

ANALYSIS OF DIFFERENTIAL ITEM FUNCTIONING IN ECONOMICS MULTIPLE CHOICE ITEMS ADMINISTERED BY WEST AFRICAN EXAMINATION COUNCIL USING LOGISTIC REGRESSION PROCEDURE

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Abstract

The study examined the analysis of differential item functioning in Economics multiple choice items administered by West African Examination Council using logistic regression model. Ex-post factor research design was employed for the study. The population for the study comprised 2,985 Senior Secondary School Three (SS3) Economics students in Nsukka education zone of Enugu State. Sample size of 339 SS3 Economics students was used for the study. A 50-item test of 2018 Economics multiple choice questions developed by West African Examination Council (WAEC) was used to collect pertinent data for the study. Reliability coefficient of 0.87 was obtained using Kuder-Richardson (K-R) 20 formula. Logistic Regression procedure was used to analyze the data collected from the study. The findings of the study revealed that out of 50 items in 2018 WAEC Economics questions, 31 items which represent 62% of the test items displayed significant location DIF at 0.05 level of significance. Among the 31 items, 27 items representing 54% were identified to exhibit significant location DIF in favour of urban school students while only 4 items representing 8% differentially functioned in favour of rural school students. The study recommended among others based on the study that examination bodies such as West Africa Examination Council, National Examination Council among others should use DIF for their pilot study using school location and other possible groupings like gender to ensure fairness in their test items.

Keywords: Differential Item Functioning (DIF), Location, Item Bias, Economics, Logistic Regression Procedure

Introduction

In every teaching and learning process, test is used to determine the outcome of responsiveness of the teaching and learning process. Test is a method of measuring students' ability, knowledge, or performance in a given domain (Brown, 2004). UKessays (2018) sees test as a systematic procedure of description, collection and interpretation in order to measure the test taker's achievement ability, knowledge, and performance what they have been learned in learning process and to get a value judgment. UKessays further opined that the purpose of a test is able to give the valid information on the students' abilities and knowledge. This is because test is used for admission, recruitment, promotion, placement, evaluation, guidance, research and teaching purpose among others (Emaikwu, 2011). In line with the submission of Emaikwu on the importance of testing, Joshua as cited in Ikeh et al (2021) stated that tests are used to gain useful information about test-takers' knowledge, skills and progress; helps each professional to perform his or her work effectively; used in promotion, placement, selection, certification and decision making. Emaikwu (2012) opined that testing has been fully accepted in most modern societies as the most objective method

of decision making in schools, industries and government establishments. This is an indication that testing is one of the powerful tools to measure students' abilities as well as enhancing their attitudes towards learning.

Meanwhile, assessment of learning outcomes using test is one of the basic issues in our educational system. This is because; test may include items that operate differently for certain groups, thereby resulting to item bias. Item bias according to Hambleton and Rogers as cited in Orluwene and Asiegbu (2016) is the presence of some characteristics of an item that result in differential performance for individuals of the same ability but from different ethnic, gender, cultural or religious groups. A test item may be biased if it contains content or language that is differentially familiar to subgroups of examinees, or if the item structure or format is differentially difficult for subgroups of examinees. To Orluwene and Asiegbu (2016), an item is considered biased when different groups but with the same ability level, have nevertheless, different probabilities of answering the item correctly. Therefore, the presence of bias in an item is a cause for concern because, tests are used as a gatekeeper for educational opportunities, and it is a very important that test items are fair for every examinee (Adedoyin, 2010).

Test fairness can be viewed as any test given to a set of testee with an equal chance to demonstrate what they know. An item is considered fair if different sub-groups of testee or examinee with equal ability have the same probability of correct responses to test items. Fair test according to Ogbebor and Onuka (2013) is a test that enables all examinees to have an equal chance to demonstrate the skills and knowledge which they have acquired and which are vital to the purpose of the test. This implies that a fair test affords all examinees an equal opportunity to demonstrate the skills and knowledge which they have acquired and which are relevant to the test's purpose (Roever as cited in Ogbebor & Onuka, 2013). In order to ensure that test items are fair for all examinees and free to bias, test item writers and examination bodies need to subject their test items to Differential Item Functioning (DIF).

Differential item functioning (DIF) procedure is a range of techniques that are used to determine if different subgroups respond differently to particular items. Differential item functioning (DIF) is a statistical technique that is used to identify differential item response patterns between groups of examinees such as urban and rural which helps in verifying potentially biased test items (Madu, 2012). DIF according to Zumbo (1999) occurs when examinees with the same underlying ability on the construct measured by the test, but who are from different groups have a different probability of correctly answering the item. To Pedrajita (2009), differential item functioning is the probabilities of success on an item of examinees of the same ability but belonging to different groups. DIF therefore concerns itself in answering question like, is the test performing in the same manner for each group of testees that takes the test? Therefore, Differential Item Functioning (DIF) analysis is typically used to identify test items that are differentially difficult for respondents who have the same level of knowledge, skill, or ability but differ in ways that should be irrelevant to their performance on the test such as culture, religion, ethnicity, gender and location among others (Miller, 2010).

In determining the Differential Item Functioning of a test, there are several statistical procedures that can be used. These procedures according to Abedi, