

ASSESSMENT OF DIFFERENTIAL ITEM FUNCTIONING IN PHYSICS MULTIPLE CHOICE USED BY WAEC AMONG SENIOR SECONDARY SCHOOL STUDENTS IN DELTA STATE

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ABSTRACT

The study assessed differential item functioning in the physics multiple choice used by WAEC among senior secondary school students in Delta State. The study assessed differential item functioning in the physics multiple choice used by WAEC among senior secondary school students in Delta State. Five research questions and five hypotheses guided the study. Ex-post facto research design was adopted for the study. The population of this study consisted of 46,759 SS3 public and private secondary students in Delta State. Multi-stage sampling was employed to select a sample of 1080 students. The instruments used for collecting data were the WAEC/SSCE 2018, 2019, and 2020 physics multiple choice items and the socio-economic status questionnaire. The instruments' validity and reliability were determined. Logistic regression (L-R) was employed to answer the research questions, while an independent Chi-square test was applied to test the hypotheses. The findings revealed that there was: (1) 40% level of differential function between high and low socio-economic status of students in the 2018 WAEC/SSCE physics multiple choice items in Delta State; (2) 40% level of differential function between public and private school students in the 2018 WAEC/SSCE physics multiple choice items in Delta State; (3) 86% level of differential function between high and low socio-economic status of students in the 2019 WAEC/SSCE physics multiple choice items in Delta State; (4) 82% level of differential function between public and private school students in the 2019 WAEC/SSCE physics multiple choice items in Delta State; and (5) 90% level of differential function between high and low socio-economic status of students in the 2020 WAEC/SSCE physics multiple choice items in Delta State. The study concluded that a level of differential item functioning exists in 2018, 2019, and 2020 in physics multiple choice items in the West Africa Examination Council/Senior Secondary School Certificate Examination in Delta State, according to SES and school ownership. Based on the findings and conclusion, it was recommended, among others, that WAEC and other examination bodies ensure that constructed physics multiple-choice test items accommodate all abilities, irrespective of students' socioeconomic status and ownership of their school.

Keywords: Senior Secondary School, Physics, Multiple Choice, Differential Item Functioning, Socioeconomic Status, Private And Public School.

INTRODUCTION

Secondary school, as the name suggests, is the level of education that children proceed to after they have completed primary school. It is a school that offers secondary education to children. The 6-3-3-4 education system in Nigeria requires students to spend six years in primary school, three years in junior secondary school and three years in senior secondary school, and four years in a tertiary institution. The nine years of the 9-3-4 system are made up of six years in primary school and three years in junior secondary school (Yahaya, 2019). Altogether, the students must spend a minimum period of six years in secondary school. During this period, students are expected to spend three years in junior secondary school and three years in senior secondary school. At the end of the first three years in senior secondary school, a student is expected to sit for Senior School Certificate Examination (SSCE) that qualifies such student to proceed to the tertiary institutions. The for Senior School Certificate Examination (SSCE) is therefore a summative examination taken by candidates at the end of three years. It is usually conducted by each the West Africa Examination Council(WAEC) across all the state of the federation.

One of the key subjects, specifically among the sciences, on which the Senior School Certificate Examination (SSCE) is based is physics. The problem of poor downward performance in physics has led to the violation of national goal of education that is supposed to provide equal opportunity for all citizens irrespective of location, background, religion among others (Osadebe, 2018). This was revealed in a statistic that shows the performance of students in senior secondary schools' examination that was conducted by the West Africa Examination Council (WAEC) in Nigeria from 2017 to 2020. According to the report only 25% of the students that sat for West Africa Senior Secondary certificate Examination in physics in 2017, 43% in 2018, 2019, and 51% in 2020 got at least credit pass in the subject while the rest failed (Okagbare, Ossai, & Osadebe, 2023). The dismal performance has no doubt, informed the present study to analyze the psychometric properties of physics multiple choice used by WAEC in the SSCE of 2018, 2019 and 2020.

The multiple choice test is a form of assessment in which students are asked to select the best possible answer out of the choices from a list. The multiple choice test format is the most frequently used in educational testing (Bontis, Hardie and Serenko, 2009). Popham (2016) notes that multiple choice is an efficient and effective way to assess a wide range of knowledge skills and aptitude. When done well, it allows broad and even deep coverage of content in relatively efficient manner. This means that test developers should have adequate knowledge of how to construct good test items. A multiple choice test items is expected to have optimal level of differential item functioning. The high level of failure among physics students in WASSCE could have been that the test measured different thing rather than their (students) ability in the subject. It is possible for an item in a test to function differently for test takers in subject and this is termed Differential item functioning (Ukwuiji, 2012).

Odili (2021) described differential item functioning as a phenomenon whereby students are performing differently in a test item that measures subject matter. A test item that is designed to measure constructs trait or subject-matter can differentially function for two students who are of the same subject level ability but from different subgroup of inhabitants of test takers. A test is said to function differently if its contents, procedures or uses of its results in a way becomes advantageous or disadvantageous to members of certain groups over others; especially if the basis of this differentiation is irrelevant to the test purpose (Karami et al, 2011).

Differential Item Functioning occurs if different sub-member of a group, who are of equal standing on the concept the test is designed to measure, display different probabilities of passing an item or of endorsing an item. In other words, DIF occurs when an item is not equally difficult or equally popular for groups that have been matched in terms of the concept being measured. There is a distinction between DIF and differences in the mean item performances of entire groups. If such a difference is due solely to a difference in the concept being measured, we are dealing with adverse impact (Ackerman, 2010). Differential item functioning analyses involve a judgment of the performances of subgroups that have been matched in terms of the relevant construct or concept and hence do not require equal test scores for the groups that are involved.

