotion Mathematics Examination items valid and reliable?

Methodology

The research design used for the study was the descriptive survey design. The population of the study consisted of all public Senior Secondary School two (SSS II) students in Ondo State for the year 2019/2020 session. The SSS2 public school students were chosen purposively for the study because as semi-final year students, the unified promotion examination determines their eligibility for government sponsorship of WAEC & NECO. The sample consisted of 609 students which were selected using multi-stage sampling procedure. At stage one, one Senatorial District was selected from the three Senatorial Districts in Ondo state using simple random sampling technique. At stage two, three Local Government Areas (LGAs) were selected from the six local government in the senatorial district using simple random technique and at stage three, three schools were selected from each of the LGAs, using simple random sampling technique. The final sample size of 609 was obtained by adding all the students (intact class) responses in each of the selected schools for the study. The instrument for data collection was 2019 Ondo State Unified Promotion Examination questions in Mathematics which comprised 34 multiple choice test items with four options (A-D). An introductory letter was obtained from the Department of Educational Foundations and Counseling to collect necessary information from the Ministry of Education at Alagbaka, Akure. 34 multiple-choice items were administered on the sampled students after receiving specific instruction for the test by the researcher with the help of research assistant and the teachers in the

selected schools. The test items were scored and the students' scores from the test were used for the analysis. The students' responses in each of the item were dichotomously scored (1 for right option and 0 for wrong option). The data were analysed using stout's test of essential unidimensionality for research question 1, 2 parameter IRT model was used to analys eresearch question 2, Cronbach's Alpha, Spearman-Brown, Split-Half Coefficient, Guttman, KR-20 and 21 and Factor Analysis were used for research question 3.

Results

Table 1: Stout's essential unidimensionality

TL	**TGbar**	**T**	**p-value**
10.9998	6.4593	4.518	0.0000

Table 1 showed that the items that were found to form the secondary dimension were dimensionally distinct from the remaining items of the test (T = 4.518, p = 0.0000). It was observed that, the 34-item unified promotion Mathematics examination violated the essential unidimensionality assumption because the p-value is less than 0.5. It led to the conclusion that the AT items were dimensionally distinct from the remaining items in PT. Therefore, multidimensionality was manifested in the unified promotion Mathematics examination items. This result implies that more than one dimensions or trait or ability underlie the performance of examinees on the test, hence it is multidimensional in nature.

Table 2: Discrimination and difficulty index of Ondo State Unified Promotion Mathematics Items

Item	Discrimination	Remark	Difficulty	Remark	Overall Remark
item1	0.31	Good	-5.74	Poor	Poor
item2	0.23	Good	-2.28	Good	Good
item3	**1.33**	**Poor**	**1.72**	**Good**	**Poor**
item4	1.01	Poor	0.1	Good	Poor
item5	0.79	Good	0.52	Good	Good
item6	1.38	Good	1.08	Good	Good
item7	1.36	Good	0.52	Good	Good
item8	0.64	Good	0.93	Good	Good
item9	1.31	Good	-0.69	Good	Good
item10	0.56	Good	-0.07	Good	Good
item11	1.47	Good	0.55	Good	Good
item12	1.17	Good	0.07	Good	Good
item13	0.75	Good	0.55	Good	Good
item14	0.03	Poor	58.73	Poor	Poor
item15	0.68	Good	2.13	Good	Good
item16	0.89	Good	1.47	Good	Good
item17	1.36	Good	0.36	Good	Good
item18	1.05	Good	1.22	Good	Good
item19	1.32	Good	-0.24	Good	Good
item20	0.23	Good	2.08	Good	Good
item21	0.65	Good	0.84	Good	Good
item22	0.95	Good	-0.87	Good	Good
item23	0.29	Good	3.33	Poor	Poor
item24	0.58	Good	1.06	Good	Good
item25	0.18	Good	-20.65	Poor	Poor
item26	1.13	Good	0.77	Good	Good
item27	0.79	Good	0.13	Good	Good
item28	0.79	Good	1.7	Good	Good
item29	0.4	Good	4.54	Good	Good
item30	0.48	Good	0.51	Good	Good
item31	1.53	Good	0.67	Good	Good
item32	0.81	Good	1.04	Good	Good
item33	0.83	Good	0.71	Good	Good
item34	0.66	Good	0.82	Good	Good

It was noticed from the Table2 how well the Ondo State unified promotion Mathematics examination items functioned in term of discrimination and difficulty. An item with "*a*" parameter estimate greater than 0.2, "*b*" parameter estimate ranging between -3 to +3 is said to be a good item (Baker, 2003). Based on this rule of thumb, 82% that is 28 item (2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 24, 26, 27, 28, 29, 30, 31, 32, 33, and 34) of the Ondo State unified promotion Mathematics examination items functioned correctly in terms of difficulty and discrimination, whereas 18% (items 1, 3, 5, 14, 23, and 25) i.e. six item of the unified promotion Mathematics item functioned poorly in terms of difficulty and discrimination. This implies that 28 items of Ondo State Unified Promotion Mathematics Examination

with 'a' parameter estimate are greater than 0.2 functioned well and 6 item are less than 0.2 'a' parameter estimate are poor items in terms of difficulty and discriminatory level

Table: 3 Reliability estimates of the Ondo State Unified Promotion Mathematics Examination Items

Cronbach's Alpha	Spearman-Brown	Split-half Coefficient	Guttman Coefficient	KR20	KR21
0.799	0.781	0.780	0.778	0.802	0.761

These triangulations in Table 3 showed internal consistency of Ondo State unified promotion Mathematics examination items. It was observed that the coefficient produced by the various internal consistency (i.e., Cronbach's alpha = 0.799, Spearman-Brown = 0.781, Split-half coefficient = 0.780, Guttman coefficient = 0.778, KR-20 = 0.802, and KR-21 = 0.761) were all above 0.7 coefficient estimates. This implies that, Ondo State unified promotion Mathematics examination was reliable.

