

# ASSESSMENT OF DIFFERENTIAL ITEM FUNCTIONING OF PHYSICS MULTIPLE CHOICE USED BY WAEC IN 2020 IN RELATION TO SEX, LOCATION AND SCHOOL OWNERSHIP IN DELTA STATE

BY

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## Abstract

The study investigated assessment of differential item functioning in physics multiple choice used by WAEC among senior secondary school students in Delta State. Twelve research questions and twelve hypotheses were formulated and tested with relevant data obtained. *Expo-facto* research design was adopted for the study. The sample of the study consists of 1080 (public and private) students drawn from the population of 46,759 which comprises of 38,092 students in public schools and 8,666 students in private schools in Delta State. Multi-stage sampling technique using stratified random sampling technique and simple random sampling were employed in composing the sample for the study. The research instrument was 2020 physics paper 2. The validity of WAEC/SSCE 2020 physics paper 2 was believed to be determined because WASSCE is a standardized examination taken at the same time across region and reliability of the four instruments were determined. A reliability coefficient of 0.69 were obtained for WAEC/SSCE 2020 physics paper 2. The instrument was administered to 1080 SS 3 students offering physics in selected secondary schools in Delta State. The research questions were answered using binary Logistic Regression and independent chi-square in SPSS version 23 was used to test the hypotheses at 0.05 level of confidence. The major findings of the study showed that there is significant difference between male and female students, , urban and rural students, public and private school students in 2018, 2019 and 2020 WAEC/SSCE physics multiple choice items in Delta State. Base on the findings it was recommended among others Examination bodies should develop test items to accommodate all abilities irrespective of the sex, location and school.

Keywords: Assessment: Differential item functioning, Location and Sex, school ownership

## INTRODUCTION

### Background to the study

The performance of students in both teacher-made test and standardized test in physics has not been very encouraging. Bello and Ariyo (2014) described physics as the bedrock of science, technology and development of a society. Given the role physics plays in technological advancement, its effective teaching, learning and testing should be given serious consideration by reforming the activities of science through Education.

Education is a tool for the realization of stable democracy and building of a society or nation where everyone, young and old in the country will have equal right and opportunities. This can only be achieved if different ability is mood towards oneness through an item of a test. Education also helps in the achievement of individual growth and creates equal opportunities for all through instructional and measurement of learning outcomes for the purpose of classification and certification of learners. In carrying out these processes (providing equal right and opportunity), education practice must recognize individual ability/differences in learners or students during testing. In the school situation there are students from different backgrounds, with corresponding difference in knowledge, attitude, values and communication as well as understanding skills. Regardless of the wide variety of differences, it is expected of the school process to present common values, skills, attitudes and knowledge that are based on the objectives of the curriculum. It is also expected of the school to administer tests items that measure common knowledge, attitude and values taught in schools. In other words, one major task of test developers is to design tests that measure these common skills and bodies of knowledge, without putting the students in tension mood (Odili, 2014). The extent to

which subject contents, experience, knowledge are achieved in the educational domain is mostly done through testing.

Testing is a process that could be used to obtain information from learners on the extent of learning. The testing process requires that an examinee organizes his thinking, knowledge and skills in order to give a right response to the test items of a test. Testing has so much positive impact on learning because retention of tested material is higher than that of material that is only read without being tested (Roediger in Lahey, 2014). Test is a tool used in testing, it consists of a set of test items to which students should respond. Test result is important in various ways to stakeholders in education. Through the use of test, a teacher determines the attainment of objectives, identifies learning difficulties and determines the effectiveness of instructional materials and methods. Test helps a student understand himself in terms of his/her knowledge, attitude and ability.

Test is an instrument for systematic measure of a person's characteristics or academic traits with the aid of a numerical scale. It is the easiest instrument to measure the cognitive level of examinee. Testing has become one of the most crucial method and parameters by which a society judges the product of her educational system. It has been a central part of the school system that even the deviant students, regular absentees, unserious learners sometime call G-boys normally turn up in school and present themselves for testing on examination days. Despite these functions of test and the fact that measurement experts have adopted testing as the most objective means of decision making in education, various criticisms have been raised on issues concerning testing in recent times (Amajuoyi, 2015). From the description of test and testing above, a test is supposed to measure examinees' ability or performance or other mental traits irrespective of various groups they belong. Tests are expected to provide equal opportunities to all examinees to demonstrate or show their latent traits, abilities and knowledge irrespective of their socio-economic, gender, location, ethnic and other factors in a subject provided the learners or examinee have been exposed to contents of a subject. But this is not so, test used in schools do not provide equal opportunity in learners.