Differential item functioning (DIF) has been recognized to be caused by multi-dimensionality in an item of a test (Linn, Levine, Hastings & Wardrop, 1980). That is, that performance on a test items depends not only on the construct or trait of primary dimension but also on secondary dimension. Primary trait here referred to the target that the test item is meant to capture and the secondary trait is what the test item may not necessary captured. DIF results when different subgroups that are matched in terms of the primary traits differ in their standing on secondary traits, such as familiarity with the content in terms of which the items are formulated. DIF are directly affected by the test items in secondary dimensions or traits, stated differently, that measure different, additional aspects in different subgroups and this can be identified through statistical means (Penfield & Lam, 2013).

Enunwah (2014) posited that DIF has become a normal means to distinguish between the reference group and focal group. Reference group according to Enunwah are groups whose performance serves as the basis for comparison, and the focal group are groups whose performance is being compared against that of the reference group. Typically, the distinction between these groups has been based on demographic variables such as socio-economic status (high and low), sex (males and females) or race/ethnicity (Urhobo Vs Ijaw or Igbo and vise visa). In the case of tests translated from one language into another, the group membership variable of interest is language group. The development of DIF analyses in the United States of America (USA), the reference group typically was taken to be the majority group, or the group for which the test was originally intended. However, the designation of one group as the reference group and the other as the focal group is psychometrically an arbitrary decision. More properly, either group may serve as a point of reference for the other (Angoff, 2012).

A test that is simple for one student or group of students and difficult for other student or group of students of the same subject level, such a test cannot lead to the attainment of physics objectives or academic excellence of some students in physics. The differentiation of these test items among students or group of students could have been determined by Socio-economic status.

Socio-economic status of students is the rating of students according to occupation, education, income, wealth, experience, career, values among others. They could be divided or rated as high socio-economics, average socio-economic and button or low socio-economic status. Alordial (2015) described Socio-Economic Status (SES) as the division of people in society according to family's income, parental education level, parent's occupation and social status that are binded characteristically in common. Onyangwu (2018) reported SES as predictor of performance in test items.

The study of Alordial showed that test item differentially functions among examinees of high and low social-economics status students. Differential item functioning could also occur among public and secondary schools. Schools are owned and could be funded and founded either by various levels of government or private individual or cooperate bodies. Studies have revealed that private school candidates performed excellently above their mates in public counterpart. Osawe (2021) reported that there is an appreciable difference in test items performance in favour of private schools for JSS three students. To achieve the goal of equal opportunity for all citizens in Nigeria there is need to address the problem of differential items functioning in the field of measurement and evaluation and other field of studies (Okagbare, Ossai, .&Osadebe, 2023). This necessitated the study with priority to first identify the test items in physics multiple choice questions used by West Africa Examination Council (WAEC) that differentially function among secondary school students and secondly, to aim at identifying if SES among other factors in physics multiple choice test items used by WAEC/SSCE among secondary school students will possibly determine the problem of differential item functioning.

Statement of the Problem

The dismal performance of students in external examination in physics over the years calls for concern. Researchers have delved into finding solutions to this problem but more need to be done. It is not categorically known if the problem of low performance was due to the student's learning difficulty, teaching deficiency or inherent errors on the test items usually administered to students during examinations.

It is equally not certain whether the tests are appropriate for the level of candidates in terms of differential items function. Test result and its functions and purpose for groups could be weak when test items differentially function. This will of course hinder the Federal Government goal on education (FRN) since education is a tool to achieving oneness. This can only be achieved when test item responses are the same for all students irrespective of students' socioeconomic status. Tests with differential functioning items cannot be used to achieve any meaningful goal. The problem of differential item functioning may be attributed to difficulty in physics WAEC test items response (Okagbare, Ossai, & Osadebe, 2023). To the best of the researcher's knowledge no research has been carried out to find solution to the problem of poor performance of candidate in Senior School Certificate Examination in relation to the level of differential item functioning of physics multiple choice used by WAEC.

Thus problem of this study put in a question form is: What is the level of test items in physics multiple choice questions used by West African Examinations Council in the Senior School Certificate Examination (WASSCE/SSCE) that differentially function for examinees with the same physics ability from different high and low socio economics status of student such that they have a say to the poor academic performance in the subject matter?

Research Questions

The following research questions have been raised to guide the study.

1. What is the level of differential function between high and socio-economic status students in the 2018 WASSCE/SSCE physics multiple choice questions test items in Delta State?
2. What is the level of differential function between public and private school students in the 2018 WASSCE/SSCE physics multiple choice questions test items in Delta State?

3. What is the level of differential function between high and socio-economic status students in the 2019 WASSCE/SSCE physics multiple choice questions test items in Delta State?
4. What is the level of differential function between public and private school students in the 2019 WASSCE/SSCE physics multiple choice questions test items in Delta State?
5. What is the level of differential function between high and socio-economic status students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State?

Hypotheses

The following hypotheses were tested at 0.05 level of significance:

1. There would be no significant difference in the level of differential function between high and low socio-economic status students in 2018 WASSCE/SSCE physics multiple choice questions test items in Delta State.
2. There would be no significant difference in the level of differential function between public and private school students in the 2018 WASSCE/SSCE physics multiple choice questions test items in Delta State.
3. There would be no significant difference in the level of differential function between high and low socio-economic status students in 2019 WASSCE/SSCE physics multiple choice questions test items in Delta State.
4. There would be no significant difference in the level of differential function between public and private school students in the 2019 WASSCE/SSCE physics multiple choice questions test items in Delta State.
5. There would be no significant difference in the level of differential function between high and low socio-economic status students in 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State.

Research method

The study adopted casual-comparative design because the study is retrospective, data collection focuses on the past. In the *ex-postfacto*, the researcher has no control over the variables of interest and therefore cannot be manipulated. The population used for the study is 46,759 SS3 students in public and private owned secondary schools in all the twenty-five local government. The sample of this study consists of 1080 (540 public and 540 private) physics students drawn from both public and the government approved private secondary school. The study adopted the multi-stage sampling technique consisting of Stratified Random Sampling Technique (SRST) and simple Simple Random Sampling Technique (SRST) by balloting (Okagbare, Ossai & Osadebe, 2023).

