# DIFFERENTIAL ITEM FUNCTIONING OF 2010 JUNIOR SECONDARY SCHOOL CERTIFICATE MATHEMATICS EXAMINATION IN SOUTHERN EDUCATIONAL ZONE OF CROSS RIVER STATE, NIGERIA

**Mrs. Beatrice Ojong Ndifon**
Secondary Education Board,Calabar
Cross River State, Nigeria
Email:drhenryndifon@yahoo.com

**Prof. Imo Edet Umoinyang,**
Institute of Education
University of Calabar
Calabar Nigeria
**&**
**Dr. Friday Ogar Idiku**
Department of Agricultural Economics and Extension
University of Calabar
Calabar Nigeria

**ABSTRACT**

The research is aimed at finding out whether the 2010 junior secondary certificate examination (JSSCE) in mathematics exhibits gender, school location and school ownership differential item functioning (DIF) in the Southern Educational zone of Cross River State. Three hypotheses were formulated for the study. A sample of 1,833 candidates was selected from a population of 11,811 candidates who sat for the examination in 2010. The instrument for the study was the 60 multiple- choice JSS three mathematics items. Two DIF detection methods were used to identify items that exhibited DIF in 2010 JSSCE in mathematics. The findings showed that there was no significant gender differential item functioning as none of the detection method identified items that function differentially between males and females. There was a significant school location differential item functioning as the Mantel-Haenszel Statistics detected two items that function differentially against urban students while the Scheuneman chi-square ($SSX^2$) detected one item that function differentially against urban students. Also, there was a significant school ownership differential item functioning as the Mantel-Haenszel statistics identified two items that did not favour public school students. On the other hand, the Scheuneman chi-square ($SSX^2$) did not flagged any item as functioning differentially between public and private school students. It was concluded that some items in a test used locally could exhibit significant DIF and it was recommended that DIF studies should be conducted by test developers on their test so that the items exhibiting Differential Item Functioning (DIF) could be revised or eliminated so that fairness can be enhanced.

**KEYWORDS**: Differential item functioning, Educational Zone, Junior secondary certificate examination, Mathematics, Nigeria

## INTRODUCTION

Education is a vital tool for national development; it enables its recipients to function very effectively in the society which they belong. The direction to which the nation is looking out for its development is geared towards science and technology. However, Nigeria is regarded as a developing country due to its level of science and technology development. The social, political and economic growth and development of Nigeria depends heavily on the foundation of science and technology. The bedrock to which the much expected technological development is hinged on is mathematics, which equips us with the most powerful practical tool that brings about the realization of the goals of science and technology. Mathematics plays a foundational role in the study of basic science subjects like, Physics, Chemistry, Biology and Computer science. Mathematics stands out as the "queen of sciences". The role this subject plays in science and technology is enormous and far- reaching. In recognition of this, the Federal Government of Nigeria in 1979 made mathematics a compulsory subject to be offered in both primary and secondary school levels (FRN, 2004). Mathematics is a pre-requisite for admission into technological based and other science oriented courses in higher institutions of learning.

In spite of the crucial role mathematics plays in everyday life, it has remained one of the least successful subjects in Nigerian schools. Students dread and dislike the subject; this has greatly contributed to the persistent poor performance in all national examinations in Nigeria. Many students belief that mathematics competence is reserved for selected few. Studies between 2008–2012, showed that students' performance has not yet significantly improved. The percentage of students that passed mathematics at credit level from 2008-2011 still fell between 30% and 47% except in 2008 where the percentage got up to 57%. Many research findings in Nigeria have shown that there are always differences in performance between examinees.

Etukudo (2002) found out that boys generally perform better than girls despite the fact that they are put into the same classroom situation. Males continue to outperform females in mathematics achievement test especially in advanced mathematical processes and in higher grade levels (McGraw, 2006). An explanation to this could be that boys always develop a positive attitude in the subject; while females do not have rather they see mathematics as "male subject".

Also, Inyang (2004) found out that students from urban areas have a higher level of academic performance than students from rural areas. He went further to state that urban students are exposed to a wide range of experiences (TV, internet services etc) than their rural counterparts. Another study reported that pupils from privately owned primary schools perform better than their counterparts in the state government owned schools similarly Alutu and Ersikhumemen (1999) reported that there was appreciable difference in academic performance in favour of private schools in 1996 and 1998 for JSS three students. These differences in performance may be connected with effective management, supervision, class size that can be manageable by their teachers which creates room for good teacher-student relationship that will encourage individualized method of teaching. While in public schools because of overcrowded classrooms; teachers cannot effectively control their large classrooms. And so does not give room for individualized method of teaching as such, affects students' academic performance. In conformity with the declaration on Education For All (EFA) and the Millennium Development Goals (MDGs) of September 2000, the Universal Basic Education (UBE) came as a replacement of Universal Primary Education (UPE). One of the objectives of the UBE scheme as specified in the implementation guideline by government in 1999 was to provide free Universal Basic Education for every Nigeria child of school going age (FRN; 2004). The UBE entails nine (9) years uninterrupted schooling from one class to another. This involves 6 years primary school

and 3 years of junior secondary school culminating in the 9 years. At the end of their nine years continuous schooling, the students are made to write their Junior Secondary School Certificate Examination (JSSCE) of which important decisions are made such as promotion, selection and certification to enable those transits to their SS classes. If incorrect decisions are made that affect a certain group of students negatively, the test indicates the presence of differential item functioning. Before delving into the issue of differential item functioning, it is necessary to explain the concept of test and testing. Testing in any form and from which ever direction one may look at it, is quite indispensable in the field of education. According to Joshua (2005) a test is "an instrument for systematic measure of a sample of behavior". A test is a series of tasks or a set of questions that learners must respond to orally or in writing that makes it possible to examine differences between learners. Tests are used to gain useful information about test-takers' knowledge, skills and progress; it helps each professional to perform work effectively. Tests are used in promotion, placement, selection, certification and decision making.

Sometimes, however, the results of these tests are incorrect due to differences in test performances among various groups of examinees. Test controversy and debate had its origin in the observed differences in the average IQ scores between various racial groups and ethnic groups in the early 1900s (Cole & Zieky, 2001). In 1905 the first practical test of intelligence of Binet-Simon was used on the children of Parisian working class and children of higher status, there was difference observed in the scores obtained. The children of higher status performed better than the Parisian working class children. (Jenson, 1980). Binet reported that language, cultural background, and a common background of experience were the factors that caused the differences in the test scores. In his second revision of the Binet-Simon scale in 1911, Binet scrutinized all the items and eliminated those items that could possibly result to differences in

their test scores (Umoinyang, 1991). Even at that, the elimination did not reduce the average social-class differences in overall test scores.

Since then, many other psychologists carried out their studies and reported on the social class differences in intelligence test as well as their causes. According to Umoinyang (1991), among them were the Knox battery and Pinter-Paterson scale of performance used on the illiterates, poorly and non-English speaking. The American psychologists developed the Army Alpha and Army Beta in World War I developed by the American psychologists used for selection of draftees and for non-English speaking draftees. In 1940 Raymond Catell proposed a "culture free" intelligence which he later changed to "culture fair" when he was misunderstood by sociologists, psychologists and anthropologist. Studies on Differential Item Functioning started to gain possible attention in 1970s when the concepts of Differential Item Functioning and fairness came under thorough scrutiny by specialists in the field of psychometrics (Umoinyang, 2004).