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 statistics 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 as shown in table 1 below.

Table 1: Students performance in WASSCE/SSCE Physics between 2017-2020

Year	Total No. of candidates	Total passed A1-C5	% passed	Total D7-F9	% failed
2017	704504	176126	25	528378	75
2018	728904	313487	43	415487	57
2019	762340	327806	43	434534	57
2020	714871	412457	51	302414	49

Source: WAEC chief examiner's report (2017-2020)

The table shows that 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. These frustrated results in sciences particularly in physics created concern as each falling below 40% except 2020 even with the desire for students, parents and educators are aiming for higher academic success. The evidence of this poor performance revealed by the table 1 above is corroborated by WAEC/SSCE Chief Examiners' report in physics for Nigerian candidates in 2017, 2018, 2019 and 2020. This report is believed to be consistent on the fact that students that failed were weak in areas of expression, knowledge of the subject matter (physics), definition of physics terms, spellings, principles and physics application or little or no understanding on the test items generated and inability of their scheme of work to cover the contents. The failure 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 phenomena whereby students are performing differently in a test item that measures knowledge of 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 (Joshua, 2015). 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 so many factors.

Sex is a set of characteristics of being a male or female particularly, in the case of man and woman which, depending on the context, may vary from sex to social role and to gender identity (Bland, 2013). Nevertheless, Chang and Tzou (2018) reported that although there is a downward gap in sex differential in students' performance in physics and other subjects, female portion in subjects involving calculation like sciences is on the low in comparison with their male counterparts. Considering socio-cultural background, Oludipe (2013) observed that in Nigeria, certain vocations and professions have traditionally been assigned as men's and others as women's career. Some of these vocations are Medicine, engineering, architecture and nursing, catering, typing respectively. The society's socio-cultural construct of female as weaker sex, together with female self-perception of themselves as weaker sex, inferior and subordinate to the males, has imposed some socio-cultural limitations on female aspirations and achievement in physics and sciences in general (Ojobo, 2014). Abiam (2006) as cited by Osadebe and Agbure (2019) show that test conducted by examination bodies in Nigeria differentially function among gender irrespective of the test purpose.

Location is another variable that could determine DIF among learners of the same ability on subject content. Location of students refers to the geo-graphical area where the examinee or tester leaves to learn and apply physics principles. Locations are classified into urban, semi-urban and rural location. Ndfon, Umoinyang and Idiku (2013) stated the location in which an examinee finds himself or herself will enhance effectively its academic performance in physics and other subjects matter ability.

Differential item functioning could also occur on the basis of school ownership (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.

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. 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**

In recent times the teaching and learning of physics have been faced with numerous problems like Conducive learning environment, poor or absence of physics laboratory that are capable of impeding the realization of its objectives (Okagbare, 2021). Learning behaviour of students and the method through which physics is taught could have contributed to the students' differential items functioning in physics at West African senior school certificate examination (WASSCE). Despite efforts by researchers to improve academic excellence in students the persisted differential achievement is still found among physics students. Tests items that have differential functioning could bring about downward trend in performance of students of reference and focal groups in a body of knowledge (subject area). 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 sex, and location. Tests with differential functioning items cannot be used to achieve any meaningful goal. Considering the high rate of poverty, insecurity, and inter-ethnics conflict, political war across the country and since government has determination to deal with these problems or issues, there is need for education stakeholders, most especially those in the measurement sectors to look at ways to reduce or eliminate test items that are differentially functioning across groups in public and private testing. The problem of differential item functioning may be attributed to difficulty in physics WAEC test items response.

The problem of this study is, put in questions form: 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 urban and rural schools, and gender 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 male and female students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State?
2. What is the level of differential function between urban and rural students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State?
3. What is the level of differential function between public and private school 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 is no significant difference in the level of differential function between male and female students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State.
2. There is no significant difference in the level of differential function between urban and rural students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State.
3. There is no significant difference in the level of differential function between public and private school students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State?

