ANALYSES OF PSYCHOMETRIC PROPERTIES OF 2021 SENIOR SECONDARY SCHOOL MATHEMATICS MOCK EXAMINATION IN GOMBE STATE, NIGERIA

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Abstract

This study was on psychometric properties analyses of 2021 senior secondary school Mathematics Mock Examination in Gombe State with purpose to determine its difficulty index, discrimination index, validity and reliability. Four research objectives and questions were formulated and answered. Expost - Facto research design was employed; all examination scripts are populations of the study. Data was collected through an application to the Ministry of Education Gombe state for permission to collect data, upon collected the responses of section A objective part was converted as 1 for correct response and 0 for wrong response which transferred to excel for further analyses conventionally using classical test theory to determine the indices of discrimination , difficulty, for the content validity was determined by the used of CVR based on expert ratings using Lawshe formula and for reliability estimation, Kuder Richardson KR20 was used to determine the internal consistency of the items. Findings revealed that the Gombe state 2021 Mathematics Mock examination are too easy with 0.76 difficulty index, low discrimination index of 0.27, has low content validity index of 0.04, with acceptable reliability of 0.75 correlation coefficient. Recommendations were made on the importance of item analyses of mock items before its administering.

Keywords: Analyses, Psychometric properties, Mathematics, Mock examination

Introduction

Decisions about the level of academic achievement and efficiency of education are to rely solely on test results and examination of the specific objectives of education which usually carried out in formative and summative form. Teacher made test and standardized test are the most commonly used to assess learning outcome. Teacher made test is the examination use in our schools to ascertain the extent to which educational goal have been achieved this test is constructed administered marked and scored by classroom teachers or subject teachers at any level of education while standardized test is a type of examination that is developed by expert whose it psychometric properties is known.

The quality of any examination is always examined through item analysis of examinees' response. Furthermore, this analysis of test items can be computed or derived both qualitatively and quantitatively in order to evaluate test items to determine their usefulness and functionality. Item analysis is mainly carried out on already administered test or pilot test, with the hope that the test will be corrected for further use. Mostly, item analysis is being carried out with the principles of Classical Test Theory (CTT), (Xinming & Yung-Fai, 2014).

Item difficulty index indicates the degree of difficulty of the MCQ items in relation to the cognitive ability of the testees (Boopathiraj and Chellamani 2013). It is calculated by finding the proportion of the testees

that got the item correctly. An item is adjudged too difficult when the index is below 0.3. An item is adjudged too easy when the index is above 0.7. Depending on the purpose of the test, the cut off points for easy or difficult items can be adjusted upward or downward. Generally, the rule is that life sensitive or competitive activities require more technical/difficult items in screening; while less sensitive activities or activities requiring motivation of testees often use less difficult items. For most summative assessments such as those handled by the West African Examinations Council, moderate difficulty index ranging around 0.5 are often preferred. It is important to note that an item may record high difficulty index if the content of such item was not taught, the concept was not understood or if the question was not properly worded. According to Suruchi and Rana (2015) the two purposes of Item analysis are: firstly, to identify defective test items and secondly, to indicate the areas where the learners have or have not mastered. This is actually the essence of item analysis to check for flaws of this nature and find ways of correcting them before finally administering the questions.

Discrimination power refers to the ability to distinguish between high and low achievers. The right answer must have a positive discrimination. Sabri (2013) submitted that discriminatory index depicts the power of an item in discriminating between high and low performing Testees. Item discrimination determines whether those who did well on the entire test did well on a particular item. An item should in fact be able to discriminate between upper and lower scoring groups. One way to determine an item's power to discriminate is to compare those who have done very well with those who have done very poorly, known as the extreme group method.

Validity of a test is the degree to which a test measures what it claims or purports to be measure in conventional usage, validity refers to the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration (Babbie, 2005).It also suggested the degree to which the test measure adequately and sufficiently a particular skills or behaviour it sets out to measure.

