

## ANALYSIS OF DIFFERENTIAL ITEM FUNCTIONING OF NATIONAL EXAMINATIONS COUNCIL SSCE MULTIPLE-CHOICE PHYSICS ITEMS IN KATSINA STATE, NIGERIA

HASSAN LURWANU  
Abbashema09@gmail.com

### Abstract

The study investigated differential item functioning of National Examinations Council Physics test items (2020) in Kankia Zonal Quality Education Assurance in Katsina State. The study specifically was guided by six objectives, research questions and six null hypotheses which were formulated and tested. The study adopted descriptive survey research design. A total sample of three hundred and thirteen senior secondary school students drawn from the population of 1323 senior secondary school students across the sixteen senior secondary schools in Kankia Zonal Quality Assurance, Katsina State. Multi-stage sampling procedure was used for the study. The instrument for the data collection was NECO 2020 objective physics question papers adopted from the National Examinations Council. The instrument is a standardized test items already validated by experts. The reliability index of NECO 2020 objective physics question paper obtained was 0.76. Data obtained for the study were analyzed using the Scheuneman modified chi-square while chi-square good of fit was employed in testing the null hypotheses 1-6 at 0.05 level of significance. It was revealed that thirty three items representing 55% in 2020 NECO (SSCE) physics multiple choice test items significantly function differentially for testees on the basis of gender. Generally, it was revealed that, 17 items out of 33 items representing 51 % in 2020 NECO (SSCE) physics multiple choice test items, that displayed DIF favored male while 16 items out of 33 items representing 49% were in favor of female. Such items measured different things for testees of the same subject matter ability from male and female testees and that there is no significant differences between the gender on the percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination. Based on the findings, it was recommended among others that test experts and developers should consider the use of Scheuneman modified chi-square in determining differential item functioning. This approach provides an intuitive and flexible methodology for detecting DIF.

**Keywords:** Differential Item Functioning, National Examinations Council, Multiple Choice Item

### Introduction

Achievement at any level of education is crowned with certification for those who successfully complete a course of study. Thus, at the end of secondary education, students are expected to sit for public examinations such as the West African Senior School Certificate Examinations (WASSCE), conducted by the West African Examinations Council (WAEC), Senior School Certificate Examinations (SSCE), conducted by National Examinations Council (NECO) and National Technical and Business Certificate Examinations (NTBCE) also conducted by the National Business and Technical Examinations Board (NABTEB). The national examinations conducted by West African Examinations Council (WAEC), National Business and Technical Education Board (NABTEB), National Examinations Council (NECO), and Joint Admissions and Matriculation Board (JAMB) cater for candidates from various backgrounds all over the country.

Differential Item Functioning is an unexpected difference among group of examinees who are supposed to be comparable with respect to attribute measured by the item. Schumcker (2005) defined

Differential item functioning as differential item performance by sub-populations of examinees that are equal in underlying trait measured by the test. According Perrone (2016), Differential item functioning is said to occur whenever examinees from two different population groups that are same in underlying trait measured by the test perform differently on a particular item. It is expected that test items will show different performance across members of the examinee population. Therefore, an item is not identified as functioning differentially based on overall differences in performance by examinees. Perrone (2016) asserted that when an item shows differences in performance for examinees in the population, however, the basis for that performance difference should be specifically that the examinees differ on the knowledge or achievement that is assessed by the item. He further said that when the item shows different performance as a function of differing levels on the trait the item is designed to assess, the item is functioning properly.

Multiple choice items or questions are questions provided to the students to answer with a multiple options or alternatives and student will choose the right option from letter A-E. National examinations council is a standardized body that organized or conducts examinations to the students at the end of their programmed or course of study. It is the standardized examination in the sense that it has all the three psychometric properties of validity, reliability, and usability and for a test to be standardized it must not miss any of the properties.

Physics can be defined as a branch of science which deal with matter in relation to energy, it is a natural science based on experiments and mathematical analysis with the purpose of finding the quantitative physical laws for everything from the nano world of the microsomos to the planets, solar systems and galaxies that occupies the macrosomos.