Four research instruments were used for the collection of data. They are WASSCE physics paper 2 questions, used in the year 2018, 2019 and 2020 examinations with permission from ministry of education (Examine and Standard) Asaba. Each of the test instruments contains 50 multiple choice test questions constructed by the WASSCE while the fourth instrument is socio-economic status (SES) Questionnaire that was designed by the researcher. The SES questionnaire has 20 items on a 4-point scale Very High (VH), High (H), Low (L), and Very Low (VL).

They are WASSCE physics paper 2 questions was not subjected to any form of validation since that has been done by the examination body who originally construct the questions and administered it to candidate in year 2018, 2019 and 2020. The validity of the fourth instrument was established by 2 experts in Guidance and Counselling Department and the researcher's supervisors. These experts assessed the instruments for appropriateness and

suitability to the study, and their suggestions were effected for correction(s). The face and content validity for the SES questionnaire was established by ensuring the classification of students into high and low SES.

In cognizant of the fact that WASSCE is a standardized testing body, the researcher presumed that the test items are reliable and WASSCE test items in physics were not subjected to further reliability test since the tests items had been standardized by physics experts. However the researcher made effort to obtain the psychometric properties of the the tests but was unable to get them. This made the researcher to carried out the reliability of the instruments in Anambra State.

Using Kuder-Richardson method, the instruments were administered to 50 groups of public and private secondary school students offering physics in certificate classes in Anambra State. Reliability of the test was established using the Kuder - Richardson method. This was to obtain an index of internal consistency of the test items. A value of 0.54, 0.6 and 0.699 was obtained for test papers used in 2018, 2019 and 2020 examination year respectively. The reliability of the fourth instrument was also done. The Socio economic status (SES) questionnaire was administered to the same group of students in Anambra state immediately after the test instruments have been answered by an examiner. The results obtained were subjected to analysis using Cronbach Alpha and a value of 0.77 was obtained. In order to collect data for the study, Physics teachers in schools visited helped as research assistant in the administration and invigilation of the test instruments. The test was administered within the limited time as specified the examination body. The correct response for an item was assigned 1 and incorrect response was assigned 0. The SES questionnaire has 4-point scale of Very High (VH), High (H), Low (L), and Very Low (VL). The maximum score of the SES questionnaire is 80 while the minimum score is 20 when all the items are attempted to. The candidate that fall within 40 and above was said to have a high SES and student with below 40 was grouped as low SES.

The responses of the students on the tests instrument was scored and entered in the computer for the purpose of analysis. The method used to analysis the data is binary Logistic Regression (L-R) model. This method was appropriate because the outcome of the examinees ability on the tests items is dichotomizes (1 or 0). The technique is to answer the research questions and Independence Chi-square was used to test the stated hypotheses in SPSS version 23 at 0.05 levels of significance.

PRESENTATION AND DISCUSSION OF RESULTS

Research Question 1: What is the level of differential function between high and socio-economic status students in the 2018 WASSCE/SSCE physics multiple choice questions test items in Delta State?

Table 1: Logistic Regression analysis to detect items of the 2018 WASSCE/SSCE physics multiple choice test item that differential function between high and low students.

TEST ITEMS	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
1	-.079	.040	3.820	1	.051	.924	.854	1.000
2	.206	.041	25.329	1	.000	1.229	1.134	1.332
3	.598	.194	350.057	1	.366	1.819	1.244	2.661
4	.427	.043	97.315	1	.000	1.533	1.408	1.669
5	-6.429	1.000	41.363	1	.000	.002	.000	.011
6	-.019	.040	.215	1	.643	.981	.907	1.062
7	.452	.044	107.092	1	.000	1.571	1.442	1.711
8	.366	.043	74.272	1	.000	1.443	1.327	1.568
9	.694	.048	207.849	1	.000	2.002	1.821	2.200
10	.030	.123	187.313	1	.806	1.031	.810	1.312
11	1.906	.096	394.808	1	.000	6.727	5.574	8.119
12	3.401	.216	247.194	1	.000	29.984	19.624	45.815
13	.532	.045	140.236	1	.000	1.703	1.559	1.859
14	.502	.044	127.728	1	.000	1.652	1.515	1.803
15	.309	.042	54.302	1	.000	1.362	1.254	1.478
16	.117	.041	8.285	1	.004	1.124	1.038	1.217
17	.242	.041	34.369	1	.000	1.274	1.175	1.381
18	.407	.043	89.343	1	.000	1.502	1.380	1.634
19	-.192	.041	22.056	1	.000	.825	.761	.894
20	.259	.041	39.133	1	.000	1.296	1.195	1.405
21	-.188	.041	21.125	1	.000	.829	.765	.898
22	-.079	.040	3.820	1	.051	.924	.854	1.000
23	-.336	.042	63.466	1	.000	.715	.658	.776
24	.110	.041	7.387	1	.007	1.116	1.031	1.209
25	.331	.042	61.638	1	.000	1.392	1.282	1.512
26	.055	.040	1.824	1	.177	1.056	.976	1.143
27	.220	.041	28.617	1	.000	1.246	1.150	1.351
28	.414	.043	92.209	1	.000	1.513	1.390	1.647
29	.099	.040	5.938	1	.015	1.104	1.019	1.195
30	.123	.041	9.235	1	.002	1.131	1.045	1.225
31	.158	.041	15.047	1	.000	1.171	1.081	1.269
32	.155	.041	14.433	1	.000	1.167	1.078	1.264
33	.315	.042	56.299	1	.000	1.370	1.262	1.487
34	.196	.041	22.990	1	.000	1.217	1.123	1.319
35	.188	.041	21.125	1	.000	1.207	1.114	1.308
36	.161	.041	15.672	1	.000	1.175	1.085	1.273
37	.150	.041	13.537	1	.000	1.162	1.072	1.258
38	.278	.042	44.707	1	.000	1.321	1.217	1.433
39	.251	.041	36.714	1	.000	1.285	1.185	1.393
40	.446	.044	104.802	1	.000	1.562	1.434	1.701
41	.278	.042	44.707	1	.000	1.321	1.217	1.433
42	.292	.042	48.978	1	.000	1.339	1.234	1.453
43	.278	.042	44.707	1	.000	1.321	1.217	1.433
44	-.068	.040	2.798	1	.094	.935	.863	1.012