Reliability is calculated through the individual's score on the test (observed score) and the amount of errors in the test itself (error), and together these give an indication of what the person's true score would have been without the errors in the test measurements. Errors in testing occur through systematic, administrative and other factors within the process. Classical theory holds that each individual has a true score which would be obtained if there were no errors in measurement. The implication of the classical test theory for test takers is that tests are fallible imprecise tools. The score achieved by an individual examine is rarely the individual's true score. The observed score is considered as the true score influenced by some degree of error. This error influences the observed scores to be higher or lower (Magno, 2009).

Senior secondary school is a level of education beyond upper basic before tertiary it's a level where students groomed and prepare to tertiary institutions, towards the end of this level precisely in SSIII first term and to other states at the end of SSII (third term), students are exposed to an examination that are neither developed by their individual teachers nor the standard examination bodies which is called mock examination. This form of examination (mock examination) is constructed, administered marked and scored by subject experts in the Ministry of Education or any other education agency like the education resource centre, secondary school management board e.t.c. It is a new dawn for senior secondary students as they are exposed to an examination form that is not made by their teachers. Gombe State government was not in exception introduced Mock examination which was borne out of the government's interest in looking for a reliable ground for preparation of students to perform better in the external examinations which is usually taken in Senior Secondary III (SS III) in the first term. It prepares the students for external

examinations and also serves as means for the state government to make payments for external examinations for those who passed the mock examination. The examination is taken throughout the state at same time and under the same examination conditions and marked by the teachers who indicate interest the examination became the means of determine the level of readiness and also a medium of payment for senior secondary school certificate examination (SSCE) by state ministry of education for students who passed it.

Mathematics is the root of all sciences and technical disciplines and no society ever prosper without a good mathematical background. Without a solid foundation in Mathematics, meaningful advancement in science and Technology will not be made. According to Kolawole and Udoh (2012), Mathematics is the tool in the development of science based knowledge such as technology, industry and, even, for sound analytical reasoning in daily living in the present age. To realize the objectives of teaching and learning of these subject at this level in particular and at any level of the educational system in the society, there is need to monitor and maintain the quality of the educational processes and products. One major way of monitoring the quality and standards of the teaching and learning of these subject in schools is through the assessment of learning outcomes of the students. In order to stem the tide of poor performance in these all-important subject, successive governments and other education related agencies of both the public and private sectors have variously made relevant contributions towards the improvement of teaching and learning of Mathematic. Some of these notable contributions include the Mathematics Improvement Project (MIP) by the government, National Centre for Strengthening Mathematics, seminars and sensitization workshops organized by MOE, NERDC, Curriculum Development Council (CDC), National Mathematics Centre (NMC) and publishing companies like Macmillan Publishing Company among others.

Despite all efforts made by the Government in preparing students in this mock examination good performance is always recorded in the mock examination while in external examination frequent poor performance of students in Mathematics always recorded in almost every year. The nature of student performance in West African Examination Council (WAEC) examinations can be seen here. In 2018 only 12.2% made five credits and above including English and Mathematics but in 2019 the percentage pass of students in WAEC rose to 22.5%. There was a steady increase to 26.6% in 2020 (EMIS MOE Gombe, 2021). The strength of the psychometric properties of mock examinations is a source of serious concern to educationists and educational policymakers. Generally, in Nigeria, and Gombe state in particular lots of criticisms have trailed the predictability of mock examination result. These criticisms based on the fact that it is the states' ministry of education that are taking the responsibility for the design, development and conduct of mock examination and the final output do not consistent with the expected out come after taking external examination Furthermore, there is no evidence of the quality of the mock examination instrument recorded as the items in the instrument were not thorough analyse and its standard is questionable, and failure to adhere to standard may render the mock examination questions easier or more difficult than intended, so be the need to empirically investigate the quality and to contribute to the debate surrounding it.

In view of these, the present study analysed the quality of the mock examination by establishing its psychometrics properties (Item difficulty and item discrimination, validity, reliability,) to strengthen the mock for a better out come in external examination.