In Nigeria, examination bodies have incorporated elements of Differential Item Functioning into their norms for selection of candidates either for certification or placement purposes. The Joint Admission and Matriculation Board (JAMB) is a typical example where analysis of different cut-off points for admissions reveals the practice of a discriminatory admission requirement for different states. JAMB has classified states into educationally developed or less developed, though the basis for such classification remains unclear to educationalists as this practice clearly negates the policy of egalitarianism (Umoinyang, 1991). Test construction for whatever purpose it is used for should not discriminate among test-takers as a result of any factor other than the differences in the ability under measurement. If a test is unfair or yields different scores from sub-groups, of the same population having the same ability,

then such a test functions differentially (Umoinyang, 2004). According to Brown (1983), a test can be considered bias if it differentiates between members of various groups (men/women, blacks/whites) on the bases other than the characteristic being measured. A test is said to function differently if its contents, procedures or uses results in a way it becomes advantaged or disadvantaged to members of certain groups over others; especially if the basis of this differentiation is irrelevant to the test purpose (Joshua, 2005). Obviously, the presence of Differential Item Functioning is a cause for great concern, considering that test results are generally taken to be good indicators of peoples' ability level of performance in the subject

Differential Item Functioning (DIF) also referred to as "measurement bias" occurs when people from different groups (commonly gender, or ethnicity) with same latent traits (ability/skills) have a different probability of giving a certain response on a test or questionnaire. An item does not display Differential Item Functioning if people from different groups have a different probability to give a certain response; it displays Differential Item Functioning if and only if people from different groups with the same underlying true ability have a different probability of giving a certain response. When performance of the item task is within the test's capabilities, he or she will typically produce a correct response, but at times, test items may set demands other than those intended by the test developers thereby leading to different interpretations or meanings for members of different groups or sub-group within the group, such items are said to function differentially. An item shows differential item functioning when the difficulty level (b), the discrimination level (a) or the lower asymptotes (c) estimated by item response theory (IRT) of an item differs across groups of examinees. When some items in a test are found to function differently for a specific subgroup of the general group being tested, means that the items are relatively more difficult for one group than the other. Differential item functioning occurs when

an item is not equally difficult in maximal performance tests or equally popular for typical performance tests for groups that have been matched in terms of the construct being measured (Lincare, 2011).

The environment (urban/rural) which a child finds himself/herself, goes a long way to determine one's academic achievement in life. Children who come from rich environment have better academic achievement than those from poor environment. Urban areas are well equipped with learning facilities, qualified teachers, good roads and good communication networks which puts them at an advantageous position compare to their rural counterparts where such opportunities are inadequate or somehow lacking. According to Akubuiro (2002) cited by Anagbogu (2009), urban learning environment has a greater access to socio- cultural and economics facilities and services and as produce a high performing leaner. While the rural students who have not been exposed to these favourable experiences and rich. Environments find it difficult to bridge the gap and so results to poor performance in their various subjects. To find out if differential item function exists. In Ekiti state unified mathematics Examination (ESUME) and also to confirm if the test items function in different ways for groups of test- takers, Adebule (2013) used a sampling technique. A3-20 multiple-choice test items in mathematics from Ekiti state unified mathematics examination for the 2008/2009 and 2009/2010 academic sessions were used as instrument for the study. One reached question was raised and one hypothesis was generated and tested at 0.5 level of significance. Inyang (1991) cited by Umo Inyang (2003) investigation items in the 1986 common Akwa Ibom and Cross River States that function differentially between urban and rural students. The researcher reported that the 1986 common Entrance Examination mathematics items do exhibits location DIF. Similarly, Umoinyang (1991) investigated Regional DIF for northern southern Nigerian students who sat for the

November/December 1990 GCE mathematics objectives test items administered by WAEC. The result revealed that the calculated t-values -2.59 – 16-45 and 16-71 were found to be higher than the critical value of 1.96 required for significance level at .05 levels, showing that the Southern candidates significantly outperformed their Northern counterparts.

School ownership comprises public and private schools. Public schools are owned and founded by government while private schools are owned and founded by individuals or organizations. Enunwah *et al.*, (2014) conducted a study to determine the differential item and group functions of secondary school students' achievement in mathematics. The DGF contrast value between public and private schools under algebraic fractions and gradients has the same value -0.06 which also implies that private school have 6% advantage over their public school counterparts. It was finally concluded that items used in assessing students' ability has element of biasness that disadvantaged the public school examinees and favoured the private school examinees. And school there was the presence of school type bias in NECO Economics questions. In another study Adediwura (2013) conducted a study to identify differential item functioning in item in relation to gender and students' course of study using IRT and GLM methods to compare the nature of DIF identified by the two models in a dichotomous test. The study adopted descriptive survey design with a population consisting all the part three students in the Faculty of Education of Obafemi Awolowo University Ile-Ife. However, both methods detected six (6) items as exhibiting uniform DIF while four (4) items were identified as exhibiting non-uniform DIF. The researcher reported further by comparing the strength of both methods in detecting DIF, the IRT method was found to be powerful in detecting not only uniform DIF but also non-uniform DIF items. While the GLM –LR method allows for DIF items

be screened quickly and easily. In conclusion, the researcher reported that there were substantial differences across methods in terms of identify items that exhibits DIF.

The literature review about gender and differential item functioning conducted nationally and internationally have revealed test items contained differential item functioning whether the test is meant to use for certification, admission, recruitment, placement purposes. Researchers like (Doolittle and Cleary 1987, Umoinyang 1991, Abiam and Odok 2006 and many other researchers) have found out that mathematics items in the content areas of number/numeration, algebra and geometry exhibits differential item functioning (DIF).

The type of school a student attends to a large extent, influence one's academic performance. Researchers such as (Enunwah, et al 2014, Amuche and Fan 2014, Ogbebor and Onuka 2013) have reported that private schools do perform better that their public counterparts. In comparing the efficiency of most detection methods, most researchers have reported that the IRT method is most efficient in detecting DIF. But the Mantel-Haenszel, method is commonly used because of its low cost and it requires small sample Umoinyang (1991). This study will therefore, contribute meaningfully to address this issue of differential item functioning to ensure the balance of content reflecting the ability of examinees in the Junior Secondary School Certificate Mathematics Examination.

Therefore, the objective of this research was to determine whether mathematics test items in the JSSCE of 2010 exhibit any significant differential item functioning. Specifically, it was designed to: find out the 2010 junior secondary school certificate mathematics examination items that exhibits gender differential item functioning, examine the 2010 junior secondary school certificate mathematics examination items to determine those that exhibits significant school location differential item functioning and determine whether the 2010 junior secondary school

certificate mathematics examination items exhibits significant school ownership differential item functioning.

## RESEARCH METHODOLOGY

The research design for this study is the inferential survey. This is due to the fact that it attempts to infer what is present among members of large population from the result of studying representative sample from that population. The study was expected to find out the Junior Secondary School Certificate Mathematics Examination items that exhibited differential item functioning relative to gender, school location and school ownership. The researcher however, did not manipulate any of the variables, but rather, took into consideration the already taken JSSCE examination to establish the extent to which its items exhibited differential item functioning.

The area of the study was Southern educational zone of Cross River State, Nigeria made up of seven (7) local government areas among which are Akamkpa, Akpabuyo Bakassi, Biase, Calabar Municipality, Calabar South and Odukpani. Geographically, the area is bounded by Abi local government area in the North, Akwa Ibom State and Atlantic Ocean in the South. In the East by Etung local government area and Republic of Cameroon while in the West by Ebonyi and Abia States. The socio-economic activities of the people are predominantly farming and fishing, small scale farming is equally practiced at commercial and subsistence levels. The food crop includes cassava, yam, plantain, banana, vegetable crops like fluted pumpkin and waterleaf. The zone lies between latitude $4^0 28'$ and $6^0 55'$ North of the equator and longitude $7^0 50'$ and $9^0 28'$ East of the Greenwich Meridan. The zone is composed of two major languages, Efik and Ejagham. The Efik language is widely spoken. The zone has a rich cultural heritage that is expressed in rthymical dance and festivals. Each rhythm and dance express the intrinsic feelings

of the people that are related to particular events, festivals or their way of life. The most popular dishes are pounded yam and white soup, eba and edikang ikong and afang soup. The zone has Calabar as its capital where a lot of tourist attraction centres are situated like: Tinapa, Marina Resort and Old Residency Museum, Kwa falls etc. some other institutions of higher learning located in the zone includes University of Calabar, Cross River State University of Technology, College of Education Akamkpa, School of Health Technology, School of Psychiatry, School of Nursing etc.

