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ASSESSMENT OF DIFFERENTIAL ITEM FUNCTIONING IN MATHEMATICS MULTIPLE CHOICE TEST QUESTIONS IN SENIOR SECONDARY SCHOOL CERTIFICATE EXAMINATION IN DELTA CENTRAL SENATORIAL DISTRICT

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Abstract
The study examined assessment of differential item functioning in mathematics multiple choice test questions in senior secondary school certificate examination in delta central senatorial district. Five research questions and five hypotheses guided the study. The purpose of the study was to assess differential item functioning in mathematics multiple choice test questions in senior secondary school certificate examination in Delta Central Senatorial District of Delta State. An ex-post facto research design was adopted for the study. The population of this study consisted of all senior Secondary school class three students in Delta central senatorial district. The proportionate stratified random sampling technique was employed. The instruments used for collecting data were the WAEC/SSCE 2021 mathematics multiple choice questions and socio-economic status whose validity and reliability were ascertained. Logistic Regression (L-R) was used to answer the research questions while Chi-square test was used to test the hypotheses. The finding revealed that there is occurrence of gender, location, socio-econonic, school type and school owneship differential item functioning in WAEC/SSCE 2021 mathematics multiple choice test items. The study concluded that differential item functioning exists in 2021 in mathematics multiple choice test questions in senior secondary school certificate examination in Delta Central Senatorial District of Delta State with respect to gender, location, among other. Based on the findings and conclusion, it was recommended, among others, that test experts and developers should explore the use of DIF approach to detect items that are bias in mathematics Assessment, test experts and developer should explore the use of differential item functioning method, particularly the use of logistic regression statistic to detect uniform and non- uniform test items that are bias with regards to mathematics multiple questions.

Keywords: Differential Item Functioning, Multiple Choice Test, Mathematics

Introduction

Over the decades, tests have been employed to assess the academic performance of students in various subjects including mathematics. Mathematics is a mandatory subject that a student must pass with a credit weight before being considered for admission into institution of higher learning, especially in the field of sciences, engineering and economy. It is one of the subjects that are examined by WAEC in the SSCE and it is taken by all candidates. Despite some progress in research efforts in the area of instructional improvement, Edjere (2018) revealed that there is underperformance of students in mathematics. Historically, educational institutions have employed tests of student performance to determine how in good health they perform in comparison to their peers in mathematics.

In the enlightening system, it is assumed that tests are administered or given in order to determine the qualities of examinees. In Nigeria, there are a number of national examination bodies that are in charge of administering tests for a variety of purposes, including promotion, selection, and placement, among others. Since the examination bodies in Nigeria cater for candidates from a variety of different backgrounds, the examinations are different in tone for a variety of personal and environmental reasons (Emaikwa, 2012). Consequently, there are some instances in which an item in these tests may be more difficult for a particular group of examinees who are on the same ability level but from different subgroups to perform differently; in these instances, the item is referred to as exhibiting differential item functioning (DIF). Odili (2021) stated that ability is the quality of being able to perform a task. As a result, the ability level is defined as the highest level of accomplishment that an individual has achieved and has been recorded. No issue is more visible in national examinations conducted in a heterogeneous country like Nigeria than differential item functioning, and this is perhaps the most serious of the issues (DIF). The challenge that prompted this study revolves around the impact of a test that performs differently in different situations.

Odili (2014) defined differential item functioning as the phenomenon that occurs when test takers from different groups who have been matched on ability levels perform in test items in a different way. As a result, some examinees will perform exceptionally well, while others will perform below average. Equal opportunity among examinees has become a concern as a result of this situation. According to the National Policy on Education of the Federal Government of Nigeria (FGN) (2004), every Nigerian child shall have the right to equal educational opportunities irrespective of any real or imagined disabilities, each according to his or her ability, and there shall be the provision of equal access to educational opportunities for all citizens of the country at the primary level, secondary level, and tertiary level both inside and outside the country. In order to avoid the problem of testing not providing equal opportunity for all examinees, it is necessary to design test items that performed differently. The importance of education in improving the lives of children, families, communities, and entire countries cannot be overstated. The fact that some examinees are failing while others are passing as a result of the difficulty of the test has distorted the chances of those who did not pass to be promoted.

There is also the issue of class differentiation to consider. It is the division of people in a society into groups on the basis of their shared economic or social characteristics that are being discussed in this context of class differentiation. As a result of the threat posed by the effect of DIF, the goal of education may be defeated, and the purpose of education may be defeated. The presence of DIF has also resulted in differential drop-out in schools, as the test items are proving difficult to the examinees, resulting in failure not because of their ability to

answer the items correctly, but rather because of the unfairness of the test, it have resulted in many students withdrawing from school. Odili (2010) reported that interest in the study of differential item functioning in tests stems from the fact that education is perceived as an instrument for achieving equality among individuals. In order to meet these requirements, test items should measure characteristics that are taught in schools. Examinees are failing as a result of the unfairness of the test items, rather than as a result of their ability to answer the questions correctly, resulting in their dropping out. As a result of school dropouts, there seems to be an increase in criminal activity and vices in the community. As reported by the Bureau of Labor Statistics, high school dropouts are having a more difficult time finding and maintaining employment than individuals with higher levels of educational attainment In fact, the national unemployment rate for high school dropouts was 15.4 percent in July 2009, while the rate for high school graduates was 9.4 percent (Bureau of Labor Statistics 2009). This statistic is used to demonstrate the impact of a test that is performing differently.