### Purpose of the study

The purpose of the study is to assess differential item functioning in physics multiple choice questions used by West Africa Examination Council/West Africa Senior School Certificate Examination in Delta State. Specifically, the study:

1. find out the level of differential function between male and female students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State.
2. ascertain the level of differential function between urban and rural students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State.
3. determine level of differential function between public and private school students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State

### Scope and Delimitation of the Study

The study is set to assess differential item functioning in physics multiple choice test used by West Africa Examination Council among secondary school students in all the senatorial districts that form Delta State of Nigeria in relation to urban and rural geographical location, male and female students. The study shall cover only physics multiple choice questions used by WAEC in the SSCE of 2020. The study will concern only with test items that differentially function among examinees with respect to, sex and location.

## RESEARCH METHOD AND PROCEDURE

### Research Design

The study adopted *ex-post facto* design because the study is retrospective, data collection focuses on the past. In the *ex-post facto*, the researcher has no control over the variables of interest and therefore cannot be manipulated.

### Population of the study

The population used for the study is 46,759 students comprised of all the twenty-five (25) local government SS 3 students in senior secondary school in both public and government approved private schools that learn and studied physics as a certificate subject. Senior secondary school three (SS3) was chosen because they are expected to be at the same level of ability having covered the WAEC Senior Secondary School 3 physics syllabus upon which WASSCE test items are generated. The numbers of government approved private schools in the state is 622 schools and that of government owned public schools is also 477 making a total number of senior secondary school to 1,099 schools in Delta state. A total of approximately 46,759 populations which comprises of 38092 students in public schools and 8666 private schools SS3 students that was present according to Delta state ministry of Secondary Education (2022).

### Sample and Sampling Techniques

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. The first stage was Stratified Random Sampling Technique (SRST) to select six (6) Local Government Area in the three senatorial districts of Delta State. At the second stage, Simple Random Sampling Technique was used to select 9 public and 9 private senior secondary schools in each of the Senatorial Districts making a total of 108 senior secondary schools that was drawn for the study.

In the last stage, the researcher used simple Simple Random Sampling Technique (SRST) by balloting to select ten (10) students in each of the one hundred and eight (108) senior secondary schools drawn from Delta North, Delta Central and Delta South Senatorial District of Delta State making a total of 1080 students used for the study.

### Research Instrument

The research instrument used for the collection of data was WASSCE physics paper 2 questions, used in the year 2020 examination. The test instrument contains 50 multiple choice test questions constructed by the WASSCE. The student were also asked to indicate their sex and location at the topic of their answer script.

### Validity of the Research Instrument

The instruments were prepared by WAEC and as such validation had been taken care of. The content validity of the instrument was believed to be valid because WASSCE is a standardized examination taken at the same time across regions and some selected West African countries. This was as a result of the fact that WAEC is a reputable examination body not only in Nigeria but across English Speaking West African Countries.

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).

### Reliability of the Research Instrument

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 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 0.699 was obtained for test paper used in 2020 examination year respectively. The SPSS computer programme was used for the computation. These values were significant at 0.05 level of significance.

### Method of Data Collection

Physics multiple choice test items was used to collect data from the sample population. 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.

### Method of Data Analysis

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.

## RESULTS AND DISCUSSION OF FINDINGS

**Research Question One:** What is the level of differential function between male and female students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State?

**Table 1: Logistic Regression analysis to detect items of the 2020 WASSCE/SSCE physics multiple choice test item that differentially function between male and female students**

TEST ITEMS	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
1	.246	.042	34.438	1	.000	1.279	1.178	1.388
2	.159	.041	14.864	1	.000	1.173	1.082	1.272
3	.639	.048	180.852	1	.000	1.895	1.727	2.080
4	.225	.042	29.030	1	.000	1.252	1.154	1.359
5	.834	.052	256.447	1	.000	2.303	2.079	2.551
6	.281	.042	44.415	1	.000	1.325	1.220	1.439
7	.294	.042	48.186	1	.000	1.342	1.235	1.458
8	.408	.044	87.523	1	.000	1.504	1.381	1.639
9	.531	.046	136.269	1	.000	1.701	1.556	1.860
10	.542	.046	140.544	1	.000	1.719	1.572	1.880
11	2.184	.112	381.805	1	.801	8.880	7.133	11.055
12	.546	.046	142.267	1	.000	1.726	1.578	1.888