The population of this study comprised Junior Secondary School three (JSS3) students from the Southern Educational Zone of Cross River State who sat for the 2010 Junior Secondary School Certificate Examination. There are *one hundred and eighty four (184) secondary schools (both public and privates), Department of Research and Statistics, State Secondary Education Board Calabar, (2014). It is from this population that the representative sample was drawn for the study. The purposive sampling technique was employed to select four (4) local government areas out of the zone and 15 schools were selected by taking 10% out of 152 schools. This was to reduce cost and also have a manageable sample to work with. Having determined the number, the random sampling technique of the hat and draw method was employed to select the schools for the study. Secondly, the schools were stratified into urban and rural areas. Then the purposive sampling was employed to select four (4) public schools from rural areas. A breakdown is in tables 2 and 3. Lastly, the random sampling was used to select males and females from each stratum since each of the selected schools was made up of both sexes (male/female). A sample size of one thousand, eight hundred and thirty-three (1,833) candidates comprising 874 males and 959 females was drawn from fifteen (15) schools out of this number, 960 were from urban schools and 873 were from rural schools. The instrument for the study was the 60 multiple choice test

items used for 2010 Junior Secondary School Certificate Examination in Mathematics. The test items were developed by test experts and developers in the Ministry of Education. These items were developed to cover areas of the Junior Secondary School Mathematics Curriculum on number and numeration, basic operation, measurement, algebraic processes, geometry/mensuration and everyday statistics. The test items were designed by highly trained and qualified professionals in test development without the researcher's contribution to the design or administration of the instrument. It is therefore assumed that the junior secondary school certificate examination in mathematics administered to the students in 2010 is valid and reliable. The reliability was tested using the Cronbach alpha. The result obtained was .79 which indicates that it was a good test.

TABLE 1: Number of schools in the sampled Local Government Areas

| **LGAs** | **No of schools** |
|---|---|
| Akamkpa | 30 |
| Baise | 27 |
| Calabar Municipality | 65 |
| Calabar south | 30 |
| Total | 152 |

Source: Field survey, 2014

**TABLE 2:** Urban and rural schools and private and public schools

| | School ownership | | |
|---|---|---|---|
| School location | Private | Public | Total |
| Urban | 4 | 4 | 8 |
| Rural | 4 | 3 | 7 |
| Total | 8 | 7 | 15 |

Source: Field survey, 2014

**TABLE 3:** Number of male and female students from urban and rural areas

| **Location** | **M** | **F** | **Total** |
|---|---|---|---|
| **Urban** | 502 | 458 | 960 |
| **Rural** | 372 | 501 | 873 |
| **Total** | 874 | 959 | 1833 |

Source: Field survey, 2014

**TABLE 4:** Number of males and females from private and public schools

| **School ownership** | **M** | **F** | **Total** |
|---|---|---|---|
| Private | 439 | 436 | 875 |
| Public | 435 | 523 | 958 |
| Total | 874 | 959 | 1,833 |

Source: Field survey, 2014

**PROCEDURE FOR DATA COLLECTION**

To obtain the data, the researcher had to apply through the Institute of Education University of Calabar to Cross River State Ministry of Education for permission to have access to the candidates marked scripts, with the permission granted, the researcher was able to extract information from the responses made by the candidates and a person by item matrix was prepared. The data collected was prepared using the person by- item-matrix see appendix B. In scoring, if a candidate answered an item correctly, the score of (1) was recorded. If a candidate answered wrongly, a score of (0) was recorded.

**PROCEDURE FOR DATA ANALYSIS**

**Hypothesis 1:** There is no significant gender differential item functioning in 2010 junior secondary school certificate mathematics examination. **Variables:** Gender is the independent variable while differential item functioning (DIF) is the dependent variable. **Statistical Test:** Mantel-Haenszel (MH) and Scheuneman ($SSX^2$)

**Hypothesis 2:** The 2010 Junior Secondary School Certificate Mathematics Examination does not significant exhibits school location differential item functioning. **Variables:** School location is the independent variable, and differential item functioning is the dependent variable. **Statistical tests:** The Mantel-Haenszel and Schueneman's chi-square ($SSX^2$).

**Hypothesis 3:** There is no significant school ownership differential item functioning in 2010 Junior Secondary School Certificate Mathematics Examination. **Variables:** School ownership is the independent variable while Differential Item Functioning is the dependent variable. **Statistical test:** The Mantel-Haenszel Statistics and Schueneman's chi-square ($SSX^2$)

**Operational definition of variables**

The variables are operationalised so as to facilitate the understanding and avoid ambiguity.

1. Independent variable

i. Gender: The two levels are male and female. These were measured using examinees from JSS three who wrote the JSSCE in 2010.

ii. Location: Two levels are Urban and rural. The researcher measured urban and rural examinees who wrote the JSSCE mathematics test.

iii. School ownership: The two levels are private and public schools. Examinees from private and public schools were used.

2. Dependent variable

The dependent variable in this study is the differential item functioning (DIF) of test items. The examinees' correct/incorrect responses to items were coded as:

(1) For correct answer and (o) for incorrect answer. The DIF for each test item was calculated using the frequencies of the examinees that passed or failed at each of the 60 items in the mathematics examination.

## RESULTS AND DISCUSSIONS

The results of this study are discussed here. First, each of the three hypotheses of the study were re-stated in its null form. In testing the three hypotheses, two differential item functioning detection methods were used. The Mantel-Haenszel (MH) statistics and the Scheuneman's modified chi-square ($SSX^2$). A total of 1833 examinees were used in the study with 874 males and 959 females. The number of urban and rural students was 960 and 873 respectively while 875 were used from private schools and 958 were from public students.

**TABLE 5:** Person by item matrix of student responses in 2010 junior secondary school certificate mathematics examination

| **Person** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **…..60** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | ……. | 8 |
| 2 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | ……. | 8 |
| 3 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | ……. | 7 |
| 4 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | ……. | 7 |
| 5 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | ……. | 6 |
| 6 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | | 5 |
| 7 | . | . | . | . | . | . | . | . | . | . | . | . |
| 8 | . | . | . | . | . | . | . | . | . | . | . | . |
| 9 | . | . | . | . | . | . | . | . | . | . | . | . |
| 10 | . | . | . | . | . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1833 | . | . | . | . | . | . | . | . | . | . | . | . |

**Hypothesis one**

The null hypothesis states that there is no significant gender differential item functioning in 2010 Junior Secondary School Certificate Mathematics Examination. To test this hypothesis, male and female examinees were subjected to two statistics analyses: (1) Mantel- Haenszel (M-H) statistics and the Scheuneman modified chi-square ($SSX^2$) test. The result as presented in Table 6 and 7. From Table 6 and 7, no item exhibited significant gender differential item functioning. This means that all the items favoured both male and female students. Hence, the null hypothesis was upheld at the 0.05 level of significance.