In this paper the researcher interested in finding the analysis of differential item functioning of national examinations council multiple-choice physics items in katsina state

### **Statement of the Problem**

The presence of bias in an item is a concern for educators since tests are used as a gatekeeper for educational opportunities, and it is a very important issue that test items are fair for every examinee (Adedoyin, 2010). Test bias is the existence of some irrelevant elements present in items that causes differences in the achievement for students of the same ability but from different subgroups like gender (Ogbebor & Onuka, 2013). Educational opportunities vary from one location to another, while some places are known to have enough schools with facilities and teachers, while others do not have.

The urban-rural students are also expected to be studying physics just like any other science subject because of the psychological influence it may have on the teachers and students resulting mainly from gender, school type and school location. Since there may be students based on gender (male & female), school type (private & public) and school location (rural & urban). Hence, it is important to find out biased items in physics examination conducted by examination bodies like National Examinations Council (NECO), West African Examinations Council (WAEC), National Business and Technical Examination Board (NABTEB). Therefore, this study investigates the differential item functioning of National Examinations Council multiple choice physics items.

### **Objectives of the Study**

The main objective of this study is to examine the differential item functioning of National Examinations Council Physics multiple choice test items (2020) in Kankia Zonal Quality Education Assurance in Katsina State. Specifically, the study sought to:

1. Determine the percentage of items in the 2020 NECO (SSCE) Physics multiple choice test items that functioned differentially by gender.
2. Find out the percentage of items in the 2020 NECO (SSCE) Physics multiple choice test items that

functioned differentially by school location.

3. Examine the percentage of items in the 2020 NECO (SSCE) Physics multiple choice test items that functioned differentially by school type.

### **Hypotheses**

The following research hypotheses formulated were tested at 0.05 level of significance.

Ho1: There is no significant difference in the gender and percentage of items which functioned differentially in the 2020 NECO (SSCE) Physics multiple choice test examination.

Ho2: There is no significant difference in the school location and percentage of items which functioned differentially in the 2020 NECO (SSCE) Physics multiple choice test examination.

Ho3: There is no significant difference in the school type and percentage of items which functioned differentially in the 2020 NECO (SSCE) Physics multiple choice test examination.

### **Methodology**

The researcher adopted descriptive research design of survey type for the study. Descriptive survey research design is an important type of research design which can be useful when conducting research whose aim is to identify characteristics, frequencies, trends, correlations, and categories. Descriptive research is a type of research that describes a population, situation, or phenomenon that is being studied. The population of this study comprises of one thousand, three hundred and twenty three (1323) students from public and private senior secondary schools across the sixteen public and private senior secondary schools in Kankia Zonal Quality Assurance, Katsina State. The number comprises of eight hundred and fifteen (815) male and five hundred and eight (508) female students. While the sample size of this study comprises of three hundred and thirteen (313) Senior Secondary School Students from the three local government area in Kankia Zonal Education Quality Assurance, Katsina state, out of which two hundred and thirteen (213) were male and one hundred (100) were female students.

Krejcie and Morgan (1971) table for determining sample size of a given population was adapted, which stated that for the population of one thousand three hundred and twenty three (1,323), the appropriate sample size should be three hundred and thirteen (313) students. In selecting the sample of the study, multi-stage sampling procedure was used for the research. Stratified sampling technique was used in selecting nine (9) schools from which sample was obtained. Three (3) schools were selected each from Kankia, Kusada, and Ingawa local governments in the zone, this was done because the schools have similar characteristics, and stratified sampling will greatly assist in selecting the representative sample. In selecting students, proportional and random sampling technique was used.

The instrument for the data collection was NECO SSCE 2020 objective physics question paper adopted from the National Examinations Council (2020) to measure the achievement of the students. The instrument consists of two sections (section A&B). Section A of the NECO (2020) contains the bio data of the respondents in terms of class, gender and name of school while section B contains 60 multiple choice test items each with five (5) options lettered A-E from which students will choose the correct answer. The instrument (NECO 2020) multiple choice Physics question paper is a standardized examination already validated by experts, as such no more validation is required.

### **Testing Hypotheses**

Corresponding hypotheses formulated to further address the research question are:

**Hypothesis One:** There is no significant difference in the gender and percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination.