45	.059	.040	2.165	1	.141	1.061	.980	1.149
46	.038	.040	.898	1	.343	1.039	.960	1.124
47	-.122	.041	8.992	1	.003	.885	.818	.959
48	-.218	.041	28.196	1	.000	.804	.742	.871
49	-.180	.041	19.336	1	.000	.836	.771	.905
50	-.047	.216	7.171	1	.829	.955	1.030	1.407
0.05								

Table 1 shows the items that relate to socio-economic status of students (high and low), identified by logistic regression method using SPSS version 23. Out of fifty items in physics multiple choice test items DIF was present in 40 items. These items are item 2, 4, 5, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 47, 48 and item 49. Therefore the level of differential function between high and low socio-economic status of students in the 2018 WASSCE/SSCE physics multiple choice items is 80% high. That is 30% of 15 items disfavoured high socio-economic status of students while 50% of 25 items disfavoured low socio-economic status of students or examinees.

Hypothesis 1: There would be no significant difference in the level of differential function between high and low socio-economic status students in 2018 WASSCE/SSCE physics multiple choice questions test items in Delta State.

Table 2: test of chi-square Statistics showing DIF SES for 2018

SES	SES- DIF		Total	X^2 value	Df	sig	Decision
	Non-DIF item	DIF items					
High SES	6	15	21	82.431	1	28.990	Not significant
Low SES	4	25	29				
Total	10	40	50				

0.05

Table 2 shows a chi-square value of 82.431 and a P-value of 28.990. Using 0.05 to test at an alpha level, the p-value of 28.990 is greater than the alpha level of 0.05. Hence, the null hypothesis is therefore acknowledged. As a result, no significant in the level of differential function between high and low socio-economic status students in 2018 WASSCE/SSCE physics multiple choice questions test items.

Research Question 2: What is the level of differential function between public and private school students in the 2018 WASSCE/SSCE physics multiple choice questions test items in Delta State?

Table 3: Logistic Regression analysis to detect items of the 2018 WASSCE/SSCE physics multiple choice test item that differentially function between public and private school students.

TEST ITEMS	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
1	-.405	.088	21.306	1	.000	.667	.561	.792
2	.163	.086	3.577	1	.059	1.177	.994	1.395
3	-.571	.090	40.555	1	.000	.565	.474	.674
4	.223	.087	6.639	1	.010	1.250	1.055	1.481
5	-1.506	.112	182.013	1	.000	.222	.178	.276
6	.186	.086	4.616	1	.032	1.204	1.016	1.426
7	.314	.087	12.960	1	.000	1.368	1.154	1.623
8	.329	.087	14.212	1	.000	1.389	1.171	1.648
9	.251	.457	198.693	1	.000	5.207	4.139	6.550
10	1.692	.119	202.995	1	.138	2.702	.401	1.418
11	2.079	.137	230.617	1	.000	8.000	6.117	10.463
12	-.234	.230	231.255	1	0.158	.229	.614	.198
13	1.840	.125	216.230	1	.000	6.297	4.928	8.048
14	.769	.093	69.124	1	.000	2.158	1.800	2.587
15	.399	.041	94.362	1	.000	1.491	1.375	1.616
16	.227	.039	33.294	1	.000	1.255	1.162	1.355
17	.244	.039	38.235	1	.000	1.276	1.181	1.379
18	.234	.217	1.158	1	.282	1.263	.825	1.933
19	.016	.057	.081	1	.777	1.016	.909	1.136
20	.121	.156	.602	1	.438	1.128	.832	1.530
21	.154	.039	15.613	1	.000	1.166	1.080	1.258
22	-.091	.039	5.500	1	.019	.913	.847	.985
23	-.104	.039	7.237	1	.007	.901	.835	.972
24	-.442	.042	112.443	1	.000	.643	.592	.697
25	.219	.039	31.155	1	.000	1.245	1.153	1.345
26	.432	.042	107.987	1	.000	1.540	1.419	1.670
27	.207	.039	27.875	1	.000	1.230	1.139	1.328
28	.371	.041	82.826	1	.000	1.449	1.338	1.569
29	.676	.046	216.378	1	.000	1.966	1.797	2.152
30	.195	.039	24.771	1	.000	1.215	1.125	1.312
31	.296	.040	54.970	1	.000	1.344	1.243	1.454
32	.236	.039	35.949	1	.000	1.266	1.172	1.368
33	.235	.039	35.500	1	.000	1.265	1.171	1.366
34	.236	.039	35.949	1	.000	1.266	1.172	1.368
35	.268	.040	45.492	1	.000	1.307	1.209	1.412
36	.291	.040	53.333	1	.000	1.338	1.237	1.447
37	.204	.039	27.083	1	.000	1.226	1.135	1.324
38	.192	.039	24.023	1	.000	1.211	1.122	1.308
39	.315	.040	61.744	1	.000	1.371	1.267	1.483
40	.268	.040	45.492	1	.000	1.307	1.209	1.412
41	.609	.045	186.643	1	.000	1.838	1.684	2.005
42	.310	.040	60.017	1	.000	1.364	1.261	1.475
43	.353	.041	75.708	1	.000	1.423	1.314	1.540

44	.314	.040	61.166	1	.000	1.368	1.265	1.480
45	-.116	.039	8.979	1	.003	.890	.825	.961
46	.003	.038	.006	1	.939	1.003	.930	1.082
47	-.016	.038	.179	1	.672	.984	.912	1.061
48	-.238	.039	36.401	1	.000	.788	.730	.852
49	-.167	.039	18.438	1	.000	.846	.784	.913
50	-.170	.039	19.097	1	.000	.843	.781	.910
0.05								

Table 3 shows the items that relate to school of students (public and private school), identified by logistic regression method using SPSS version 23. Out of fifty items in physics multiple choice test items DIF was present in 42 items. These items are item 1, 3, 4,6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 48, 49 and item 50. Therefore, the level of differential function between urban and rural students in the 2018 WASSCE/SSCE physics multiple choice items is 84% high. That is 30% of 15 items disfavoured private students while 54% of 27 items disfavoured public students or examinees.

Hypothesis 2: There would be no significant difference in the level of differential function between public and private school students in the 2018 WASSCE/SSCE physics multiple choice questions test items in Delta State.

Table 4: test of chi-square Statistics showing DIF SCHOOL OWNERSHIP for 2018

SCHOOL OWN.	SCHOOL- DIF			X^2 value	Df	Sig.	Decision
	Non-DIF item	DIF items	Total				
Public school	2	27	29	1709.179	1	2.566	Not significant
Private school	6	15	21				
Total	8	42	50				

0.05

Table 4 shows a chi-square value of 1709.179 and a P-value of 2.566. Using 0.05 to test at an alpha level, the p-value of 2.566 at one degree of freedom is greater than the alpha level of 0.05. Hence, the null hypothesis is therefore acknowledged. As a result, no significant difference in the level of differential function between public and private school students in the 2018 WASSCE/SSCE physics multiple choice test items.

Research Question 3: What is the level of differential function between high and low socio-economic status of students in the 2019 WASSCE/SSCE physics multiple choice questions test items in Delta State?

Table 5: Logistic Regression analysis to detect items of the 2019 WASSCE/SSCE physics multiple choice test item that differentially function between high and low socio-economic status of students

TEST ITEMS	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
1	1.203	.095	159.029	1	.000	3.329	2.761	4.013
2	.042	.080	.273	1	.601	1.043	.891	1.221
3	.074	.080	.854	1	.355	1.077	.920	1.261
4	.048	.080	.363	1	.547	1.050	.897	1.229
5	-.023	.080	.079	1	.778	.978	.835	1.144
6	.471	.083	32.433	1	.000	1.601	1.362	1.882
7	.443	.082	28.965	1	.000	1.558	1.326	1.831
8	.652	.085	59.298	1	.000	1.920	1.626	2.266
9	.747	.086	75.335	1	.000	2.111	1.783	2.498
10	1.258	.097	168.816	1	.000	3.518	2.910	4.253
11	1.062	.092	133.345	1	.000	2.893	2.416	3.465
12	.667	.085	61.658	1	.000	1.948	1.649	2.300
13	.799	.087	84.615	1	.000	2.224	1.876	2.637
14	1.212	.096	160.657	1	.000	3.359	2.785	4.051
15	.588	.084	49.178	1	.000	1.801	1.528	2.123
16	.638	.085	56.977	1	.000	1.893	1.604	2.233
17	.837	.088	91.499	1	.000	2.310	1.946	2.743
18	.423	.082	26.486	1	.000	1.527	1.299	1.793
19	.740	.086	74.044	1	.000	2.095	1.770	2.479
20	.979	.090	117.837	1	.000	2.663	2.231	3.178
21	.923	.089	107.327	1	.000	2.517	2.114	2.997
22	.645	.085	58.132	1	.000	1.906	1.615	2.250
23	1.543	.106	213.832	1	.000	4.679	3.805	5.754
24	.029	.080	.131	1	.718	1.030	.879	1.205
25	.159	.081	3.871	1	.049	1.172	1.001	1.373
26	.923	.089	107.327	1	.000	2.517	2.114	2.997
27	.688	.085	65.274	1	.000	1.990	1.684	2.352
28	.845	.088	92.900	1	.000	2.328	1.960	2.764
29	.792	.087	83.263	1	.000	2.207	1.862	2.616
30	.955	.090	113.295	1	.000	2.599	2.180	3.099
31	1.140	.094	147.692	1	.000	3.127	2.602	3.758
32	1.671	.110	230.257	1	.000	5.316	4.284	6.597
33	1.315	.098	178.620	1	.000	3.725	3.072	4.518
34	.631	.084	55.832	1	.000	1.879	1.593	2.217
35	1.203	.095	159.029	1	.000	3.329	2.761	4.013
36	1.623	.108	224.427	1	.000	5.069	4.099	6.268
37	.732	.086	72.763	1	.000	2.080	1.758	2.461
38	.868	.088	97.150	1	.000	2.383	2.005	2.831
39	1.122	.093	144.478	1	.000	3.072	2.559	3.689
40	.595	.084	50.260	1	.000	1.814	1.538	2.138
41	1.184	.095	155.778	1	.000	3.269	2.714	3.937
42	1.478	.103	204.445	1	.000	4.383	3.579	5.367

43	1.258	.097	168.816	1	.000	3.518	2.910	4.253
44	.807	.087	85.975	1	.000	2.241	1.889	2.658
45	1.286	.098	173.719	1	.000	3.619	2.989	4.382
46	21.203	1615.492	.000	1	.990	1615474865.787	.000	.
47	.667	.085	61.658	1	.000	1.948	1.649	2.300
48	.963	.090	114.803	1	.000	2.620	2.197	3.125
49	-.087	.080	1.177	1	.278	.916	.783	1.073
50	6.426	1.001	41.233	1	.220	618.000	86.916	4394.186

Table 5 shows the items that relate to socio-economic status of students (high and low), identified by logistic regression method using SPSS version 23. Out of fifty items in physics multiple choice tests DIF was present in 42 items. These items are item 1, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 47, and 48 item. Therefore the level of differential function between high and low socio-economic status students in the 2019 WASSCE/SSCE physics multiple choice items is 84% high. That is 30% of 15 items disfavoured high socio-economic status students while 54% of 27 items disfavoured low socio-economic students or examinees.