**TABLE 6**: Mantel-Haenszel Differential Item Functioning (DIF) Chi Square Analysis of Responses by Male and Female Students from 2010 Examination in Mathematics by JSS 3 Southern Educational Zone of Cross River State, Nigeria

| Item | p-value | | Mantel-Haenszel Statistics | | P< | Favoured Group | Item | P-value | | Mantel- Haenszel statistics | | P< | Favoured group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | F | $X^2$ – value | Odds ratio Est. | | | | M | F | $X^2$ – value | Odds ratio Est. | | |
| 1. | .75 | .76 | 0.00 | 1.01 | .95 | - | 31. | .74 | .73 | .41 | 0.92 | .52 | - |
| 2. | .80 | .83 | 1.70 | 1.20 | .19 | - | 32. | .70 | .74 | 2.64 | 1.21 | .10 | - |
| 3. | .82 | .81 | 0.12 | 0.95 | .73 | - | 33. | .70 | .72 | 0.58 | 1.10 | .45 | - |
| 4. | .79 | .78 | 0.40 | 0.92 | .53 | - | 34. | .77 | .75 | 0.35 | 0.92 | .55 | - |
| 5. | .79 | .79 | 0.12 | 0.98 | .90 | - | 35. | .73 | .73 | 0.00 | 1.00 | .98 | - |
| 6. | .81 | .81 | 0.00 | 0.99 | .97 | - | 36. | .75 | .76 | 0.12 | 1.05 | .73 | - |
| 7. | .80 | .77 | 1.48 | 0.85 | .22 | - | 37. | .74 | .75 | 0.45 | 1.09 | .50 | - |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8. | .78 | .78 | 0.08 | 0.96 | .78 | - | 38. | .73 | .75 | 0.57 | 1.10 | .45 | - |
| 9. | .75 | .77 | 1.05 | 1.14 | .31 | - | 39. | .75 | .76 | 0.21 | 1.07 | .64 | - |
| 10. | .78 | .78 | 0.00 | 1.00 | .97 | - | 40. | .75 | .75 | 0.00 | 1.01 | .97 | - |
| 11. | .78 | .77 | 0.02 | 0.97 | .88 | - | 41. | .76 | .77 | 0.08 | 1.04 | .78 | - |
| 12. | .75 | .77 | 0.63 | 1.11 | .43 | - | 42. | .76 | .75 | 0.18 | 0.94 | .67 | - |
| 13. | .79 | .80 | 0.13 | 1.06 | .72 | - | 43. | .76 | .80 | 2.98 | 1.25 | .09 | - |
| 14. | .79 | .78 | 0.96 | 0.88 | .33 | - | 44. | .81 | .80 | 0.13 | 0.95 | .72 | - |
| 15. | .79 | .75 | 1.23 | 0.79 | .27 | - | 45. | .78 | .76 | 0.77 | 0.89 | .38 | - |
| 16 | .76 | .76 | 0.00 | 0.76 | .96 | - | 46. | .82 | .81 | 0.10 | 0.95 | .70 | - |
| 17. | .77 | .76 | 0.19 | 0.94 | .66 | - | 47. | .83 | .83 | 0.03 | 1.03 | .86 | - |
| 18. | .78 | .79 | 0.30 | 1.08 | .58 | - | 48. | .82 | .84 | 0.61 | 1.12 | .44 | - |
| 19. | .75 | .79 | 2.22 | 1.21 | .14 | - | 49. | .83 | .82 | 0.41 | 0.91 | .52 | - |
| 20. | .79 | .82 | 1.71 | 1.20 | .19 | - | 50. | .83 | .84 | 0.16 | 1.07 | .69 | - |
| 21. | .73 | .69 | 1.96 | 0.85 | .16 | - | 51. | .73 | .69 | 1.96 | 0.85 | .16 | - |
| 22. | .72 | .73 | 0.17 | 1.06 | .68 | - | 52. | .72 | .73 | 0.23 | 1.06 | .64 | - |
| 23. | .73 | .73 | 0.06 | 0.97 | .77 | - | 53. | .73 | .73 | 0.04 | 0.97 | .85 | - |
| 24. | .74 | .77 | 0.86 | 1,13 | .35 | - | 54. | .74 | .77 | 0.83 | 1.12 | .36 | - |
| 25. | .74 | .75 | 0.11 | 0.75 | .74 | - | 55. | .74 | .75 | 0.89 | 1.04 | .77 | - |
| 26. | .77 | .77 | 0.05 | 1.04 | .83 | - | 56. | .77 | .78 | 0.05 | 1.04 | .83 | - |
| 27. | .74 | .75 | 0.39 | 1.08 | .53 | - | 57. | .74 | .75 | 0.37 | 1.08 | .54 | - |
| 28. | .72 | .74 | 0.21 | 0.74 | .65 | - | 58. | .72 | .73 | 0.17 | 1.06 | 68 | - |
| 29. | .70 | .73 | 1.61 | 1.16 | .21 | - | 59. | .70 | 73 | 1.70 | 1.17 | .19 | - |
| 30. | .75 | .76 | 0.01 | 1.02 | .92 | - | 60. | .75 | .76 | 0.01 | 1.02 | .91 | - |

Source: Field survey (2014)

**TABLE 7:** Scheuneman Signed Modified Chi Square Analysis for Location Bias Analysis of Responses by Male and Female Students from Southern Educational Zone of Cross River State, Nigeria to 2010 JSS 3 examination in Mathematics.

| Item | Scheuneman's signed $X^2$ – value | | | Favoured group | Item | Scheuneman's signed $X^2$- value | | | Favoured group |
|---|---|---|---|---|---|---|---|---|---|
| | Urban(U) | Rural (R) | Total (±) | | | Urban (U) | Rural (R) | Total (±) | |
| 1. | 5.91 | 3.28 | 9.19 | - | 31. | 0.60 | 0.01 | 0.61 | - |
| 2. | 4.42 | 2.69 | 7.12 | - | 32. | 8.28 | 2.01 | 10.29 | - |
| 3. | 2.55 | 0.09 | 3.43 | - | 33. | 1.71 | 1.22 | 2.93 | - |
| 4. | 4.15 | 1.50 | 5.64 | - | 34. | 1.43 | 0.80 | 2.23 | - |
| 5. | 2.26 | 1.67 | 3.92 | - | 35. | 7.25 | 3.84 | 11.09 | - |
| 6. | 2.18 | 0.13 | 2.31 | - | 36. | 4.73 | 0.10 | 4.83 | - |
| 7. | 7.33 | 0.07 | 7.40 | - | 37. | 1.33 | 0.00 | 1.33 | - |
| 8. | 0.11 | 0.92 | 0.20 | - | 38. | 3.73 | 3.60 | 7.33 | - |
| 9. | 2.75 | 0.04 | 2.79 | - | 39. | 2.70 | 0.17 | 2.87 | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 10. | 2.20 | 0.45 | 2.75 | - | 40. | 0.96 | 0.60 | 1.56 | - |
| 11. | 1.39 | 0.00 | 1.39 | - | 41. | 2.77 | 2.33 | 5.01 | - |
| 12. | 5.02 | 0.00 | 5.02 | - | 42. | 2.20 | 0.01 | 2.31 | - |
| 13. | 1.02 | 0.78 | 1.80 | - | 43. | 6.24 | 2.25 | 8.49 | - |
| 14. | 4.96 | 1.20 | 6.16 | - | 44. | 1.97 | 0.07 | 2.03 | - |
| 15. | 1.21 | 0.10 | 2.00 | - | 45. | 1.67 | 0.88 | 2.56 | - |
| 16 | 2.36 | 1.02 | 3.38 | - | 46. | 2.38 | 0.34 | 2.72 | - |
| 17 | 2.88 | 0.94 | 3.81 | - | 47 | 4.31 | 0.73 | 5.04 | - |
| 18 | 2.12 | 0.26 | 2.38 | - | 48. | 2.29 | 3.25 | 5.54 | - |
| 19. | 2.99 | 2.82 | 5.81 | - | 49. | 5.65 | 3.27 | 8.92 | - |
| 20. | 7.20 | 0.28 | 7.48 | - | 50. | 0.60 | 0.52 | 1.12 | - |
| 21. | 8.43 | 0.11 | S..54 | - | 51. | 9.28 | 0.11 | 9.39 | - |
| 22. | 4..02 | 1.01 | 5.11 | - | 52. | 3.12 | 1.90 | 5.12 | - |
| 23. | 4.94 | 0.36 | 5.20 | - | 53. | 4.94 | 0.36 | 5.20 | - |
| 24. | 6.09 | 0.09 | 6.17 | - | 54. | 5.09 | 0.09 | 5.17 | - |
| 25. | 4.11 | 0.62 | 4.73 | - | 55. | 2.44 | 0.68 | 3.12 | - |
| 26. | 3.75 | 0.65 | 4.30 | - | 56. | 2.62 | 1.78 | 6.30 | - |
| 27. | 5.32 | 1.73 | 7.05 | - | 57. | 0.47 | 0.19 | 0.66 | - |
| 28. | 2.33 | 0.66 | 2.99 | - | 58. | 2.33 | 0.66 | 2.99 | - |
| 29. | 3.07 | 0.48 | 3.65 | - | 59. | 6.57 | 0.00 | 6.57 | - |
| 30. | 5.77 | 2.17 | 7.94 | - | 60. | 5.77 | 2.22 | 7.99 | |