13	.879	.053	271.867	1	.000	2.408	2.169	2.673
14	.484	.045	117.220	1	.000	1.623	1.487	1.772
15	.887	.054	274.742	1	.000	2.428	2.186	2.697
16	.314	.043	54.439	1	.000	1.369	1.259	1.488
17	.624	.047	174.391	1	.000	1.866	1.701	2.047
18	.378	.043	76.203	1	.000	1.459	1.341	1.589
19	.672	.048	194.047	1	.000	1.958	1.782	2.153
20	.599	.047	164.367	1	.000	1.821	1.661	1.996
21	1.306	.068	372.060	1	.051	3.690	3.231	4.213
22	.578	.046	155.407	1	.000	1.782	1.627	1.951
23	.669	.048	193.002	1	.447	1.952	1.777	2.146
24	.729	.049	216.804	1	.000	2.072	1.881	2.283
25	.753	.050	226.438	1	.000	2.124	1.926	2.343
26	.580	.046	156.296	1	.000	1.786	1.631	1.956
27	.919	.054	285.221	1	.000	2.507	2.254	2.790
28	.248	.042	34.908	1	.000	1.281	1.180	1.391
29	.113	.041	7.609	1	.006	1.120	1.033	1.214
30	.137	.041	11.075	1	.001	1.147	1.058	1.244
31	.112	.041	7.386	1	.007	1.118	1.032	1.212
32	.108	.041	6.950	1	.008	1.115	1.028	1.208
33	.166	.041	16.140	1	.000	1.181	1.089	1.281
34	.119	.041	8.298	1	.004	1.126	1.039	1.221
35	.115	.041	7.835	1	.005	1.122	1.035	1.216
36	.124	.041	9.016	1	.003	1.132	1.044	1.227
37	.049	.041	1.457	1	.227	1.051	.970	1.139
38	.085	.041	4.265	1	.039	1.088	1.004	1.180
39	.108	.041	6.950	1	.008	1.115	1.028	1.208
40	.080	.041	3.775	1	.052	1.083	.999	1.174
41	.092	.041	4.966	1	.026	1.096	1.011	1.188
42	.083	.041	4.098	1	.043	1.087	1.003	1.178
43	.092	.041	4.966	1	.026	1.096	1.011	1.188
44	.107	.041	6.737	1	.009	1.113	1.026	1.206
45	.108	.041	6.950	1	.008	1.115	1.028	1.208
46	.103	.041	6.320	1	.012	1.109	1.023	1.202
47	.105	.041	6.527	1	.011	1.111	1.025	1.204
48	.139	.041	11.347	1	.001	1.149	1.060	1.246
49	.119	.041	8.298	1	.004	1.126	1.039	1.221
50	.386	.043	79.114	1	.000	1.471	1.351	1.601

0.05

Table 1 shows the items that relate to sex of students (male and female), 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, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 and 50 item. Therefore, the level of differential function between male and female students in the 2020 WASSCE/SSCE physics multiple choice items is 90% high. That is 34% of 17 items disfavoured male students while 56% of 28 items disfavoured female students or examinees.

**Research Question Two:** What is the level of differential function between urban and rural students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State?

**Table 2: Logistic Regression analysis to detect items of the 2020 WASSCE/SSCE physics multiple choice test that differentially function between urban and rural students.**

TEST ITEMS	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
1	.103	.086	1.435	1	.231	1.108	.937	1.311
2	.236	.086	7.467	1	.006	1.266	1.069	1.498