Hypothesis 3: There would be no significant difference in the level of differential function between high and low socio-economic status students in 2019 WASSCE/SSCE physics multiple choice questions test items in Delta State.

Table 6: test of chi-square Statistics showing DIF SES FOR 2019

SES	SES- DIF		Total	X ² value	Df	Sig.	Decision
	Non-DIF item	DIF items					
High SES	5	15	27	96.176	1	20.576	Not significant
Low SES	3	27	23				
Total	8	42	50				

0.05

Table 6 shows a chi-square value of 96.176 and a P-value of 20.576. Using 0.05 to test at an alpha level, the p-value of 20.576 at one degree of freedom is greater than the alpha level of 0.05. Hence, the null hypothesis is therefore acknowledged. As a result, no significant difference in the level of differential function between high and low socio-economic status students in 2019 WASSCE/SSCE physics multiple choice questions test items.

Research Question 4: What is the level of differential function between public and private school students in the 2019 WASSCE/SSCE physics multiple choice questions test items in Delta State?

Table 7: Logistic Regression analysis to detect items of the 2019 WASSCE/SSCE physics multiple choice test item that differentially function between public and private school students

TEST ITEMS	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
1	1.296	.105	153.016	1	.000	3.655	2.977	4.488
2	.134	.086	2.396	1	.122	1.143	.965	1.353
3	.037	.086	.185	1	.667	1.038	.877	1.228
4	.329	.087	14.212	1	.000	1.389	1.171	1.648
5	.261	.087	9.023	1	.003	1.298	1.095	1.539
6	.089	.086	1.066	1	.302	1.093	.923	1.294
7	.336	.087	14.859	1	.000	1.400	1.180	1.661
8	.595	.090	43.762	1	.000	1.812	1.520	2.162
9	.595	.090	43.762	1	.000	1.812	1.520	2.162
10	1.021	.098	109.613	1	.000	2.776	2.293	3.361
11	.847	.094	81.411	1	.000	2.333	1.941	2.805
12	.555	.089	38.478	1	.000	1.741	1.461	2.075
13	.483	.089	29.757	1	.000	1.621	1.363	1.929
14	.892	.095	88.558	1	.000	2.439	2.026	2.937
15	.436	.088	24.527	1	.000	1.547	1.302	1.839
16	.452	.088	26.217	1	.000	1.571	1.322	1.868
17	.531	.089	35.457	1	.000	1.700	1.428	2.024
18	.367	.088	17.587	1	.000	1.443	1.216	1.714
19	.499	.089	31.605	1	.000	1.647	1.384	1.960
20	.635	.090	49.347	1	.120	1.888	1.581	2.254
21	.718	.092	61.382	1	.000	2.051	1.714	2.455
22	.491	.089	30.675	1	.000	1.634	1.373	1.944
23	1.221	.103	141.582	1	.000	3.390	2.773	4.145
24	.067	.086	.600	1	.439	1.069	.903	1.266
25	.261	.087	9.023	1	.003	1.298	1.095	1.539
26	1.421	.109	170.887	1	.000	4.143	3.348	5.127
27	.291	.087	11.188	1	.001	1.338	1.128	1.586
28	.352	.087	16.195	1	.000	1.422	1.198	1.687
29	.413	.088	22.091	1	.050	1.512	1.272	1.796
30	.531	.089	35.457	1	.000	1.700	1.428	2.024
31	.821	.093	77.230	1	.000	2.273	1.892	2.729
32	.137	.079	3.002	1	.083	1.147	.982	1.339
33	.974	.096	101.933	1	.000	2.649	2.192	3.200
34	.821	.093	77.230	1	.000	2.273	1.892	2.729
35	.761	.092	67.808	1	.000	2.140	1.785	2.564
36	-1.242	.103	144.846	1	.597	3.463	2.829	4.239
37	.563	.089	39.510	1	.000	1.755	1.473	2.092
38	.919	.095	92.947	1	.000	2.506	2.079	3.021
39	.821	.093	77.230	1	.000	2.273	1.892	2.729

40	.769	.093	69.124	1	.000	2.158	1.800	2.587
41	.821	.093	77.230	1	.000	2.273	1.892	2.729
42	1.285	.104	151.381	1	.000	3.615	2.946	4.437
43	.856	.094	82.823	1	.000	2.354	1.958	2.831
44	.710	.092	60.129	1	.000	2.034	1.700	2.433
45	.944	.096	96.808	1	.000	2.570	2.129	3.101
46	6.290	1.001	39.487	1	.000	539.000	75.788	3833.360
47	.965	.096	100.417	1	.000	2.624	2.173	3.169
48	1.296	.105	153.016	1	.000	3.655	2.977	4.488
49	-1.650	.117	198.693	1	.000	.192	.153	.242
50	21.203	1720.100	.000	1	.999	1615474	-	.000
						865.622		

Table 4 shows the items that relate to school of students (public and private), identified by logistic regression method using SPSS version 23. Out of fifty items in physics multiple choice tests DIF was present in 41 items. These items are item 1, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 25, 26, 27, 28, 30, 31, 33, 34, 35, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48 and 49 item. Therefore, the level of differential function between public and private school students in the 2019 WASSCE/SSCE physics multiple choice items is 82% high. That is 50% of 25 items disfavoured public school students while 32% of 16 items disfavoured private students or examinees.

Hypothesis 4: There would be no significant difference in the level of differential function between public and private school students in the 2019 WASSCE/SSCE physics multiple choice questions test items in Delta State.