*Critical *X*-Value = 27.69, df = 5, p < .01

The findings in this study revealed that there was no significant gender differential item functioning in the 2010 junior secondary school certificate mathematics examination. Studies conducted by researchers such as (Umoinyang, 1991, Abedalaziz 2010, Siamisang 2010; Madu 2012,) have reported that mathematics items exhibits differential item functioning in favour of male examinees. However, this study agrees with the findings of Ajai and Imoko 2015, Abiam and Odok, 2006 who reported that there was no significant difference between males and females in mathematics achievement test as females were capable of competing with their male counterparts. Female students do not see mathematics as a male subject any longer. Another reason could be due to the fact that, the female students were adequately prepared for the examination or the female students got the answers correct through guessing. Considering the detection methods used for this study (Mantel-Haenszel (MH) and Scheuneman ($SSX^2$), none of the methods detected items that function differentially between males and females. Based on the

findings, it was concluded that there was no significant gender differential item functioning in 2010 junior secondary school certificate mathematics examination.

**Hypothesis Two**

In a null form, the hypothesis is stated that the 2010 Junior Secondary School Certificate Mathematics Examination does not significantly exhibits school location differential item functioning. The responses by the urban and rural students were subjected to two detection methods- Mantel-Haenszel statistics and Scheuneman's modified chi-square ($SSx^2$) techniques. The summary of the analysis is presented in Tables 9 and 10

**TABLE 8:** Mantel-Haenszel Differential Item Functioning (DIF) Analysis of Responses by Students from Urban and Rural Areas of Southern Educational Zone of Cross River State, Nigeria to 2010 JSS 3 Examination in Mathematics

| Item | p-value | | Mantel- | | P< | Favoured group | Item | p-value | | Mantel-Haenszel Statistics | | P< | Favoured group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Urban (U) | Rural (R) | **$X^2$ –value** | Odds ratio Est. | | | | Urban (U) | Rural (R) | **$X^2$ – value** | Odds ratio Est. | | |
| 1. | .76 | .75 | 0.07 | 0.96 | .79 | - | 31. | .73 | .74 | 0.43 | 1.09 | .51 | - |
| 2. | .82 | .81 | 0.02 | 0.97 | .88 | - | 32. | .73 | .71 | 0.72 | 0.90 | .37 | - |
| 3. | .80 | .83 | 1.80 | 1.21 | .18 | - | 33. | .72 | .71 | 0.06 | 0.97 | .80 | - |
| 4. | .81 | .76 | 6.09 | 0.73 | .02 | U | 34. | .77 | .76 | 0.11 | 0.95 | .75 | - |
| 5. | .78 | .80 | 1.16 | 1.16 | .28 | - | 35. | .74 | .72 | 0.79 | 0.90 | .37 | - |
| 6. | .81 | .81 | 0.09 | 0.95 | .76 | - | 36. | .75 | .76 | 0.39 | 1.09 | .53 | - |
| 7. | .77 | .80 | 2.04 | 1.21 | .15 | - | 37. | .76 | .72 | 2.35 | 0.83 | .13 | - |
| 8. | .80 | .76 | 2.08 | 0.83 | .15 | - | 38. | .73 | .74 | 0.07 | 1.04 | .79 | - |
| 9. | .78 | .74 | 2.90 | 0.81 | .09 | - | 39. | .75 | .76 | 0.15 | 1.06 | .70 | - |
| 10. | .79 | .78 | 0.05 | **0.97** | .83 | - | 40. | .75 | .74 | 0.07 | 0.96 | .80 | - |
| 11. | .78 | .-o | 0.89 | 0.88 | .35 | - | 41. | .79 | .74 | 4.69 | 0.76 | .03 | U |
| 12. | .76 | .76 | 0.02 | 0.98 | .90 | - | 42. | .76 | .75 | 0.02 | 0.98 | .88 | - |
| 13. | .80 | .79 | 0.26 | 0.93 | .61 | - | 43. | .79 | .76 | 1.48 | 0.85 | .22 | - |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14. | .76 | .80 | 2.62 | 1.23 | .11 | - | 44. | .82 | .79 | 2.92 | 0.79 | .09 | - |
| 15. | .79 | .79 | 0.04 | 0.97 | .85 | - | 45. | .78 | .76 | 0.91 | 0.88 | .34 | - |
| 16 | .76 | .77 | 0.16 | 1.06 | .69 | - | 46. | .81 | .83 | 1.07 | 1.16 | .30 | - |
| 17. | .76 | .78 | 0.97 | 1.14 | .32 | - | 47. | .85 | .81 | 2.25 | 0.81 | .13 | - |
| 18. | .78 | .79 | 0.27 | 1.08 | .61 | - | 48. | .83 | .82 | 0.24 | 0.93 | .63 | - |
| 19. | .78 | .75 | 1.28 | 0.86 | .26 | - | 49. | .81 | .84 | 2.24 | 1.24 | .13 | - |
| 20. | .79 | .82 | 1.59 | 1.19 | .21 | - | 50. | .83 | .84 | 0.42 | 1.11 | .52 | - |
| 21. | .70 | .71 | 0.09 | 1.04 | .76 | - | 51. | .70 | .71 | 0.09 | 1.04 | .76 | - |
| 22. | .74 | .71 | 1.74 | 0.85 | .19 | - | 52. | .74 | .71 | 1.67 | 0.86 | .20 | - |
| 23. | .74 | .72 | 0.89 | 0.89 | .35 | - | 53. | .74 | .72 | 0.97 | 0.89 | .32 | - |
| 24. | .76 | .75 | 0.02 | 0.98 | .90 | - | 54. | .76 | .75 | 0.02 | 0.98 | .88 | - |
| 25. | .75 | .74 | 0.27 | 0.93 | .60 | - | 55. | .75 | .74 | 0.05 | 0.97 | .83 | - |
| 26. | .77 | .77 | 0.02 | 0.98 | .89 | - | 56. | .76 | .77 | 0.02 | 0.98 | .89 | - |
| 27. | .75 | .74 | 0.08 | 0.96 | .79 | - | . 57. | .75 | .74 | 0.08 | 0.96 | .77 | - |
| 28. | .74 | .72 | 0.82 | 0.89 | .37 | - | 58. | .74 | .72 | 0.75 | 0.90 | .39 | - |
| 29. | .72 | .70 | 0.52 | 0.92 | .47 | - | 59. | .72 | .70 | 0.58 | 0.91 | .45 | - |
| 30. | .76 | .75 | 0.04 | 0.97 | .84 | _ | 60. | .76 | .75 | 0.05 | 0.97 | .83 | _ |

**TABLE 9:** Scheuneman Signed Modified Chi Square Analysis for Location Bias Analysis of Responses by Students from Urban and Rural Areas of Southern Educational Zone of Cross River State, Nigeria to 2010 JSS 3 Examination in Mathematics .