3	1.055	.098	116.437	1	.100	2.872	2.371	3.479
4	.760	.092	68.445	1	.000	2.138	1.786	2.560
5	.802	.093	75.121	1	.000	2.231	1.861	2.675
6	.777	.092	71.086	1	.000	2.174	1.815	2.605
7	.962	.096	101.013	1	.000	2.616	2.169	3.155
8	1.123	.099	127.559	1	.000	3.075	2.530	3.736
9	1.807	.123	215.918	1	.000	6.091	4.787	7.751
10	1.355	.106	163.344	1	.000	3.875	3.148	4.770
11	.548	.089	38.077	1	.000	1.730	1.454	2.059
12	1.173	.101	135.623	1	.000	3.233	2.653	3.938
13	1.596	.114	194.933	1	.000	4.935	3.944	6.174
14	.718	.091	62.022	1	.000	2.050	1.715	2.451
15	.794	.092	73.766	1	.000	2.212	1.845	2.651
16	.989	.096	105.574	1	.000	2.689	2.227	3.248
17	.588	.089	43.310	1	.000	1.800	1.511	2.144
18	1.204	.102	140.495	1	.000	3.333	2.732	4.068
19	1.583	.114	193.424	1	.000	4.871	3.897	6.089
20	1.389	.107	168.213	1	.000	4.009	3.250	4.945
21	.846	.093	82.035	1	.000	2.329	1.940	2.797
22	1.366	.106	164.970	1	.000	3.919	3.182	4.827
23	5.198	.579	80.628	1	.090	181.000	58.194	562.958
24	.693	.091	58.295	1	.000	2.000	1.674	2.389
25	1.055	.098	116.437	1	.000	2.872	2.371	3.479
26	.820	.093	77.858	1	.000	2.269	1.892	2.723
27	.628	.090	48.843	1	.000	1.874	1.571	2.234
28	.952	.095	99.506	1	.000	2.592	2.150	3.126
29	.898	.094	90.624	1	.000	2.456	2.041	2.955
30	.890	.094	89.172	1	.000	2.434	2.024	2.927
31	.828	.093	79.241	1	.000	2.289	1.908	2.747
32	.572	.089	41.180	1	.000	1.772	1.488	2.110
33	.556	.089	39.099	1	.000	1.744	1.465	2.076
34	.751	.092	67.140	1	.000	2.120	1.771	2.537
35	.280	.086	10.510	1	.001	1.323	1.117	1.568
36	.532	.089	36.070	1	.000	1.703	1.431	2.026
37	.669	.090	54.666	1	.000	1.951	1.634	2.330
38	.726	.091	63.286	1	.000	2.067	1.729	2.473
39	.846	.093	82.035	1	.000	2.329	1.940	2.797
40	.925	.095	95.031	1	.000	2.523	2.094	3.038
41	.660	.090	53.479	1	.000	1.935	1.622	2.310
42	.925	.095	95.031	1	.000	2.523	2.094	3.038
43	.872	.094	86.291	1	.000	2.391	1.990	2.874
44	.837	.093	80.634	1	.000	2.309	1.924	2.772
45	.612	.090	46.594	1	.000	1.844	1.547	2.198
46	.726	.091	63.286	1	.000	2.067	1.729	2.473
47	.794	.092	73.766	1	.000	2.212	1.845	2.651
48	.751	.092	67.140	1	.000	2.120	1.771	2.537
49	.863	.094	84.864	1	.000	2.370	1.973	2.848
50	.693	.091	58.295	1	.000	2.000	1.674	2.389

0.05

Table 2 shows the items that relate to location of students (urban and rural), identified by logistic regression method using SPSS version 23. Out of fifty items in physics multiple choice tests DIF was present in 47 items. These items are item 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 29, 30, 31, 32, 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 urban and rural students in the 2020 WASSCE/SSCE physics multiple choice items is

94% high. That is 40% of 20 items disfavoured urban of students while 54% of 27 items disfavoured rural students or examinees.

**Research Question Three:** What is the level of differential function between public and private school students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State?