Students and pupils are not given equal opportunities because of inequalities in educational opportunities, increased class differentiation, and differential drop out, which results in distinct crimes and vices by students who are not in school. Therefore, items on the examinations should be equally fair to all segments of the population, as a result of this conclusion. In order for the test items to be fair to all groups of equal ability, there should be nothing in the test items that would favor one group over another group of equal ability.

Atar (2016) posited that it is critical that test items do not discriminate among examinees based on their gender, race, or ethnic background, but rather that they differentiate between them based on their abilities. In order to be considered fair, a test must be comparable, valid for all groups and individuals, and it must provide all examinees with an equal opportunity to demonstrate the abilities and knowledge that are relevant to the test's goal. The presence of a large number of items with DIF poses a serious threat to the validity of a test, and any inference drawn from test scores with DIF may not be supported by evidence.

Gender refers to specific central patterns of behaviour and mechanism that can be attributed to both males and females in terms of behaviour (Okoro, 2011). It refers to the psychological and socio-cultural interpretation of male and female gender roles and behaviors. In the socio-cultural interpretation of male and female, the expected role, contributions, and assigned duties of each are taken into consideration (Ija, 2009). Gender performance on test items could contain differential item functioning, regardless of whether the test was intended for categorization, admission, recruitment, or placement purposes among male and female students. A gender biased test item in mathematics is an item that may likely favour one gender over the other.

Another variable that could be a source of DIF is socio-economic status (SES). Socio-Economic Status (SES) refers to the ranking of a people in the society based on values such as education, wealth and occupation. Based on these, persons are rated as high SES, middle SES and low SES. Studies by Mcgregor as cited in Osadebe (2018), showed that the performance of students in mathematics competence is influenced by the ranking of the parents' social economic status (SES). Thus children from high and middle SES have higher mathematics competence compared with those children from low SES. According to Alordiah (2015), socio-economic status (SES) is the way in which people are divided into groups in a society so that they may share certain economic or social characteristics in common, rather than the way in which they are divided into groups for other reasons. When it comes to families, the socio-economic status is usually determined by the family's income,

the educational level of their parents, their occupational status as well as their social status. High expectations are said to be associated with the socio-economic status of one's parents.

Students' location refers to the environment where the child lived to learn mathematics as a compulsory subject. Jessa (2021) stated that students' location affects their mathematics and other subjects competence. If a child grows up in an urban environment, his or her academic achievement will be significantly higher than the child that grows up in a less desirable environment (Ndifon, Umoinyang & Idiku, 2013). When compared to their rural counterparts, urban areas have better learning facilities, more qualified teachers, better roads, and better communication networks, which put them in a better position when compared to their rural counterparts, who have insufficient or non-existent learning opportunities. Mathematical items in the 1986 Common Entrance Examination were investigated by Iyang as cited in Jessa (2021), who discovered that they did exhibit location DIF.

The type of school a child attends whether single-sex school or mixed-sex school has the potential to have a significant impact on his or her academic performance. Single sex student that attended single-sex schools are more likely than not to be surrounded by other people of their own gender when they are in elementary, secondary, or postsecondary school, according to the American Association of University Women. Mixed-sex education is education in which both male and female students received knowledge or skill with either only male or female students. Allison (2014) compared the performance of single and mixed school students in a published meta-analysis achievement test and discovered that DIF was present among the items used

Public and private school ownership are both types of school ownership. Private schools, on the other hand, are owned and founded and funded by individuals or organizations, whereas public schools are owned and funded by the government. Private schools, according to research, outperform their public counterparts in terms of academic achievement. Ogbebor and onuka (2013) carried out a study on differential item functioning method as an item bias indicator. They showed that the items in relation to private and public school using logistic regression method in SPSS version 18, DIF occur in 10 items out of 60 test items used by NECO

There are various examination bodies in Nigeria that cater for examinee needs irrespective of disability, religious and background in public examination such as National Business and Technical Examination Board (NABTEB), National Examination Council (NECO), West Africa Examination Council (WAEC). It has been claimed that some of the national examinations differentially function among some groups e.g., cultural or linguistics groups to the extent that is now believed that a particular section of the country perform most woefully in these national examination (Emaikwu, 2012). A careful look at the perception of people on such nation examination in Nigeria showed the serious nature of DIF. When different attributes are being measured as in an item, the issue of test bias enters into consideration if such item is administered to two different groups and the responses of one of the groups are depended on the secondary skill. This type of items measures different types of skills among different groups. If the test makes the individual of one group look worse than their attainment, that test is bias against that group. According to Emaikwu (2012), examination bodies often carry out empirical verification for detecting biased items in their respective examination in order to redeem and exclude items found to be biased so that all the testees can be assured of equity in the examination and also to ensure that the ability of testees are reliably assessed. examination bodies are expected to construct test items in such a way that test items are free from writing errors such as wordiness, irrelevancy, offensiveness,

and excessive stimulation, so that when an inadequacy exists between groups of examination item scores, the disparity will be attributed to true differences in whatever the test supposed to measure in the testees (Dibu-Ojerinde in Umoinyang, 2011). In Nigeria, particularly Delta Central Senatorial District who participated in the examination conducted by WAEC and other standardized examination or test in mathematics objectives are from different background and race and therefore performed differently for personal and environmental reasons in the subject. As a result of this, the problem of differential item functioning in test items cannot be over ruled in these examinations in regard to mathematics objective test. In line with this, the study is aimed at assessing differential item functioning in mathematics multiple choice test questions in senior secondary school certificate examination in Delta Central Senatorial District of Delta State