**Table 1: Chi-square Summary of 2020 NECO (SSCE) Physics Multiple Choice Test Examination in Favor of Male and Female Students**

Gender	Percentage	Item favored due to DIF	Df	Chi-square	Sig.(2-tailed)
Male	51	17(16.5)			
Female	49	16(16.5)	1	0.03	0.86
<b>Total</b>	<b>100</b>	<b>33</b>			

$\chi^2$  tabulated at 0.05 level of significant with 1 df = 3.84

Data in Table 1 showed that the chi-square calculated value of 0.03 is less than the tabulated chi-square value of 3.84 when tested at 0.05 level of significance with 1 degree of freedom. Therefore, the null hypothesis which states that ‘there is no significant differences between the gender on the percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination is thereby uphold. It implies that there is no significant differences between the gender on the percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination.

**Hypothesis Two:** There is no significant difference in the school location and percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination.

**Table 2: Chi-square Summary of 2020 NECO (SSCE) Physics Multiple Choice Test Examination Functioned Differentially in Favor of Urban and Rural Students**

School location	Percentage	Item favored due to DIF	Df	Chi-square	Sig.(2-tailed)
Rural	38	15(19.5)			
Urban	62	24(19.5)	1	2.08	0.15
<b>Total</b>	<b>100</b>	<b>39</b>			

$\chi^2$  tabulated at 0.05 level of significant with 1 df = 3.84

Data in Table 2 showed that the chi-square calculated value of 2.08 is less than the tabulated chi-square value of 3.84 when tested at 0.05 level of significance with 1 degree of freedom. Therefore, the null hypothesis which states that ‘there is no significant differences between the school location on the percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination is thereby uphold. It implies that there are no significant differences between the school locations on the percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination

**Hypothesis Three:** There is no significant difference in the school type and percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination.

**Table 3: Chi-square Summary of 2020 NECO (SSCE) Physics Multiple Choice Test Examination Differential Items Functioning in Favor of Public and Private School Students**

School Type	Percentage	Item favored due to DIF	Df	Chi-square	Sig.(2-tailed)
Public	57	17(15)			
Private	43	13(15)	1	0.53	0.47
<b>Total</b>	<b>100</b>	<b>39</b>			

$\chi^2$  tabulated at 0.05 level of significant with 1 df = 3.84

Data in Table 3 showed that the chi-square calculated value of 0.53 was less than the tabulated chi-square value of 3.84 when tested at 0.05 level of significance with 1 degree of freedom. Therefore, the null hypothesis which states that ‘there is no significant differences between the school type on the

percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination is thereby uphold. It implies that there is no significant differences between the school type on the percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination

### **Discussion**

Hypotheses one affirmed that there is no significant difference in the gender and percentage of items which functioned differentially in the 2020 NECO (SSCE) Physics multiple choice test examination. The finding is similar with the finding of Ihechu (2019) who revealed that Agricultural science multiple-choice test items used in NECO and NABTEB 2015-2017, contain test items that significantly functioned differentially for testees on the basis of gender, school location, school type and socio-economic status. That there is no significant difference in the percentage of the number of items that functioned differentially by gender in favor of males and those in favor of females in the 2015-2017 NECO and NABTEB Agricultural Science multiple choice test examination. The finding of this study is similar to the finding of Obinne and Amali (2014) who revealed that there was a significant difference in the differential item functioning of items in the Biology examinations of NECO and WAEC. The finding of this study also did not agree with the findings of Madu (2012) who revealed that items significantly function differentially by gender for male and female examinees in 39 items and 11 items did not exhibit DIF. So, in effect, there is no conclusive rule about the influence of gender. This notwithstanding, there is still need to maintain non-bias in test items among gender.

Hypotheses two affirmed that there is no significant difference in the school location and percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination. This study is in agreement with the findings of Olutola (2022) investigated regional DIF for Northern and Southern Nigerian students who sat for the November/December 1990 GCE Mathematics as objective tests administered by WAEC. The result revealed that the Southern candidates significantly outperformed their Northern counterparts. However, the study disagrees with the findings of Ugodulunwa (2008) found out that students from Urban areas have a higher level of academic performance than students from rural areas. Urban students are exposed to wide range of experiences (TV, Internet, Services etc) than their rural counterparts. Another reason could be that the urban students did not have adequate coverage of their syllabus in those areas that the items were set. So, in effect, there is no hard and fast rule about the influence of location. This notwithstanding, there is still need to maintain non-bias in test items.