**Table 3: Logistic Regression analysis to detect items of the 2020 WASSCE/SSCE physics multiple choice test 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	.367	.088	17.587	1	.000	1.443	1.216	1.714
2	.382	.088	19.034	1	.000	1.466	1.234	1.740
3	1.128	.100	127.004	1	.000	3.091	2.540	3.761
4	.283	.087	10.625	1	.001	1.328	1.120	1.574
5	1.069	.099	117.443	1	.000	2.913	2.401	3.534
6	.460	.088	27.082	1	.000	1.584	1.332	1.883
7	.444	.088	25.365	1	.000	1.559	1.312	1.853
8	.491	.089	30.675	1	.000	1.634	1.373	1.944
9	.421	.088	22.890	1	.000	1.523	1.282	1.810
10	.786	.093	71.787	1	.000	2.195	1.830	2.633
11	6.290	1.001	39.487	1	.900	539.000	75.788	3833.360
12	.901	.095	90.013	1	.000	2.462	2.044	2.965
13	1.190	.102	136.700	1	.000	3.286	2.692	4.011
14	.892	.095	88.558	1	.000	2.439	2.026	2.937
15	1.636	.117	197.232	1	.159	5.136	4.088	6.454
16	.523	.089	34.475	1	.000	1.687	1.417	2.008
17	1.021	.098	109.613	1	.000	2.776	2.293	3.361
18	.932	.096	94.720	1	.000	2.539	2.105	3.064
19	.928	.095	94.426	1	.000	2.529	2.098	3.050
20	.946	.096	97.407	1	.000	2.576	2.135	3.109
21	2.346	.153	236.136	1	.000	10.447	7.745	14.091
22	.838	.094	80.008	1	.000	2.313	1.925	2.779
23	1.128	.100	127.004	1	.058	3.091	2.540	3.761
24	1.200	.102	138.325	1	.000	3.320	2.718	4.055
25	1.089	.099	120.612	1	.000	2.971	2.446	3.608
26	1.200	.102	138.325	1	.000	3.320	2.718	4.055
27	1.937	.130	223.114	1	.000	6.941	5.383	8.950
28	.444	.088	25.365	1	.000	1.559	1.312	1.853
29	.216	.087	6.206	1	.113	1.241	1.047	1.470
30	.198	.086	4.992	1	.205	1.313	1.024	1.437
31	.104	.086	1.451	1	.228	1.109	.937	1.314
32	.104	.086	1.451	1	.228	1.109	.937	1.314
33	.193	.086	4.992	1	.025	1.213	1.024	1.437
34	.119	.086	1.894	1	.169	1.126	.951	1.333
35	.141	.086	2.670	1	.102	1.151	.972	1.364
36	.134	.086	2.396	1	.122	1.143	.965	1.353
37	.082	.086	.896	1	.344	1.085	.916	1.284
38	.186	.086	4.616	1	.032	1.204	1.016	1.426
39	.193	.086	4.992	1	.025	1.213	1.024	1.437
40	.186	.086	4.616	1	.032	1.204	1.016	1.426
41	.208	.087	5.786	1	.016	1.231	1.039	1.459
42	.171	.086	3.909	1	.048	1.186	1.001	1.405
43	.208	.087	5.786	1	.016	1.231	1.039	1.459
44	.201	.086	5.382	1	.020	1.222	1.032	1.448
45	.208	.087	5.786	1	.016	1.231	1.039	1.459



46	.186	.086	4.616	1	.032	1.204	1.016	1.426
47	.193	.086	4.992	1	.025	1.213	1.024	1.437
48	.193	.086	4.992	1	.025	1.213	1.024	1.437
49	.231	.087	7.087	1	.008	1.259	1.063	1.493
50	.701	.091	58.886	1	.000	2.017	1.686	2.412

0.05

Table 12 shows the items that relate to school of students (public and rural), identified by logistic regression method using SPSS version 23. Out of fifty items in physics multiple choice tests DIF was present in 39 items. These items are item 1, 2,3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 33, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 and 50 item. Therefore, the level of differential function between public and private school students in the 2020 WASSCE/SSCE physics multiple choice items is 78% high. That is 54% of 27 items disfavoured public school students while 24% of 12 items disfavoured private students or examinees.

**Hypothesis One:** There would be no significant difference in the level of differential function between male and female students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State.

**Table 4: test of chi-square Statistics showing DIF GENDER for 2020**

GENDER- DIF							
GENDER	Non-DIF item	DIF items	Total	$\chi^2$ value	Df	Sig.	Decision
Male	3	17	20	101.897	1	25.276	Not significant
Female	2	28	30				
Total	5	45	50				

0.05

Table 4 shows a chi-square value of 101.897 and a P-value of 25.276. Using 0.05 to test at an alpha level, the p-value of 25.276 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 male and female students in the 2020 WASSCE/SSCE physics multiple choice test items.

**Hypothesis Two:** There would be no significant difference in the level of differential function between urban and rural students in the 2020 WASSCE/SSCE physics multiple choice test items in Delta State.

**Table 5: Test of Independent Chi-Square Statistics Showing Level Of DIF Location For 2020**

Location.	Level Of DIF Non-DIF items	Location- DIF item	Total	$\chi^2$ value	Df	Sig.	Decision
	Urban	2	20	22	109.758	1	22.447
Rural	1	27	28				

Total	3	47	50
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0.05  
Table 5 show an independent chi-square value of 109.758 and a P-value of 22.447. Using 0.05 to test at an alpha level, the p-value of 22.447 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 urban and rural students in the 2020 WASSCE/SSCE physics multiple choice test items.