Statement of the Problem

Students' performance in various school subjects over the years in both teacher-made and standardized test in mathematics has been on the steady decline and not very accepted. This problem has created worry among education stakeholders across the state and researchers are delving seriously to finding solution to the problem of this downward performance in the subject. It is not categorically known if this problem of low or unsuccessful performance among mathematics students in secondary schools is due to the difficulty of students learning ability, teaching inefficiency. The problem of underachievement in mathematics at the WAEC/SSCE has persisted despite research efforts in improving the performance of students in various subject particularly mathematics. Tests that have differentially functioning items in mathematics can distort the meaning of test results and the decision that is based on it for some groups. Tests that contained differential functioning items in mathematics cannot be used in achieving the goals of a stable educational objectives and the mathematics curriculum, rather, they will give rise to school drop-out who will eventually become serious social or media and political problems in the society. The problem of differential item functioning may be attributed to complexity in the use of English language to phrase mathematics test items (Odili, 2014). The problem of this study is put in question form; what are the items in mathematics test used by West African Examinations Council in the Senior School Certificate Examination that differentially function for candidates with the same level of understanding or ability in mathematics from different socio-economic status, urban and rural schools, school type and students' gender such that they influence the undeserved poor achievement in the subject?

Research Questions

The following research questions guided this study:

1. What items of the WASSCE/SSCE 2021 mathematics multiple choice test questions function differentially between male and female?
2. What items of the WASSCE/SSCE 2021 mathematics multiple choice test questions function differentially between high and low socio-economic Status (SES)?
3. What items of the WASSCE/SSCE 2021 mathematics multiple choice test questions function differentially between urban and rural location?
4. What items of the WASSCE/SSCE 2021mathematics multiple choice test questions function differentially between mixed and single schools?
5. What items of the WASSCE/SSCE 2021 mathematics multiple choice test questions function differentially between public and private?

Hypotheses

The under-listed hypotheses directed the study:

1. Items of the WAEC/SSCE 2021 mathematics multiple choice test questions do not significantly function differentially between male and female testees.
2. Items of the WAEC/SSCE 2021 mathematics multiple choice test questions do not significantly function differentially between high and low socio-economic status (SES) testees.
3. Items of the WAEC/SSCE 2021 mathematics multiple choice test questions do not significantly function differentially between urban and rural testees.
4. Items of the WAEC/SSCE 2021 mathematics multiple choice test questions do not significantly function differentially between mixed and single school testees.
5. Items of the WAEC/SSCE 2021 mathematics multiple choice test questions do not significantly function differentially between public and private testees.

Purpose of the study

The purpose of the study was to assess differential item functioning in mathematics multiple choice test questions in senior secondary school certificate examination in Delta Central Senatorial District of Delta State. In specific terms, the study:

1. examined the items in WAEC/SSCE 2021 mathematics multiple choice test questions that differentially function between male and female testees;
2. ascertained the items in WAEC/SSCE 2021 mathematics multiple choice test questions that differentially function between high and low SES testees;
3. find out the items in WAEC/SSCE 2021 mathematics multiple choice test questions that differentially function between urban and rural testees;
4. evaluated the items in WAEC/SSCE 2021 mathematics multiple choice test questions that differentially function between mixed and single school testees;
5. ascertained the items in WAEC/SSCE 2021 mathematics multiple choice test questions that differentially function between public and private school testees.

Significance of the study

The outcome of this study will be beneficial in many to examination conducting bodies, research organizations, government and teachers.

Findings from this study will be useful to public examination bodies like West Africa Examinations Council, National Examination Council (NECO), National Business and Technical Education Board (NABTEB), Joint Admissions and Matriculation Board (JAMB), National Teacher Institute (NTI), among others in prescribing guidelines that will enable test developers to write test items that are free from DIF and items that are unidimensional in the measurement of learning outcome.

These findings will open a new vista to the wall of research institutions. The findings will provide theoretical and empirical foundations upon which other studies will be based.

Teachers will practically benefit from the study, knowledge of DIF will guide test developers and teachers in teaching and evaluation process. Development of guide lines for designer of test so that future items or test can be answerable by all testees within and outside the classroom settings.

Finally, result of this study will be of great benefits to government and other ranking education agencies that will use test for classification, certification and selection of candidates for admission into higher school and employment.

Scope and Delimitation of the study

The study is set to assess differential item functioning in mathematics multiple choice test items in senior secondary school certificate examination in Delta Central Senatorial District of Delta State in relation to male and female, high and low SES (socio-economic status), urban and rural geographical location, mixed and single schools, public and private schools. The study covered only mathematics multiple choice questions used by WAEC/SSCE of 2021. The study was concerned only with test items that differentially function among examinees in SS 3 with respect to SES, location, gender, private and public, schools, and school type.

Research Method and Procedure

Ex-post-facto research design is adopted for the study. Ex-post-facto research design is a design that involves the collection of past data. Students' performance or ability will be determined with respect to male and female, high and low SES, single and mixed schools, public and private schools. The dependent variable is the DIF of students' ability in mathematics while the independent variables include gender, SES, location, school type and school ownership. The population of the study comprises of 15,170 senior secondary three (SS3) students in secondary schools in the Eight Local Government Area of Delta Central Senatorial at as the time of the study.