The following research objectives were raised to guide the study:

1. ascertain the difficulty levels of 2021 Mathematics Mock Examination in Gombe State.
2. find out the discrimination indices of 2021 Mathematics Mock Examination in Gombe State.
3. determine the content validity of 2021 Mathematics Mock Examination in Gombe State.
4. find out the internal consistency of the items in 2021 Mathematics Mock Examination in Gombe State.

The following research questions formulated and answered:

1. What is the difficulty indices of Multiple choice items in 2021 senior secondary school Mathematics Mock Examination in Gombe state?
2. What is the discrimination indices of Multiple choice items in 2021 senior secondary school Mathematics Mock Examination in Gombe state?
3. What is the content validity of 2021 senior secondary school Mathematics Mock Examination in Gombe state?
4. What is the reliability index of the items in 2021 senior secondary school Mathematics Mock Examination in Gombe State?

Methodology

The study modelled after classical test theory and adopted an expost- facto research design, the study employed two forms of populations one as unit of observation and other as unit of analysis. The responses of the students that sat for the mock constituted the unit of observation in the population and the fifty Mathematics items constituted the unit of analysis with a total number of 22238 so five (5) percent of the population was used as a sample which is 1119 served as the sample size Creswell (2015) opines that the larger the sample the lesser the potential error is that the sample will be different from the population. Data was collected by the use of written application to the Ministry of Education Gombe state seeking for permission to collect students' response to the item and test scores of Mathematics 2021 senior secondary school Mock examinations. Upon securing the approval the 2021 Mathematics items and students response scores were collected, these scores were converted to 1 for correct response and 0 for wrong response which later transferred to excel for further analyses and for the content validity data was collected from ten (10) subject matter experts (SME's) for each subject selected randomly based on qualification, years of experience (12 year and above) and experienced external examination marking to indicate each item as essential or non-essential and later subject to analysis using Lawshe formular.

The Data analysis was carried out in two forms, one is the item analysis and the other conventional statistical analyses. The item analyses were carried out using classical test theory with the aid of Excel to determine the indices of discrimination index, difficulty index. While the conventional statistical analyses were done through using SPSS scale analysis to determine the internal consistency.

For content validity was determined through the use of content validity ratio CVR based on the expert ratings of each items of the instrument as either essentials or nonessential using Lawshe formula.

Results

Research Question One: What is the difficulty indices of multiple choice items in 2021 senior secondary school Mathematics Mock Examination in Gombe state?

Table 1: The Mean Difficulty index of the items on 2021 Mathematics Mock Examination

N	Mean Difficulty index	Standard Deviation
50	.76	.066

Table 1 above depicts the mean difficulty index and standard deviation of the items on the 2021 Mathematics Mock Examination in Gombe state. The mean difficulty index was found to be .76 with standard deviation of .066 respectively. Thus, the average p-value was also an indication that the items on 2021 Mathematics Mock Examination in Gombe state are easy. This is in line with the findings of Ogunkoru (2018), whose study revealed that most of the items were easy, but it contradicts the findings of Anigbo (2015) and Sharma (2020), which showed acceptable indices.

Research Question Two: What is the discrimination indices of multiple choice items in 2021 senior secondary school Mathematics Mock Examination in Gombe state?

Table 2: The Mean Discrimination index of the items on 2021 senior secondary school Mathematics Mock Examination

N	Mean Discrimination Index	Standard Deviation
50	.27	.100

Table 2 above depicts the mean discrimination index and standard deviation of the items on the 2021 Mathematics Mock Examination in Gombe state. The mean discrimination index was found to be .27 with standard deviation of .100 respectively. Thus, the average discrimination index was also an indication that the items on 2021 Mathematics Mock Examination in Gombe state are moderately discriminating. This is in agreement with the findings of Alkurusi (2011) but contradicts the findings of Patil, Beattis, and MacDermdm (2017), which showed low discrimination power.

Research Question Three: What is the content validity of 2021 senior secondary school Mathematics Mock Examination in Gombe state?