**Hypothesis 6:** There would be no significant difference in the level of differential function between public and private school students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State.

**TABLE 6: Test of Chi-Square Statistics Showing DIF School Ownership For 2020**

SCHOOL	School- DIF		Total	$\chi^2$ value	Df	Sig.	Decision
	Non-DIF Item	DIF Items					
Public	4	27	31	248.552	1	20.490	Not significant
Private	7	12	19				
Total	11	39	50				

0.05  
Table 6 show an independent chi-square value of 248.552 and a P-value of 20.490. Using 0.05 to test at an alpha level, the p-value of 20.490 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 2020 WASSCE/SSCE physics multiple choice questions 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 male and female students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State

Data obtained from research question one 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 male and female students. 34% of 17 items which are 1, 3, 6, 8, 15, 22, 25, 26, 27, 28, 33, 34, 39, 42, 43, 45 and item 48 disfavoured male students while 56% of 28 items which are 2, 4, 5, 7, 9, 10, 12, 13, 14, 16, 17, 18, 19, 20, 24, 29, 30, 31, 32, 35, 36, 38, 41, 44, 46, 47, 49 and item 50 disfavoured female students. This implied that there is level of differential function between male and female students in the 2020 WAEC/SSCE physics multiple choice test items. This finding is in line with that of Ozdemir and Alshamrani (2020) that reported potentially bias/DIF test items across male and female and examine their effect on test score to ensure item fairness.

#### Level of differential function between urban and rural students in the 2020 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 94% level of DIF in 47 items in 2020 WASSCE/SSCE physics multiple choice against urban and rural students. 40% of 20 items which are 2, 6, 8, 15, 21, 22, 25, 26, 27, 28, 33, 34, 39, 40, 42, 43, 45, 48, 49 and item 50 disfavoured urban students while 54% of 27 items which are 4, 5, 7, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 24, 29, 30, 31, 32, 35, 36, 37, 38, 41, 44, 46, and item 47 disfavoured rural students. This implied that there is level of differential function between urban and rural students in the 2020 WAEC/SSCE physics multiple choice test items. This finding is in disagreement with Cornelius (2015) who revealed that there is no advantage to urban or rural schools in item response. This finding agrees with Akanwa, Agommouh and Ihechu (2019) revealing DIF items among urban and rural schools in 2015 NABTEB Agricultural Science, Biology multiple choice items.

### Level of differential function between public and private school students in the 2020 WASSCE/SSCE physics multiple choice questions test items in Delta State

Finally, data obtained from research question three and its hypothesis revealed that logistic regression model statistic detected 78% level of DIF in 39 items in 2020 WASSCE/SSCE physics multiple choice against public and private school students. 54% of 27 items which are 1, 2, 3, 6, 9, 12, 14, 16, 18, 19, 20, 22, 24, 26, 28, 33, 38, 39, 40, 41, 42, 44, 46, 47, 48, 49 and item 50 disfavoured public students while 24% of 12 items which are 4, 5, 7, 8, 10, 13, 17, 21, 25, 27, 43, and item 45 disfavoured private students. This implied that there is level of differential function between public and private school students in the 2020 WAEC/SSCE physics multiple choice test items. This finding is in line with Uremu and Onuka (2013) who have reported that most private schools do perform excellently better than their public counterparts in test items. This finding also agrees with Shu'aibu and Abba (2019) revealing incident of DIF items among public and private schools in 2010 NECO/SSCE English language multiple choice items.

### Conclusion

Based on the forgoing findings the following conclusions were made. There were presences of DIF se, location, and school ownership test items in 2020 WAEC/SSCE physics multiple choice questions. The study concluded that, there were levels of differential item functioning that exists in 2020 WAEC/SSCE physics multiple choice items in senior secondary schools of Delta State.

### Recommendations

In respect of the findings and conclusion, the following recommendations are made:

1. Examination bodies should develop test items to accommodate all abilities irrespective of the sex, location and school.
2. Test items professionals and item makers should explore different methods of differential item functioning detection, for the most part the use of logistic regression statistic in detect uniform and non- uniform test items that are bias with regards to physics multiple questions.
3. Test makers should be watchful of the differences that exist between gender, location, , and school ownership as differential function would not lead to oneness.

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