The sample size of the study is 375 in accordance with Krejcies and Morgan (2006). In Krejcies and Morgan statistical table the sample size of a population of about 15000 is 375. This is adequate for .05 confidence level. This statistical table was used to make sure that a controllable sample size from the population of the study. The sampled population is students who are in SS3 from the schools in Delta Central Senatorial District. A proportionate stratified random sampling technique based on location (urban/rural) was used to draw the sample for the study. Using the stratification, nine (9) schools which constitute 8% of the entire schools in urban area was selected and ten (10) schools which constitute 8% of the entire schools in rural area was selected making a total 15 schools that was selected. Simple random sampling techniques was then used to select 25 students from the selected schools. The research instrument that was used for the study in data collection is 2021 WAEC Mathematics multiple choice test question and SES Questionnaire. The mathematics multiple choice test question is a 50 items question that covered the WASSCE mathematics syllabus of Senior Secondary School in Delta State. The SES questionnaire has 15 items on a 4-point scale Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). In order to ensure the validity of the instrument, the mathematics multiple choice test items were examined to know whether they cover the mathematics syllabus for SSS3 and it was found to be so as shown in table of specification. Content validity for the SES questionnaire was established by ensuring that the classification of students into high and low SES. To ensure the further validity of the SES questionnaire, content and face validity was also established by the researcher's supervisor and two experts in the Guidance and Counseling Department. The reliability of the instruments was carried out with Kuder-Richardson. The instrument was administered to group of 35 senior secondary school students offering mathematics in SS3 from Delta North Senatorial District. The students' responses were used to estimate coefficient of internal consistency using Kuder-Richardson (KR- 20) approach for the instruments which resulted in 0.83 making it suitable for the study. The reliability for SES questionnaire was also established using Cronbach Alpha. A value of 0.67 was obtained. Mathematics multiple choice test items was used to collect data from the sample population. Mathematics teachers in school visited helped to assist in the administration of the test instrument. The test was administered within the limited time as specified the examination body. The correct response for an item was assigned 1 and not correct response was assigned

0. The SES questionnaire has 4-point scale Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). The maximum score of the SES questionnaire is 80 while the minimum score is 20 when all the items are attempted to. The student with 41 and above was said to have a high SES and student with 40 and below was said to have a low SES. The method used for the data analysis is Logistics Regression model. The techniques were necessary for the fact that the response to the framed research questions are 0 or 1 and Chi-square was used to test the hypotheses at significance level of .05 of confidence

Results and Discussion of Findings

Analysis of Research Questions

Research Question One: What items of the WASSCE/SSCE 2021 mathematics multiple choice test questions function differentially between male and female?

Table One: Logistic Regression analysis to detect items of the WASSCE/SSCE 2021 mathematics multiple choice test questions that function differentially between male and female examinee.

					95% C.I. for EXP(B)	
Items	B	S.E.	Sig.	Exp(B)	Lower	Upper
1	.109	.156	.484	1.115	.822	1.514
2	.612	.163	.000	1.845	1.340	2.540
3	.482	.160	.003	1.619	1.183	2.216
4	.482	.160	.003	1.619	1.183	2.216
5	.431	.159	.007	1.538	1.126	2.102
6	.431	.159	.007	1.538	1.126	2.102
7	.431	.159	.007	1.538	1.126	2.102
8	.0862	.170	.000	2.367	1.695	3.306
9	.891	.171	.000	2.437	1.742	3.411
10	.891	.171	.000	2.437	1.742	3.411
11	.891	.171	.000	2.437	1.742	3.411
12	.891	.171	.000	2.437	1.7	3.411
13	.891	.171	.000	2.437	1.742	3.411
14	.748	.167	.000	2.113	1.524	2.930
15	.748	.167	.000	2.113	1.524	2.930
16	.776	.168	.000	2.173	1.565	3.018
17	.776	.168	.000	2.173	1.565	3.018
18	.776	.168	.000	2.173	1.565	3.018
19	.776	.168	.000	2.173	1.565	3.018
20	.776	.168	.000	2.173	1.565	3.018
21	.776	.168	.000	2.173	1.565	3.018
22	.776	.168	.000	2.173	1.565	3.018
23	.776	.168	.000	2.173	1.565	3.018
24	.776	.168	.000	2.173	1.565	3.018
25	.776	.168	.000	2.173	1.565	3.018
26	.158	.156	.312	1.171	.862	1.590
27	-.012	.156	.938	.988	.728	1.341
28	-.036	.156	.815	.964	.711	1.308
29	-.134	.156	.392	.875	.644	1.188
30	-.134	.156	.392	.875	.644	1.188

31	-.085	.156	.586	.919	.677	1.247
32	-.109	.156	.484	.897	.660	1.217
33	-.085	.156	.586	.919	.677	1.247
34	-.085	.156	.586	.919	.677	1.247
35	-.207	.157	.186	.813	.598	1.105
36	.012	.156	.938	1.012	.746	1.373
37	.109	.156	.484	1.115	.822	1.514
38	.109	.156	.484	1.115	.822	1.514
39	.109	.156	.484	1.115	.822	1.514
40	.085	.156	.586	1.089	.802	1.477
41	.109	.156	.484	1.115	.822	1.514
42	.109	.156	.484	1.115	.822	1.514
43	.109	.156	.484	1.115	.822	1.514
44	.109	.156	.484	1.115	.822	1.514
45	.109	.156	.484	1.115	.822	1.514
46	.109	.156	.484	1.115	.822	1.514
47	.109	.156	.484	1.115	.822	1.514
48	.109	.156	.484	1.115	.822	1.514
49	.134	.156	.392	1.143	.842	1.552
50	.134	.156	.392	1.143	.842	1.552

0.05

From Table 1 shows the items in relation to gender of students (male and female), identified by logistic regression method using SPSS version 23. Out of fifty items in mathematics multiple choice test items questions DIF was present in 24 items. These items are item 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24 and item 25.

Research Question Two: What items of the WASSCE/SSCE 2021 mathematics multiple choice test questions function differentially between high and low socio-economic Status (SES)?