Table 8: test of chi-square Statistics showing DIF SCHOOL OWNERSHIP for 2019

SCHOOL- DIF							
SCHOOL	Non-DIF item	DIF items	Total	χ^2 value	Df	Sig.	Decision
Public	3	25	28	1035.01	1	7.045	Not significant
Private	6	16	32				
Total	9	41	50				

0.05

Table sixteen shows a chi-square value of 1035.01 and a P-value of 7.045. Using 0.05 to test at an alpha level, the p-value of 7.045 at one degree of freedom is greater than the alpha level of 0.05. Hence, the null hypothesis is therefore acknowledged. As a result, no significant difference in the level of differential function between public and private school students in the 2019 WASSCE/SSCE physics multiple choice test items.

Research Question 5: What is the level of differential function between high and low socio-economic status students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State?

Table 9: Logistic Regression analysis to detect items of the 2020 WASSCE/SSCE physics multiple choice test item that differentially function between high and low socio-economic status of students

TEST ITEMS	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
1	.237	.041	32.997	1	.000	1.267	1.169	1.374
2	.139	.081	2.982	1	.084	1.149	.981	1.346
3	.947	.090	111.793	1	.000	2.578	2.163	3.073
4	.777	.087	80.585	1	.000	2.174	1.835	2.576
5	.792	.087	83.263	1	.000	2.207	1.862	2.616
6	.754	.086	76.634	1	.000	2.126	1.796	2.517
7	.892	.089	101.468	1	.000	2.439	2.050	2.901
8	1.114	.093	142.876	1	.000	3.046	2.537	3.656
9	1.565	.106	216.904	1	.000	4.785	3.885	5.893
10	1.394	.101	191.631	1	.000	4.033	3.310	4.913
11	.588	.084	49.178	1	.061	1.801	1.528	2.123
12	1.203	.095	159.029	1	.000	3.329	2.761	4.013
13	1.499	.104	207.600	1	.000	4.478	3.652	5.491
14	.777	.087	80.585	1	.000	2.174	1.835	2.576
15	.837	.088	91.499	1	.000	2.310	1.946	2.743
16	1.045	.092	130.203	1	.000	2.845	2.377	3.404
17	.602	.084	51.354	1	.000	1.826	1.549	2.154
18	1.184	.095	155.778	1	.000	3.269	2.714	3.937
19	1.510	.104	209.168	1	.000	4.527	3.689	5.555
20	1.405	.101	193.247	1	.000	4.074	3.342	4.966
21	.868	.088	97.150	1	.000	2.383	2.005	2.831
22	1.354	.100	185.141	1	.200	3.874	3.187	4.709
23	.646	.047	188.237	1	.080	1.908	1.740	2.093
24	.681	.085	64.059	1	.070	1.976	1.672	2.335
25	.988	.090	119.364	1	.000	2.685	2.249	3.205
26	.747	.086	75.335	1	.000	2.111	1.783	2.498
27	.574	.084	47.044	1	.000	1.776	1.507	2.092
28	.868	.088	97.150	1	.000	2.383	2.005	2.831
29	.762	.086	77.942	1	.000	2.142	1.809	2.537
30	.784	.087	81.920	1	.000	2.191	1.849	2.596
31	.696	.085	66.498	1	.000	2.005	1.696	2.370
32	.505	.083	37.025	1	.000	1.657	1.408	1.949
33	.505	.083	37.025	1	.000	1.657	1.408	1.949
34	.437	.082	28.127	1	.000	1.547	1.317	1.818
35	.667	.085	61.658	1	.000	1.948	1.649	2.300
36	.198	.081	5.992	1	.014	1.219	1.040	1.428
37	.437	.082	28.127	1	.000	1.547	1.317	1.818
38	.532	.083	40.900	1	.000	1.703	1.447	2.005

39	.617	.084	53.572	1	.000	1.853	1.571	2.185
40	.717	.086	70.229	1	.000	2.049	1.733	2.424
41	.822	.087	88.720	1	.000	2.275	1.917	2.700
42	.574	.084	47.044	1	.000	1.776	1.507	2.092
43	.792	.087	83.263	1	.000	2.207	1.862	2.616
44	.754	.086	76.634	1	.000	2.126	1.796	2.517
45	.717	.086	70.229	1	.000	2.049	1.733	2.424
46	.532	.083	40.900	1	.000	1.703	1.447	2.005
47	.588	.084	49.178	1	.000	1.801	1.528	2.123
48	.681	.085	64.059	1	.000	1.976	1.672	2.335
49	.703	.085	67.732	1	.000	2.020	1.708	2.387
50	.740	.086	74.044	1	.000	2.095	1.770	2.479
0.05								

Table 9 shows the items that relate to socio-economic status of students (high and low background), identified by logistic regression method using SPSS version 23. Out of fifty items in physics multiple choice tests DIF was present in 45 items. These items are item 1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 and 50 item. Therefore, the level of differential function between high and low socio-economic status of students in the 2020 WASSCE/SSCE physics multiple choice items is 90% high. That is 38% of 19 items disfavoured high socio-economic status of students while 52% of 26 items disfavoured low socio-economic status of students or examinees.

Hypothesis 5: There would be no significant difference in the level of differential function between high and low socio-economic status students in 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State.

Table 10: test of chi-square Statistics showing level of DIF SES for 2020

SES	Level of SES-DIF			χ^2 value	Df	Sig.	Decision
	Non-DIF item	DIF items	Total				
High SES	4	19	23	100.344	1	26.503	Not significant
Low SES	1	26	27				
Total	5	45	50				

0.05

Table twenty-two shows a chi-square value of 100.344 and a P-value of 26.503. Using 0.05 to test at an alpha level, the p-value of 26.503 at one degree of freedom is greater than the alpha level of 0.05. Hence, the null hypothesis is therefore acknowledged. As a result, no

significant difference in the level of differential function between high and low socio-economic status students in 2020 WASSCE/SSCE physics multiple choice test items

Discussion of Results

The study is an assessment of differential item functioning in physics multiple choice used by WAEC among senior secondary school students in Delta State.