| Item | Scheuneman's signed $X^2$- value | | | Favoured group | Item | Scheuneman's signed $X^2$- value | | | Favoured group |
|---|---|---|---|---|---|---|---|---|---|
| | Urban (U) | Rural (R) | Total (±) | | | Urban (U) | Rural (R) | Total (±) | |
| 1. | 7.98 | 0.00 | 7.98 | - | 31. | 5.86 | 3.38 | 9.24 | - |
| 2. | 4.79 | 1.43 | 6.21 | - | 32. | 4.96 | 0.78 | 5.64 | - |
| 3. | 12.32 | 0.90 | 13.23 | - | 33. | 5.85 | 3.97 | 9.82 | - |
| 4. | 28.17 | 3.50 | 31.76 | U | 34. | 0.98 | 0.82 | 1.80 | - |
| 5. | 6.91 | 0.00 | 6.91 | - | 35. | 2.92 | 0.40 | 3.32 | - |
| 6. | 8.61 | 2.73 | 11.34 | - | 36. | 4.78 | 0.00 | 4.78 | - |
| 7. | 13.28 | 0.80 | 14.09 | - | 37. | 6.27 | 0.34 | 6.60 | - |
| 8. | 6.96 | 1.19 | 8.15 | - | 38. | 3.12 | 1.70 | 4.82 | - |
| 9. | 5.39 | 0.17 | 5.56 | - | 39. | 2.28 | 0.26 | 2.54 | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 10. | 2.76 | 1.07 | 3.83 | - | 40. | 2.66 | 2.27 | 4.94 | - |
| 11. | 1.59 | 0.17 | 1.76 | - | 41. | 9.79 | 7.91 | 17.70 | - |
| 12. | 6.83 | 0.-4 | -.5′ | - | 42. | 1.55 | 0.49 | 2.04 | - |
| 13. | 3.62 | 2.56 | 6.18 | - | 43. | 4.00 | 0.00 | 4.00 | - |
| 14. | 5.17 | 0.00 | 5.17 | - | 44. | 10.11 | 0.12 | 10.21 | - |
| 15. | 7.12 | 2.04 | 9.16 | - | 45. | 1.79 | 0.52 | 2.31 | - |
| 16 | 1.10 | 0.20 | 1.40 | .-. | 46. | 6.89 | 1.29 | 8.19 | - |
| 17. | 7.60 | 0.55 | 7.67 | - | 47. | 6.46 | 0.00 | 6.464 | - |
| 18. | 4.95 | 099. | 5.15 | - | 48. | 4.33 | 1.49 | 5.83 | - |
| 19. | 9.39 | 1.07 | 10.46 | - | 49. | 5.90 | 1.93 | 793 | - |
| 20. | 7.70 | 2.17 | 9.88 | - | 50. | 4.56 | 0.07 | 4.62 | - |
| 21. | 8.48 | 2.94 | 11.41 | - | 51. | 9.80 | 1.51 | 11.31 | - |
| 22. | 5.70 | 0.28 | 6.08 | - | 52. | 6.08 | 0.00 | 6.08 | - |
| 23. | 5.67 | 0.23 | 588 | - | 53. | 5.77 | 0.22 | 5.98 | - |
| 24. | 2.97 | 2.07 | 5.07 | - | 54. | 2.86 | 2.18 | 5.04 | - |
| 25. | 5.27 | 4.31 | 9.58 | - | 55. | 5.27 | 4.31 | 9.58 | - |
| 26. | 2.11 | 1.30 | 3.41 | - | 56. | 2.11 | 1.30 | 3.41 | - |
| 27. | 0.29 | 0.27 | 0.56 | - | 57. | 0.22 | 0.22 | 0.44 | - |
| 28. | 3.02 | 0.32 | 3.34 | - | 58. | 3.02 | 0.32 | 3.34 | - |
| 29. | 1.21 | 1.17 | 2.38.. | - | 59. | 1.82 | 0.57 | 2.39 | - |
| 30. | 0.59 | 0.52 | 1.10 | - | 60. | 0.59 | 0.52 | 1.10 | - |

"Critical x-Value = 27.69, df = 5, p < .01

Source: Field survey (2014)

From Table 8, two items in the area at algebraic processes and arithmetic were identified by the Mantel- Haenszel method to exhibits significant differential item functioning in favour of the urban students. From Table 9, in using the Scheuneman's modified chi-square statistics, one (1) item was identified to exhibit differential item functioning at .05 level of significance in the content area of algebraic processes in favour of the rural students. The items identified as exhibiting school location differential item functioning by Mantel- Haenszel (MH) statistics and Scheuneman chi-square are presented in the table 10.

Table 10: The items identified as exhibiting school location differential item functioning by Mantel- Haenszel (MH) Chi-square statistics and Scheuneman chi-square are presented in the table 11.

| **Method** | **Mantel-Haesnzel (MH)** | **Scheuneman chi-square** |
|---|---|---|

| | | |
|---|---|---|
| Item | 4 and 41 | 4 |
| | 2 (3.33) | 1(1.67) |

In testing the second hypothesis of the study, the findings revealed that the 2010 junior secondary school certificate mathematics examination significantly exhibits school location differential item functioning. The Mantel-Haenszel (MH) method identified two (2) items that functioned differentially against urban students in the content area of algebraic processes and arithmetic. While the Scheuneman ($SSX^2$) method identified one (1) item in the content area of algebraic processes that functioned differentially against urban students. This study is not in agreement with the findings of Inyang 1991, Umoinyang 1991, Eng and Hoe 2010, Amuche and Fan 2014, Mokabi and Adedoyin, 2014) who have reported on the existence of differential item functioning between urban and rural students. However, the study agrees with the findings of Inyang 2004 who reported that rural students performed better than their urban counterparts. The reason for rural students to out-performed urban students could be due to their interpersonal ties with their community which provides a conducive learning environment, moreso, rural schools have small population, so their small class size creates room for a higher teacher-to-student ratio which is known to be beneficial to learning which enhances good performances. Another reason could be that the urban students did not have adequate coverage of their syllabus in those areas that the items were set. Based on these findings it was concluded that the 2010 junior secondary school certificate mathematics examination significantly exhibits location DIF in arithmetic and algebraic processes.

**Hypothesis three**

In a null form, the hypothesis states that, the Junior Secondary School Certificate Examination in Mathematics in 2010 do not significantly exhibits school ownerships differential item functioning. To test this hypothesis, the Mantel- Haenszel statistics and Scheuneman's Chi-square statistics were used. The result of the analysis are presented in tables 11 and 12.

**TABLE 11:** Mantel-Haenszel Differential Item Functioning (D1F) Analysis of Responses by JSS 3 Students from Public and Private Schools in Southern Educational Zone of Cross River State, Nigeria to 2010 Examination in Mathematics Items