Table Two: Logistic Regression analysis to detect items of the WASSCE/SSCE 2021 mathematics multiple choice test questions that function differentially between high and low socio-economic Status (SES) examinees

					95% C.I. for EXP(B)	
Items	B	S.E.	Sig.	Exp(B)	Lower	Upper
1	.152	.123	.219	1.164	.914	1.483
2	-.383	.125	.002	1.467	1.148	1.876
3	.511	.127	.000	1.667	1.299	2.138
4	.305	.125	.014	1.357	1.063	1.732
5	-.543	.128	.000	1.722	1.341	2.211
6	-.560	.128	.000	1.750	1.362	2.249
7	-.543	.128	.000	1.722	1.341	2.211
8	1.224	.147	.000	3.400	2.550	4.534
9	1.335	.152	.000	3.800	2.823	5.114
10	1.245	.148	.000	3.475	2.601	4.642
11	1.335	.152	.000	3.800	2.823	5.114
12	1.335	.152	.000	3.800	2.823	5.114
13	1.335	.152	.000	3.800	2.823	5.114

14	.676	.130	.000	1.966	1.523	2.538
15	1.160	.144	.000	3.190	2.404	4.234
16	1.109	.143	.000	3.031	2.290	4.012
17	1.139	.144	.000	3.125	2.358	4.141
18	1.181	.145	.000	3.258	2.451	4.331
19	1.014	.140	.000	2.757	2.097	3.624
20	1.119	.143	.000	3.062	2.314	4.051
21	1.556	.162	.000	4.739	3.448	6.513
22	1.454	.157	.000	4.280	3.146	5.823
23	1.335	.152	.000	3.800	2.823	5.114
24	1.479	.158	.000	4.388	3.217	5.984
25	1.946	.186	.000	7.000	4.861	10.081
26	.352	.125	.005	1.422	1.113	1.817
27	.259	.124	.037	1.296	1.016	1.653
28	.244	.124	.049	1.276	1.001	1.627
29	.061	.123	.623	1.062	.835	1.353
30	.061	.123	.623	1.062	.835	1.353
31	.091	.123	.460	1.095	.860	1.394
32	.061	.123	.623	1.062	.835	1.353
33	-.091	.123	.460	1.095	.860	1.394
34	.091	.123	.460	1.095	.860	1.394
35	.030	.123	.806	1.031	.810	1.312
36	.259	.124	.037	1.296	1.016	1.653
37	.259	.124	.037	1.296	1.016	1.653
38	.305	.125	.014	1.357	1.063	1.732
39	-.305	.125	.014	1.357	1.063	1.732
40	-.321	.125	.010	1.378	1.080	1.760
41	.274	.124	.027	1.316	1.031	1.679
42	.321	.125	.010	1.378	1.080	1.760
43	.321	.125	.010	1.378	1.080	1.760
44	.321	.125	.010	1.378	1.080	1.760
45	.244	.124	.049	1.276	1.001	1.627
46	.244	.124	.049	1.276	1.001	1.627
47	.259	.124	.037	1.296	1.016	1.653
48	.259	.124	.845	12.296	1.111	1.564
49	.431	.126	.001	1.538	1.202	1.969
50	.383	.125	.002	1.467	1.148	1.876

0.05

From Table 2 shows the items in relation to socio-economic status of students (high and low) identified by logistic regression method using SPSS version 23. Out of fifty items in mathematics multiple choice test items questions DIF was present in 41 items. These items are item 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 49 and item 50.

Research Question Three: What items of the WASSCE/SSCE 2021 mathematics multiple choice test questions function differentially between urban and rural location?

Table Three: Logistic Regression analysis to detect items of the WASSCE/SSCE 2021 mathematics multiple choice test questions that function differentially urban and rural examinee

Items					95% C.I. for EXP(B)	
	B	S.E.	Sig.	Exp(B)	Lower	Upper
1	.163	.125	.192	1.176	.921	1.502
2	.447	.127	.000	1.564	1.219	2.008
3	2.594	.244	.000	13.389	8.294	21.614
4	.256	.125	.041	1.292	1.011	1.652
5	.480	.128	.000	1.616	1.258	2.076
6	.480	.128	.000	1.616	1.258	2.076
7	.447	.127	.000	1.564	1.219	2.008
8	1.114	.144	.000	3.047	2.297	4.041
9	5.553	1.002	.000	258.000	36.205	1838.524
10	1.156	.146	.000	3.177	2.388	4.227
11	1.381	.155	.000	3.981	2.937	5.395
12	1.114	.144	.000	3.047	2.297	4.041
13	2.328	.218	.000	10.261	6.687	15.744
14	.647	.131	.000	1.910	1.478	2.468
15	1.311	.152	.000	3.709	2.754	4.996
16	1.125	.145	.000	3.079	2.318	4.092
17	1.114	.144	.000	3.047	2.297	4.041
18	1.156	.146	.000	3.177	2.388	4.227
19	2.062	.197	.000	7.862	5.342	11.571
20	1.073	.143	.000	2.924	2.211	3.867
21	1.481	.160	.000	4.396	3.213	6.014
22	1.533	.163	.000	4.630	3.367	6.368
23	1.406	.156	.000	4.078	3.003	5.540
24	1.533	.163	.000	4.630	3.367	6.368
25	1.959	.189	.000	7.094	4.899	10.271
26	.335	.126	.008	1.398	1.092	1.790
27	.225	.125	.072	1.252	.980	1.600
28	.209	.125	.094	1.233	.965	1.575
29	.023	.124	.852	1.023	.802	1.306
30	.023	.124	.852	1.023	.802	1.306
31	.163	.125	.192	1.176	.921	1.502
32	.054	.124	.664	1.056	.827	1.347
33	.070	.124	.576	1.072	.840	1.368
34	.054	.124	.664	1.056	.827	1.347
35	.054	.124	.664	1.056	.827	1.347
36	.225	.125	.072	1.252	.980	1.600
37	.225	.125	.072	1.252	.980	1.600
38	.209	.125	.094	1.233	.965	1.575
39	.241	.125	.055	1.272	.995	1.626
40	.178	.125	.154	1.195	.936	1.526
41	.241	.125	.055	1.272	.995	1.626
42	.225	.125	.072	1.252	.980	1.600
43	.241	.125	.055	1.272	.995	1.626
44	.163	.125	.192	1.176	.921	1.502