Table 3: CVRs and CVI of 2021 Mathematics Mock Examination

Item No	CVR	Item No	CVR	Item No	CVR
1	0.2	**18**	0.2	**35**	0.4
2	0.6	**19**	-0.4	**36**	0.4
3	-0.4	**20**	0.2	**37**	-0.2
4	-0.8	**21**	-0.2	**38**	-0.6
5	-0.6	**22**	0.2	**39**	0.2
6	-0.2	**23**	0.8	**40**	-0.4
7	-0.2	24	0.8	**41**	-0.4
8	1	25	-0.2	**42**	0.8
9	0.4	26	0.2	**43**	-0.2
10	0	27	0	**44**	0.2
11	0.2	28	0.2	**45**	-0.2
12	0.2	29	0.6	**56**	-0.2
13	0.4	30	0.2	**47**	-0.2
14	0.6	31	-0.4	**48**	0
15	-0.8	32	-0.2	**49**	-0.8
16	-0.2	33	0.2	**50**	0.2
17	0.4	34	-0.2		

Content Validity Index (CVI)	**0.04**

Table 3 above presents the content validity analysis calculated by Lawshe (1975) formula via excel spread sheet. From the analysis it can be observed that, the CVR for each item on the 2021 Gombe state Mathematics Mock Examination ranges from -0.8 to 0.8 and the CVI of 0.04 for the whole examination respectively. According to Lawshe (1975), the CVR values ranges between -1 (perfect disagreement) to +1 (perfect agreement). The accepted CVR value for 5, 6 and 7 panelists are 1 and that of 10 panelists is .875 and for 40 panelists is .650 respectively. Thus, the CVR in the table above were for 10 panelists meaning that, only items 23, 24 and 42 (with CVRs of 0.8) proved acceptable. The CVI which is the mean value of the CVRs was found to be 0.04 and as suggested by Lawshe (1975), the CVI value of 0.08 and above with three or more experts is considered evidence of good content validity index. By implication, the 2021 Gombe state Mathematics Mock Examination has a poor content validity with CVI of 0.04 respectively. This finding is consistent with Wesley (2018) but contradicts the findings of Hussain (2011) and Ndalai, Beattie, and MacDermdm (2017), which revealed construct validity.

Research Question 4: What is the reliability index of the items in 2021 senior secondary school Mathematics Mock Examination in Gombe State?

Table 4: Scale Analysis of the 2021 Mathematics Mock Examination

K-R 20 Coefficient	N of Items
0.75	50

Table 4 above presents the summary of reliability analysis performed via SPSS in an attempt to determine the internal consistency reliability coefficient (KR20) of the 2021 Mathematics Mock Examination in Gombe state. The responses were subjected to scale analysis in determining the internal consistency reliability. The result of the analysis revealed 0.75 as the KR20 reliability coefficient. Thus, the reliability coefficient is within the acceptable region of reliability coefficients (Field, 2005). This is in line with findings of Adeleke and Joshua (2015)

Conclusion

Conclusively, it is clear the results of this findings revealed that majority of the items in 2021 senior secondary school Mathematics Mock examinations in Gombe state are easy and have poor discrimination power, it was also revealed that the items have low validity but a moderate reliability, all these accounted to the high passes recorded on yearly basis.

Recommendations

On the strength of the findings and conclusion derived from this study, the researcher wishes to make the following recommendations:

1. There is need for the teachers to ensure content coverage and removal of too easy and too difficult items.
2. tems with acceptable level of difficulty could be withheld and integrated into future test.
3. The need for the removal of poor discriminating items for future use and dependable item bank.
4. Items with high discrimination and moderate discrimination power should be accepted for improving the quality of Mock.
5. The school authority provide and ensure adequate and sincere supervision of the mock examination

should be implemented.

6. The Gombe state Ministry of Education should have an elaborate measure or system to establish reliability of Mock examination.
7. That the Mock examination should be made without any form of bias and free from gender stereotype.

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