Level of differential function between high and socio-economic status students in the 2018 WASSCE/SSCE physics multiple choice questions test items in Delta State

Data obtained from research question two and its hypothesis revealed that logistic regression model statistic detected 80% level of DIF in 40 items in 2018 WASSCE/SSCE physics multiple choice against high and low SES students. 30% of 15 items which are 2, 4, 7, 11, 12, 15, 16, 17, 18, 23, 25, 27, 33, 39, and item 49 disfavoured high students while 50% of 25 item which are 3, 5, 8, 9, 13, 14, 19, 20, 21, 22, 28, 29, 30, 31, 32, 34, 35, 36, 37, 38, 40, 41, 43, 47 and item 48 disfavoured low students. This implied that there is level of differential function between high and low socio-economic status of students in the 2018 WAEC/SSCE physics multiple choice test items. The finding of this study is in relation with study of the findings of Alordiah (2015) who identified SES DIF in test items. This study also agreed with Onyangwu (2018) who reported SES as predictor of performance in test items.

Level of differential function between public and private school students in the 2018 WASSCE/SSCE physics multiple choice questions test items in Delta State

Data obtained from research question four and its hypothesis revealed that logistic regression model statistic detected 84% level of DIF in 42 items in 2018 WASSCE/SSCE physics multiple choice against public and private students. 30% of 15 items which are 9, 7, 8, 11, 15, 16, 17, 23, 25, 27, 33, 35, 39, 38 and item 49 disfavoured private students while 54% of 27 item which are 1, 3, 4, 6, 5, 8, 9, 13, 14, 21, 22, 24, 26, 28, 29, 30, 31, 32, 36, 37, 40, 41, 42, 43, 44, 45, and item 50 disfavoured public students. This implied that there is level of differential function between public and private school students in the 2018 WAEC/SSCE physics multiple choice test items. This finding is in line with Enunwah (2014) that reported the investigation of 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 established schools have 6% advantage over their public established school counterparts.

Level of differential function between high and socio-economic status students in the 2019 WASSCE/SSCE physics multiple choice questions test items in Delta State

Data obtained from research question six and its hypothesis revealed that logistic regression model statistic detected 84% level of DIF in 42 items in 2019 WASSCE/SSCE physics multiple choice against high and low socio-economic status of students. 30% of 15 items which are 9, 7, 8, 11, 15, 16, 17, 23, 25, 27, 33, 35, 39, 38 and item 40 disfavoured high SES of students while 54% of 27 item which are 1, 6, 8, 9, 10, 13, 14, 18, 19, 20, 21, 22, 26, 28, 29, 30, 31, 32, 36, 37, 40, 41, 42, 43, 44, 45, and item 47 disfavoured low SES of students. This implied that there is level of differential function between high and low SES of students in the 2019 WAEC/SSCE physics multiple choice test items. This finding is in agreement with the findings of Agbure and Osadebe (2018), who reported in their research study that social studies BECE multiple choice test significantly function differently based on socio-economic status (high and low) of students.

Level of differential function between public and private students in the 2019 WASSCE/SSCE physics multiple choice questions test items in Delta State

Data obtained from research question eight and its hypothesis revealed that logistic regression model statistic detected 82% level of DIF in 41 items in 2019 WASSCE/SSCE physics multiple choice against public and private students. 50% of 25 items which are 1, 4, 8, 10, 11, 12, 13, 14, 15, 16, 19, 22, 25, 26, 27, 28, 33, 34, 37, 39, 40, 42, 43, 45 and item 48 disfavoured public students while 32% of 16 items which are 5, 7, 9, 17, 18, 21, 23, 24, 30, 31, 35, 38, 41, 44, 47, and item 49 disfavoured private students. This implied that there is level of differential function between public and private students in the 2019 WAEC/SSCE physics multiple choice test items. This finding is in line with the finding of Ogbebor and Onuka (2013), who found out that there were presences of school type and bias and DIF test items in NECO economics questions. This study also agreed with Osawe (2021) that reported appreciable difference in test items performance in favour of private schools in 1996 and 1998 for JSS three students.

Level of differential function between high and socio-economic status students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State

Data obtained from research question ten and its hypothesis revealed that logistic regression model statistic detected 90% level of DIF in 45 items in 2020 WASSCE/SSCE physics multiple choice against high and low SES of students. 38% of 19 items which are 1, 3, 6, 8, 15, 22, 25, 26, 27, 28, 33, 34, 39, 42, 43, 45, 48, 49 and item 50 disfavoured high socio-economic of students while 52% of 26 items which are 4, 5, 7, 9, 10, 12, 13, 14, 16, 17, 18, 19, 20, 24, 29, 30, 31, 32, 35, 36, 37, 38, 41, 44, 46, and item 47 disfavoured low socio-economic of students. This implied that there is level of differential function between high and low SES of students in the 2020 WAEC/SSCE physics multiple choice test items. This finding is in line with that of Agbure and Osadebe (2018) that showed social studies BECE multiple choice test significantly function differently between high and low socio-economic status of students. The findings is also in agreement with the findings of Karakaya (2020) who reported item bias in science and technology subtests and mathematics subtests in Level Determination Exam (LDE) among class of students.

Conclusion and Recommendations

The following conclusions were reached in light of the aforementioned findings: In 2018, 2019, and 2020 WAEC/SSCE physics multiple-choice questions, there were DIF SES and school ownership test items. The study found that senior secondary schools in Delta State's WAEC/SSCE physics multiple-choice exams in the years 2018, 2019, and 2020 had different levels of item functioning. Based on the findings and conclusion, the following recommendations are made:

1. WAEC and other Examination bodies should ensure that constructed physics multiple-choice test items accommodate all abilities, irrespective of students' socioeconomic status and ownership of their school.
2. Mock examinations should be encouraged by society (the government, parents, and teachers, among others) to enable examination bodies to remove test items that differentially function when composing the final test for use.
3. A similar study of this type should be investigated to provide further empirical evidence on the validity of the method for detecting DIF test items.

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