Hypothesis three affirmed that there is no significant difference in the school type and percentage of items which functioned differentially in the 2020 NECO (SSCE) physics multiple choice test examination. The finding is in line with the finding of Odili, (2014) who revealed that Biology multiple choice questions used by WAEC in the SSCE contain test items that significantly function differently for students from high and low socio-economic status, urban and rural geographical locations and male and female testees. It was also found that simplifying the language of Biology test items brought about significant reduction in differential item functioning. This finding was corroborated by that of Ukwungwu (2002) who revealed that SES of parents have significant positive influence on achievement of students in biology.

### **Conclusion**

The study investigated the Differential Item Functioning of National Examinations Council Physics test items (2020) in Kankia Zonal Quality Education Assurance in Katsina State. Based on the finding, the researcher concluded that thirty three items representing 55% in 2020 NECO (SSCE) physics multiple choice test items significantly function differentially for testees on the basis of gender,

Generally, it was revealed that, 17 items out of 33 items representing 51 % in 2020 NECO (SSCE) physics multiple choice test items, that displayed DIF favored male while 16 items out of 33 items representing 49% were in favors of female. Such items measured different things for testees of the same subject matter ability from male and female testees.

The researcher also concluded that school location and school type were the greatest influence on differential item functioning. This is because majority of the items showed evidence of school location and school type differential item functioning and that 2020 NECO (SSCE) physics multiple choice test items, contained test items that significantly functioned differentially for testees on the basis of school location and school type.

Finally, the researcher concluded that differential item functioning of National examinations council SSCE multiple-choice physics items is an issue that must be properly addressed in examinations and tests designed for heterogeneous groups. It is obvious that threat in the validity of test items has been created. Such threats could influence or introduce traits irrelevant to the construct of interest. This could jeopardize classification of subgroup of candidates test scores negatively.

### **Recommendations**

On the basis of the findings and conclusion, the following recommendations are made:

1. Test experts and developers should consider the use of Scheuneman modified chi-square in determining differential item functioning between genders. This approach provides an intuitive and flexible methodology for detecting DIF.
2. For bias-free items to be produced, the NECO Examination test developers should make certain that activities and connotations reflected in the test are relevant to the life experiences of examinees responding to the items.
3. Examination bodies should organize training for item developers on the construction of valid, reliable and fair test especially in the area of DIF. In addition, items flagging DIF should be revised, modified or eliminated from the test.
4. Finally, government should make adequate provision of infrastructures to the rural areas to ensure equal learning abilities/opportunities between the urban and rural students.

### **References**

- Ukwungwu, J. O. (2002) Gender Differences Study of Performance in Integrated Science. A Summary of Studies Conducted in Nigeria. *Journal of Science Teachers Association of Nigeria*. 37 (1-2), 55-59
- Schumacker, R. (2005). Test bias and differential item functioning. Retrieved on November 18, 2015, from <http://www.applied measurement associates.com>
- Perrone, M. (2016). Differential Item Functioning and Item Bias Critical Consideration in Test Fairness. *Working Papers in TESOL & Linguistics*, 2 (6), <http://www.tc.columbia.edu/tesolalweb journal>
- Ugodulunwa, C. A (2008). *Fundamentals of educational measurements and evaluation*. Jos: Fab Anieh Nig. Ltd.
- Adeoye, A. F. (2010). Impact of Systematic Assessment in Instruction on Secondary Students Physics Achievement at Cognitive level of Knowledge. *Eurasia Journal of*
- Madu, B. C. (2012). Analysis of gender-related differential item functioning in mathematics multiple choice items administered by WAEC. *Journal of Education and Practice*. (3): 222-228.
- Ogbebor, U. & Onuka, A. (2013). Differential item functioning of economics question papers of National Examinations Council in Delta State, Nigeria, *Nigerian Journal of Educational Research and Education*, 12 (1) , 45-60.