| Item | P-value | | Mantel-Haenszel Statistics | | P< | Favoured Group | Item | P-value | | Mantel-Haenszel Statistics | | P< | Favoured Group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pub (P) | Prvt (V) | $x^2$-Value | Odds Ratio Est. | | | | Pub (P) | Pvt (V) | $X^2$-Value | Odds Ratio Est. | | |
| 1. | .76 | .76 | 0.00 | 1.00 | .97 | - | 31. | .74 | .73 | 0.65 | 0.90 | .42 | - |
| 2. | .81 | .81 | 0.00 | 1.00 | .96 | - | 32. | .71 | .73 | 0.24 | 1..06 | .62 | - |
| 3. | .82 | .81 | 0.17 | 0.94 | .68 | - | 33. | .73 | .69 | 2.35 | 0.83 | .13 | - |
| 4. | .81 | .76 | 4.19 | 0.77 | .04 | P | 34. | .77 | .75 | 1.29 | 0.87 | .26 | - |
| 5. | .79 | .80 | 0.34 | 1.09 | .56 | - | 35. | .74 | .72 | 0.70 | 0.90 | .40 | - |
| 6. | .83 | .79 | 2.36 | 0.81 | .12 | - | 36. | .76 | .74 | 0.72 | 0.90 | .40 | - |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7. | .81 | .76 | 3.78 | 0.78 | .05 | - | 37. | .77 | .72 | 4.59 | 0.77 | .03 | P |
| 8. | .79 | .78 | 0.18 | 0.94 | .67 | - | 38. | .73 | .74 | 0.35 | 1.08 | .55 | - |
| 9. | .77 | .75 | 0.27 | 0.93 | .61 | - | 39. | .75 | .75 | 0.01 | 1.02 | .94 | - |
| 10. | .79 | .78 | 0.03 | 0.97 | .86 | - | 40. | .75 | .74 | 0.27 | 0.93 | .61 | - |
| 11. | .78 | .76 | 0.92 | 0.88 | .34 | - | 41. | .77 | .76 | 0.27 | 0.93 | .60. | - |
| 12. | .77 | .74 | 1.51 | 0.86 | .22 | - | 42. | .74 | .76 | 2.69 | 1.23 | .10 | - |
| 13. | .80 | .80 | 0.01 | 1.02 | .91 | - | 43. | .78 | .77 | 0.08 | 0.96 | .77 | - |
| 14. | .79 | .77 | 0.40 | 0.92 | .53 | - | 44. | .80 | .81 | 0.39 | 1.09 | .53 | - |
| 15. | .80 | .79 | 0.23 | 0.93 | .64 | - | 45. | .77 | .78 | 0.47 | 1.10 | .47 | - |
| 16 | .76 | .77 | 0.19 | 1.06 | .67 | - | 46. | .80 | .84 | 3.31 | 1.29 | .07 | - |
| 17. | .78 | .75 | 1.45 | 0.86 | .23 | - | 47. | .84 | .82 | 1.37 | 0.84 | .24 | - |
| 18. | .81 | .77 | 3.05 | 0.80 | .08 | - | 48. | .83 | .82 | 0.18 | 0.93 | .67 | - |
| 19. | .77 | .76 | 0.14 | 0.95 | .71 | - | 49. | .83 | .83 | 0.00 | 1.02 | .95 | - |
| 20. | .80 | .81 | 0.12 | 1.06 | .73 | - | 50. | .84 | .84 | 0.02 | 1.03 | .90. | - |
| 21. | .70 | .71 | 0.08 | 1.03 | .78 | - | 51. | .70 | .71 | 0.08 | 1.04 | .78 | - |
| 22. | .72 | .73 | 0.03 | 1.03 | .85 | - | 52. | .72 | .73 | 0.03 | 1.03 | .88 | - |
| 23. | .74 | .71 | 1.33 | 0.87 | .25 | - | 53. | .74 | .71 | 1.43 | 0.86 | .23 | - |
| 24. | .77 | .74 | 2.03 | 0.84 | .15 | - | 54. | .77 | .74 | 2.26 | 0.83 | .13 | - |
| 25. | .76 | .74 | 0.88 | 0.89 | .35 | - | 55. | .76 | .73 | 1.59 | 0.86 | .21 | - |
| 26. | .76 | .79 | 1.08 | 1.15 | .30 | - | 56. | .76 | .79 | 1.08 | 1.15 | 30. | - |
| 27. | .74 | .74 | 0.00 | 1.82 | .98 | - | 57. | .74 | .74 | 0.00 | 1.00 | .97 | - |
| 28. | .73 | .73 | 0.03 | 1.03 | .87 | - | 58. | .73 | .73 | 0.01 | 1.02 | .91 | - |
| 29. | .72 | .70 | 0.95 | 0.89 | .94 | - | 59. | .72 | .70 | 1.03 | 0.89 | .31 | - |
| 30. | .74 | .76 | 0.70 | 1.11 | .40 | _ | 60. | .98 | .92 | 0.72 | 1.12 | .40 | _ |

**TABLE 12:** Scheuneman Signed Modified Chi Square Analysis for Location Bias Analysis of Responses by Students from Public and Private Schools Areas of Educational Zone of Cross River State, Nigeria to 2011 JSS 3 Examination in Mathematics.

| Item | Scheuneman's signed $X^2$- value | | | Favoured group | Item | Scheuneman's signed $X^2$- value | | | Favoured group |
|---|---|---|---|---|---|---|---|---|---|
| | Public (P) | Private (V) | Total (±) | | | Public (P) | Private (V) | Total (±) | |
| 1. | 1.91 | 2.78 | 4.69 | - | 31. | 2.76 | 0.09 | 2.84 | - |
| 2. | 2.11 | 1.77 | 3.88 | - | 32. | 7.26 | 0.71 | 7.98 | - |
| 3. | 9.26 | 6.14 | 15.40 | - | 33. | 5.58 | 0.61 | 6.28 | - |
| 4. | 8.66 | 0.87 | 9.72 | - | 34. | 6.46 | 1.56 | 8.02 | - |
| 5 | 1..I5 | 4..32 | 5.47 | - | 35. | 13.62 | 6.27 | 19.89 | - |
| 6. | 7.73 | 0.06 | 7.74 | - | 36. | 1.92 | 0.37 | 2.37 | - |
| 7. | 13.05 | 1.71 | 14.76 | - | 37. | 6.67 | 4.74 | 11.41 | - |
| 8. | 2.23 | 0.54 | 2.77 | - | 38. | 2.47 | 0.12 | 2.59 | - |
| 9. | 11.72 | 1.11 | 12.82 | - | 39. | 1.85 | 1.75 | 3.59 | - |
| 10. | 7.71 | 6.97 | 14.68 | - | 40. | 4.42 | 4.38 | 8.80 | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 11. | 3.09 | 0.74 | 3.83 | - | 41. | 1.26 | 0.95 | 2.21 | - |
| 12. | 10.19 | 0.02 | 10.21 | - | 42. | 11.09 | 0.07 | 11.15 | - |
| 13. | 4.01 | 2.99 | 7.01 | - | 43. | 0.64 | 0.30 | 0.94 | - |
| 14. | 6.20 | 0.99 | 7.190 | - | 44. | 8.08 | 0.21 | 8.38 | - |
| 15. | 4.37 | 0.78 | 5.15 | - | 45. | 4.64 | 0.26 | 4.90 | - |
| 16 | 1.74 | o.82 | 2.56 | - | 46. | 10.37 | 0.03 | 10.31 | - |
| 17. | 4.59 | 0.01 | 4.10 | - | 47. | 4.78 | 1.67 | 6.45 | - |
| 18. | 6.84 | 0.11 | 6.96 | - | 48. | 4.78 | 1.67 | 6.45 | - |
| 19. | 8.52 | 0.47 | 8.99 | - | 49. | 1.36 | 0.45 | 1.81 | - |
| 20. | 1.29 | 8.05 | 2.01 | - | 50. | 1.96 | 1.03 | 2.99 | - |
| 21. | 8.29 | 4.64 | 12.93 | - | 51. | 7.97 | 4.96 | 12.93 | - |
| 22. | 3.87 | 2.98 | 6..84 | - | 52. | 4.44 | 2.40 | 6.84 | - |
| 23. | 4.73 | 0.01 | 4.73 | - | 53. | 3.15 | 1.48 | 4.63 | - |
| 24. | 4.07 | 3.17 | 7.24 | - | 54. | 4.07 | 3.17 | 7.24 | - |
| 25. | 2.35 | 0.01 | 2.36 | - | 55. | 1.59 | 0.77 | 2.36 | - |
| 26. | 10.79 | 3.77 | 14.56 | - | 56. | 22.19 | 0.36 | 22.56 | - |
| 27. | 1.00 | 0.43 | 1.43 | - | 57. | 1.58 | 0.03 | 1.61 | - |
| 28. | 5.76 | 2.48 | 8.24 | - | 58. | 8.03 | 0.21 | 8.24 | - |
| 29. | 2.39 | 2.23 | 4.62 | - | 59. | 2.39 | 2.23 | 4.62 | - |
| 30. | 4.16 | 0.14 | 4.30 | - | 60. | 3.15 | 1.15 | 4.29 | - |