The results of the validity were presented in Table 3, 4 and 5 below.

Table 4: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.854
Bartlett's Test of Sphericity	Approx. Chi-Square	2682.808
	Df	561
	Sig.	.000

The Table 3 Showed the Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity (BTS) of the Ondo State unified promotion Mathematics examination items. It showed that the unified Mathematics examination was suitable for factor analysis. It showed that KMO and BTS values are 0.854 and 2682.808 respectively. Furthermore, the Chi-square value of the BTS indicated a statistically significant value of less than 0.05.

Table 5: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.217	15.345	15.345	5.217	15.345	15.345	2.293	6.745	6.745
2	1.583	4.657	20.002	1.583	4.657	20.002	2.252	6.624	13.369
3	1.392	4.094	24.096	1.392	4.094	24.096	1.857	5.462	18.831
4	1.351	3.973	28.069	1.351	3.973	28.069	1.658	4.877	23.708
5	1.224	3.599	31.668	1.224	3.599	31.668	1.561	4.592	28.300
6	1.185	3.486	35.154	1.185	3.486	35.154	1.512	4.447	32.747
7	1.154	3.395	38.549	1.154	3.395	38.549	1.328	3.907	36.654
8	1.121	3.298	41.847	1.121	3.298	41.847	1.237	3.639	40.293
9	1.075	3.161	45.007	1.075	3.161	45.007	1.232	3.623	43.916
10	1.070	3.148	48.156	1.070	3.148	48.156	1.189	3.496	47.412
11	1.018	2.995	51.150	1.018	2.995	51.150	1.161	3.416	50.828
12	1.007	2.962	54.112	1.007	2.962	54.112	1.117	3.284	54.112
13	.972	2.857	56.969						
14	.968	2.848	59.818						
1`5	.910	2.676	62.494						
16	.870	2.559	65.053						
17	.844	2.482	67.535						
18	.825	2.426	69.961						
19	.797	2.345	72.305						
20	.776	2.283	74.588						
21	.764	2.247	76.835						
22	.739	2.173	79.008						
23	.705	2.072	81.081						
24	.678	1.993	83.074						
25	.668	1.965	85.039						
26	.639	1.880	86.918						
27	.632	1.859	88.777						
28	.620	1.823	90.600						
29	.597	1.755	92.355						
30	.580	1.707	94.062						
31	.554	1.629	95.691						
32	.512	1.507	97.198						
33	.487	1.432	98.630						
34	.466	1.370	100.000						

Extraction Method: Principal Component Analysis demonstrating all the factors extracted from the analysis along with their eigenvalues, the percent of variance attributable to each factor, and the cumulative variance of the factor and the previous factors

Table 5 showed the Ondo State unified promotion Mathematics examination items loaded on 12 factors structures. It was noticed that 28 items (items 1, 2, 3, 5, 6, 7, 9, 10, 12, 13, 14, 16, 17, 18, 19, 20,21, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33, and 34) above 0.4 was retained in the analysis. It was concluded that the Ondo State unified promotion Mathematics examination items was valid at 28 items.

Discussion of Findings

The assessed characteristics include dimensionality, difficulty index, discrimination index, validity and reliability of the items with the use of item response theory. Findings revealed that items of the test which indicate that the assumption of unidimensionality was violated. Which is in line with Adediwura, Adeyemoand Diyan(2018) who used stout's test of essential unidimensionality to ascertain the dimensionality of 2016 NECO examination. The study revealed that

Ondo State unified promotion Mathematics examination items functioned in term of discrimination and difficulty. Twenty-eight items representing 82% of the Ondo State unified promotion Mathematics examination items functioned correctly in terms of difficulty and discrimination whereas 18% (i.e., six items) of the unified promotion Mathematics items functioned poorly.

In addition, the coefficient produced by the various internal consistency (i.e., Cronbach's alpha = 0.799, Spearman-Brown = 0.781, Split-half coefficient = 0.780, Guttman coefficient = 0.778, KR-20 = 0.802, and KR-21 = 0.761) were all above 0.7 coefficient estimates. Hence, the Ondo State unified promotion Mathematics examination items were reliable. This study is in line with Alu and Afolabi (2012) who examined the significant influence of Local Item Dependence on the reliability of WAEC and NECO Mathematics examinations in Nigeria

Conclusion.

The study concluded that the psychometric properties of the Ondo State unified promotion examination items in Mathematics were accurate and capable of assessing the students' ability in Mathematics adequately.

Recommendations

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

1. Teachers should consistently test the ability of their students to ensure reliability and validity of the schools' internal examinations (Mock exam) and to serve as benchmark for those students that will sit for unified promotion examination before their eligibility for WAEC and NECO.
2. Conferences and seminars should be organized for the examination experts of the State for them to improve in the area of construction of standardize items for their generated items to comply with the assumption of unidimensionality

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