45	.178	.125	.154	1.195	.936	1.526
46	.178	.125	.154	1.195	.936	1.526
47	.194	.125	.121	1.214	.950	1.550
48	.415	.127	.001	1.515	1.181	1.942
49	.194	.125	.121	1.214	.950	1.550
50	.351	.126	.005	1.421	1.109	1.819

0.05

Table 3 shows the items in relation to location of examinees (urban and rural) identified by logistic regression method using SPSS version 23. Out of fifty items in mathematics multiple choice test items questions DIF was present in 27 items. These items are item 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 48 and item 50.

Research Question Four: What items of the WASSCE/SSCE 2021 mathematics multiple choice test questions function differentially between mixed and single schools?

Table Four: Logistic Regression analysis to detect items of the WASSCE/SSCE 2021 mathematics multiple choice test questions that function differentially between mixed and single examinees.

					95% C.I. for EXP(B)	
Items	B	S.E.	Sig.	Exp(B)	Lower	Upper
1	.093	.216	.666	1.098	.719	1.676
2	.892	.237	.000	2.440	1.532	3.886
3	.949	.240	.000	2.583	1.613	4.138
4	.376	.219	.086	1.457	.948	2.240
5	.523	.223	.019	1.687	1.090	2.613
6	.523	.223	.019	1.687	1.090	2.613
7	.474	.222	.033	1.606	1.040	2.480
8	.676	.228	.003	1.966	1.257	3.073
9	21.203	4334.119	.996	16154748 65.823	.000	-.
10	.676	.228	.003	1.966	1.257	3.073
11	.892	.237	.000	2.440	1.532	3.886
12	.676	.228	.003	1.966	1.257	3.073
13	1.401	.271	.000	4.059	2.387	6.900
14	.234	.217	.282	1.263	.825	1.933
15	.782	.232	.001	2.185	1.386	3.446
16	.711	.231	.002	2.036	1.295	3.200
17	.728	.230	.002	2.071	1.319	3.252
18	.728	.230	.002	2.071	1.319	3.252
19	2.147	.352	.000	8.556	4.289	17.065
20	.624	.226	.006	1.867	1.198	2.908
21	1.068	.247	.000	2.909	1.792	4.722
22	1.008	.244	.000	2.739	1.699	4.416
23	1.068	.247	.000	2.909	1.792	4.722
24	1.920	.323	.000	6.818	3.621	12.838
25	.187	.217	.389	1.205	.788	1.843
26	-.093	.216	.666	.911	.597	1.391
27	-.093	.216	.666	.911	.597	1.391

28	-.093	.216	.666	.911	.597	1.391
29	-.093	.216	.666	.911	.597	1.391
30	-.047	.216	.829	.955	.625	1.457
31	-.140	.216	.518	.870	.569	1.328
32	-.047	.216	.829	.955	.625	1.457
33	-.093	.216	.666	.911	.597	1.391
34	-.234	.217	.282	.792	.517	1.212
35	.000	.216	1.000	1.000	.655	1.526
36	.140	.216	.518	1.150	.753	1.757
37	.093	.216	.666	1.098	.719	1.676
38	.140	.216	.518	1.150	.753	1.757
39	.047	.216	.829	1.048	.686	1.599
40	.140	.216	.518	1.150	.753	1.757
41	.093	.216	.666	1.098	.719	1.676
42	.140	.216	.518	1.150	.753	1.757
43	.187	.217	.389	1.205	.788	1.843
44	.234	.217	.282	1.263	.825	1.933
45	.187	.217	.389	1.205	.788	1.843
46	.234	.217	.282	1.263	.825	1.933
47	.676	.228	.003	1.966	1.257	3.073
48	.234	.217	.282	1.263	.825	1.933
49	.624	.226	.006	1.867	1.198	2.908
50	.892	.237	.000	2.440	1.532	3.886

0.05

Table 4 shows the items in relation to school type of examinees (mixes and single school) identified by logistic regression method using SPSS version 23. Out of fifty items in mathematics multiple choice test items questions DIF was present in 23 items. The items are 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 47, 49 and item 50.

Research Question Five: What items of the WASSCE/SSCE 2021 mathematics multiple choice test questions function differentially between public and private?

Table Five: Logistic Regression analysis to detect items of the WASSCE/SSCE 2021 mathematics multiple choice test questions that function differentially between public and private examinees.