*Critical $X^2$ - Value = 27.69, df = 5, $p < .01$

Source: Field survey, (2014)

Summary of Mantel- Haenszel differential item functioning analysis of response by Junior secondary school students from private and public schools for 2010 JSSCE in mathematics. From table 11, two (2) items in the area of algebraic processes and number and numeration out of the 60 items were identified as exhibiting differential item functioning in favour of private school students. With 3.33 percent of the entire test

Summary of Scheuneman's statistical tool analysis of responses from private and public school students in 2010 JSS three (3) examination in mathematics. In using Scheuneman's Chi-square ($SSX^2$) as shown in the Table 12, none of the items exhibited or was identified as functioning significantly differential for either public or private students. In this study, it was revealed that the Mantel Haenszel (MH) method identified two (2) items that exhibited differential item functioning in favour of private schools while the Scheuneman ($SSX^2$) method did not identify any item that functioned differentially between public and private schools. The findings of (Inyang 2004, Alutu and Eraikhuemen, 1999, Anigbo 2006 Ogbebor and Onuka 2013) reported that private schools performed better than their public school counterparts. However, the findings of Enunwah et al 2014 reported that public schools performed better than their private school counterparts. The reason why private schools perform better than their public counterparts is due to the fact that, private schools have good learning facilities, the proprietors have higher regards for their job, the teachers are dedicated, there is effective supervision of their staff for effective teaching and learning. Based on this findings, as one of the methods could identify items that exhibited DIF, it was concluded that there was school ownership differential item functioning.

## CONCLUSION

This study was conducted to find out items that exhibits differential item functioning in 2010 JSSCE in mathematics in southern education zone of Cross River State, Nigeria. Based on the findings of this research, it is concluded that the junior secondary school certificate examination in mathematics is not free from Differential Item Functioning (DIF). The ministry of education should take effort to ensure that test items in junior secondary school certificate mathematics examination achievement tests are free of DIF across gender, rural/urban, ethnic, private/public, religion, age etc.

## IMPLICATIONS OF THE FINDINGS

The presence of differential item functioning is a serious threat which affects the validity of test items or test scores which must have kept some candidates at a disadvantaged position. Most candidates who aspired to study science oriented courses at the University or any tertiary institutions have been denied admission or must have found themselves into courses they never asked for. The presence of DIF has caused unemployment in which case, may be accounted for the increase in crime rate like robbery, terrorism, prostitution etc. which is a menace to the society.

## RECOMMENDATIONS

It is recommended that all examination bodies, test experts in Ministry of Education and people charged with the responsibility of developing, validating and administering of test need to carry out differential item functioning analysis for all items before administering the test. During teaching, illustrations should be drawn from the learners' environment owing to the diversified

background of learners while students should ensure that they make adequate preparation for their examinations. Meanwhile, teachers should ensure adequate coverage of their curriculum and government should ensure that public schools have small class size that will encourage the individualized method of teaching and effective classroom management by the teachers. Finally, due to the direct transfer of western science curricula and examinations and teaching methods which fail to address the continental challenges of Africa, curriculum developers should therefore design topics that reflects our African culture and not the western science curricula whereas government should make adequate provision of infrastructures to the rural areas so that there can be equal learning opportunities between the urban and rural students.

## REFERENCES


Abedalaziz, N. (2010). *A Gender-related differential item functioning of mathematics test items. International Journal of Educational and Psychological Assessment.* Vol. 5 (1) P. 101.

Abiam, P. O. & Odok, J. K. (2006). *Factors in students' achievement in different branches of secondary school mathematics. Journal of Education and Technology.* Vol. 1 (1), Pp. 161-168 in article

Adebule, S. O. (2004). *Gender differences on a locally standardized rating scale in mathematics. Nigerian Journal of Counselling and Applied Psychology.*2 (1): 22-29.

Adediwura A. A. (2013). *A Comparative Study of Item Response Theory and Generalized Linear Model Methods of detecting differential item functioning in dichotomous test*. Research Journal in Organizational Psychology and Education Studies. Vol.2 (6) p.308-316.

Alutu, A. N. G. and Araikhuemen, L. (1999). *A Comparative Study of the Academic Performance of some selected Private and Public Junior Secondary School Students in Agor Local Government Area of Edo State*. African Journal of Educational Research. 5(2). 121-130.

Anagbogu G. E. (2009). *Analysis of Psychometric properties of WAEC/NECO Examinations and Students' Ability Parameters in Mathematics in Secondary Schools in CRS*. Unpublished Ph.D Thesis. Faculty of Education, University of Calabar.

Anigbo, L. C. (2006). *Development and standardization of Mathematics Achievement test Batteries for Primary Four Pupils in Nigeria*. Unpublished doctoral dissertation, University of Nigeria, Nsukka.

Brown, F. G. (1983). *Principles of Educational and Psychological Testing* (3rd Ed). New York: Holt, Rinehart and Winston.

Cole, N. S. and Zieky, M. J. (2001). The New Faces of fairness. *Journal of Educational Measurement,* 38(4): 369-382.

Doolittle, A. E. & Clearly, T. A. (1987). *Gender based differential item performance in mathematics achievement items. Journal of Educational Measurement.* 24:157-166.

Enunwah C. I. et al (2014). *Differential Items and Group Functions of Secondary Students achievements in mathematics in Cross River State.* African Education Indices Vol. 7 No.1.

Etukudo, U. E. (2002). *The effect of computer assisted instruction on gender and performance of junior secondary school students in mathematics ABACUS Journal of Mathematics Association Nigeria.* 27(1): 1-8.

Federal Republic of Nigeria (2004). *National Policy on Education*. Lagos. NERDC Press.

Inyang, M. O. (1991). *Location bias analysis of students items test performance.* Paper presented at the 7th annual conference of Nigeria Association of Educational Psychologists Zaria, Nigeria.

Inyang, S. N. (2004). *Analysis of item difficulty and students' performance in 2002 junior secondary school mathematics test.* An unpublished M.Ed thesis. Faculty of Education, University of Calabar.

Jenson, A. R. (1980). *Bias in mental testing.* New York. The Free Press.

Joshua, M. T. (2005). *Fundamentals of test and measurement in Education*. Ultimate index book publishers. 141b. Goldie Street, Calabar- Nigeria.

Madu, B. C. (2012). Analysis of gender-related differential item functioning in mathematics multiple choice items administered by WAEC. *Journal of Education and Practice.* Vol. 3: 222-228.

McGraw, R. (2006). A closer look at gender in NAEP Mathematics Achievement and Affect data: Intersections with Achievement Race/Ethnicity and Socio-Economic Status.

Ogbebor, U. and Onuka A. (2013). *Differential item functioning methods as items Bias indicator.* Online at http://www.interesjournals.ors/ER.

Schnohr, C. W. et al (2007). *Differential Item Functioning of a family Affluence Scale*. New York. Springer Verlag.

Siamisang, F. T. (2014). *Comparative Analysis of differential item functioning in the 2011 TIMSS Examinations Among students from Africa, America, Asia, Australia and Europe.* Unpublished Doctoral Dissertation. University of Botswana.

Umoinyang, I. E. (1991). *Differential item functioning (DIF) Resulting from level of states Educational Development in Nigeria.* Paper presented at the first Regional Conference of World Council for curriculum and Instruction region. 2 (South of Sahara) Lagos.

Umoinyang, I. E. (2003). *Analysis of item bias in mathematics achievement test using three classification of candidates and three detection methods. WASER* (6): 76-90.