Items	B	S.E.	Sig.	Exp(B)	95% C.I. for EXP(B) Lower	Upper
1	-.087	.187	.641	.917	.636	1.322
2	.786	.201	.000	2.194	1.480	3.255
3	2.466	.347	.000	11.778	5.964	23.259
4	.157	.187	.402	1.170	.811	1.688
5	.333	.189	.078	1.396	.964	2.022
6	.333	.189	.078	1.396	.964	2.022
7	.298	.189	.114	1.347	.931	1.949
8	.590	.195	.002	1.805	1.232	2.643
9	21.203	3748.014	.995	16154748 64.378	.000	-.
10	.667	.197	.001	1.949	1.325	2.867
11	.786	.201	.000	2.194	1.480	3.255

12	.515	.193	.007	1.674	1.148	2.443
13	1.499	.241	.000	4.476	2.789	7.184
14	.369	.190	.052	1.447	.998	2.098
15	.910	.206	.000	2.485	1.659	3.722
16	.868	.204	.000	2.382	1.596	3.556
17	.786	.201	.000	2.194	1.480	3.255
18	.786	.201	.000	2.194	1.480	3.255
19	2.466	.347	.000	11.778	5.964	23.259
20	.629	.196	.001	1.875	1.277	2.752
21	1.087	.215	.000	2.966	1.947	4.517
22	1.386	.233	.000	4.000	2.533	6.317
23	1.281	.226	.000	3.600	2.311	5.607
24	1.386	.233	.000	4.000	2.533	6.317
25	2.150	.305	.000	8.583	4.721	15.606
26	.405	.190	.033	1.500	1.033	2.178
27	.157	.187	.402	1.170	.811	1.688
28	.122	.187	.514	1.130	.783	1.629
29	-.017	.187	.926	.983	.682	1.416
30	-.017	.187	.926	.983	.682	1.416
31	.122	.187	.514	1.130	.783	1.629
32	.052	.187	.780	1.054	.731	1.519
33	.052	.187	.780	1.054	.731	1.519
34	.017	.187	.926	1.018	.706	1.467
35	-.122	.187	.514	.885	.614	1.277
36	.192	.187	.306	1.212	.839	1.749
37	.227	.188	.226	1.255	.869	1.813
38	.192	.187	.306	1.212	.839	1.749
39	.227	.188	.226	1.255	.869	1.813
40	.157	.187	.402	1.170	.811	1.688
41	.227	.188	.226	1.255	.869	1.813
42	.192	.187	.306	1.212	.839	1.749
43	.227	.188	.226	1.255	.869	1.813
44	.052	.187	.780	1.054	.731	1.519
45	.087	.187	.641	1.091	.757	1.573
46	.087	.187	.641	1.091	.757	1.573
47	.087	.187	.641	1.091	.757	1.573
48	.553	.194	.004	1.738	1.189	2.541
49	.122	.187	.514	1.130	.783	1.629
50	.553	.194	.004	1.738	1.189	2.541

0.05

Table 5 shows the items in relation to school ownership of examinees (public and private school) identified by logistic regression method using SPSS version 23. Out of fifty items in mathematics multiple choice test items questions DIF was present in 21 items. The items are 2, 3, 8, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 48, and item 50.

Testing of Hypotheses

Hypothesis One: Items of the WAEC/SSCE 2021 mathematics multiple choice test questions do not significantly function differentially between male and female testees.

Table six: chi-square Statistics for Gender DIF

Gender	DIF- Gender						
	Correct Items	incorrect items	Total	$x2$-cal	Df	$x2$-table	Decision
Male	12	13	25	0.08	1	3.84	Not significant
Female	12	13	25				
Total	24	26	50				

Table 6 shows a chi-square calculated value of 0.08 and a table value of 3.84. Testing the hypothesis at a level of 0.05, the table value is greater than the calculated value. Therefore, the null hypothesis is accepted. Hence items of WAEC/SSCE 2021 mathematics multiple choice test items do not significantly function differently between male and female students

Hypothesis Two: Items of the WAEC/SSCE 2021 mathematics multiple choice test questions do not significantly function differentially between high and low socio-economic status (SES) testees.

Table seven: chi-square Statistics for Socio-Economic Status DIF

SES	DIF- SES						
	Correct Items	incorrect items	Total	$x2$-cal	Df	$x2$-table	Decision
High	5	11	16	3.79	1	3.84	Not Significant
low	4	30	34				
Total	9	41	50				

Table eight shows a chi-square calculated value of 3.79 and a table value of 3.84. Testing the hypothesis at a level of 0.05, the table value is greater or equal to than the calculated value. Therefore, the null hypothesis is accepted. Hence items of WAEC/SSCE 2021 mathematics multiple choice test items do not significantly function differently between male and female students.

Hypothesis Three: Items of the WAEC/SSCE 2021 mathematics multiple choice test questions do not significantly function differentially between urban and rural testees..

Table Eight: chi-square Statistics for Location DIF

Location	DIF- Location						
	Correct Items	incorrect items	Total	$x2$-cal	Df	$x2$-table	Decision
Urban	15	12	27	3.76	1	3.84	Not Significant
Rural	8	15	23				
Total	23	27	50				

Table eight shows a chi-square calculated value of 3.76 and a table value of 3.84. Testing the hypothesis at a level of 0.05, the table value is equal or greater than the calculated value.

Therefore, the null hypothesis is accepted. Hence items of WAEC/SSCE 2021 mathematics multiple choice test items significantly function differently between male and female students.

Hypothesis four: Items of the WAEC/SSCE 2021 mathematics multiple choice test questions do not significantly function differentially between mixed and single school testees.

Table Nine: Chi-square Statistics for School Type DIF

School type	DIF- School type Correct Items	incorrect items	Total	$x2$-cal	Df	$x2$-table	Decision
Mixed	13	14	27	0.92	1	3.84	Not Significant
Single	14	9	23				
Total	27	23	50				

Table nine shows a chi-square calculated value of 0.92 and a table value of 3.84. Testing the hypothesis at a level of 0.05, the table value is greater than the calculated value. Therefore, the null hypothesis is accepted. Hence items of WAEC/SSCE 2021 mathematics multiple choice test items do not significantly function differently between mixed and single school students.

Hypothesis five: Items of the WAEC/SSCE 2021 mathematics multiple choice test questions do not significantly function differentially between public and private school testees.

Table ten: Chi-square Statistics for School Ownership DIF

School ownership	DIF- School owner Correct Items	incorrect items	Total	$x2$-cal	Df	$x2$-table	Decision
Mixed	10	11	21	1.8	1	3.84	Not Significant
Single	19	10	29				
Total	29	21	50				

Table nine shows a chi-square calculated value of 1.8 and a table value of 3.84. Testing the hypothesis at a level of 0.05, the table value is greater than the calculated value. Therefore, the null hypothesis is accepted. Hence items of WAEC/SSCE 2021 mathematics multiple choice test items significantly function differently between public and private school students.

Discussion of findings

The study assesses differential item functioning in mathematics multiple choice test questions in senior secondary school certificate examination in Delta Central Senatorial District of Delta State.

The analysis of the student's response to the first research question and hypothesis formulated to guide the study revealed that mathematics multiple choice test items used in 2021 DIF was present in 24 items. 12 items which are 3, 6, 9, 10, 11, 14, 15, 18, 19, 23, 24, and item 25 disfovoured male students while 12 items which are 2, 4, 5, 7, 8, 12, 13, 16, 17,

20, 21, and item 22 disfovoured female students. This implies that WAEC/SSCE 2021 mathematics multiple choice test items function differentially for male and female testees. The finding of this study is in line with research study by Abedalaziz (2010) who reported incidence of gender DIF in mathematics. The study also agreed with Amirian, Alavi and Fidalgo (2014) who detected gender DIF in a mathematics ability test.

Analysis of research question two and its hypothesis revealed that WAEC/SSCE mathematics multiple choice test items used in 2021 DIF was present in 41 items. 30 items which are 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 21, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 49 disfovoured low SES testees while 11 items which are 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, and item 28 disfovoured high SES testees. This implies that WAEC/SSCE 2021 mathematics multiple choice test items function differentially for high and low SES testees. This finding is in agreement with the findings of Alordiah (2015) who identified test items. The result of the study was also in line with Odili (2003) that give an idea about an evidence of the presence of SES differential item functioning items in WAEC/SSCE Biology paper2 for 1999-2001.

Analysis of research question three and its hypothesis revealed that WAEC/SSCE mathematics multiple choice test items used in 2021 DIF was present in 27 items. 12 items which are 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25 and item 26 disfovoured urban testees while 15 items which are 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 48 and item 50 disfovoured rural testees. This implies that WAEC/SSCE 2021 mathematics multiple choice test items function differentially for urban and rural testees. This finding is in agreement with the findings ofAgbure and Osadebe (2018) in their work showed that social studies BECE multiple choice test significantly function differently based on location (urban and rural) of testees.

Analysis of research question four and its hypothesis revealed that WAEC/SSCE mathematics multiple choice test items used in 2021 DIF was present in 23 items. 14 items which are 2, 3, 5, 6, 7, 8, 10, 11, 12, 13 24, 47, 49 and item 50 disfovoured mixed school of testees while 9 items which are 15, 16, 17, 18, 19, 20, 21, 22, and item 23 disfovoured single testees. This implies that WAEC/SSCE 2021 mathematics multiple choice test items function differentially for mixed and single school of testees. This result agrees with Pahlke, Hyde and Allison (2014) a meta-analysis comparing achievement and attitudes in single-sex versus mixed sex schools.

Finally, analysis of research question five and its hypothesis revealed that WAEC/SSCE mathematics multiple choice test items used in 2021 DIF was present in 21 items. 11 items which are 2, 3, 8, 10, 11, 12, 13, 15, 16, 17, and item 18 disfovoured public school testees while 10 items which are 19, 20, 21, 22, 23, 24, 25, 26, 48, and item 50 disfovoured private school testees. This implies that WAEC/SSCE 2021 mathematics multiple choice test items function differentially for public and private school of testees. This finding agrees with Enunwah (2014) that investigated differential item and group functions of secondary school students' achievement in mathematics. The differential group functioning contrast value between public and private schools under algebraic fractions and gradients has the same value of -0.06 which also implies that private schools have 6% advantage over their public school counterparts.

Conclusion

Based on the forgoing findings the following conclusions were made. There were presences of DIF gender, SES, location, school type and school ownership test items in mathematics

multiple choice questions for 2021. The study concluded that differential item functioning exist in 2021 in mathematics multiple choice test questions in senior secondary school certificate examination in Delta Central Senatorial District of Delta State.

Contribution to Knowledge

The study will contribute to knowledge in the following ways:

1. Study contributed to knowledge in that it provides data relating to DIF of dichotomous or polytomous test items for the benefit of educational management and assessment;
2. The study has opened a new route for students and examination bodies in the area of DIF which could be of great help in the management of assessment practices.
3. Study has identified gender, socio-economic status, location, and school type and school ownership as a factor of DIF among secondary school students.

Recommendations

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

i. Test experts and developers should explore the use of DIF approach to detect items that are bias in mathematics Assessment.

ii. Test experts and developer should explore the use of differential item functioning method, particularly the use of logistic regression statistic to detect uniform and non- uniform test items that are bias with regards to mathematics multiple questions.

iii. A study of this should be conducted to provide further empirical evidence on the validity of the method in detecting biased test items.

vi. Test designers should be trained and retrained on how to recognize DIF items and how to write DIF- items.

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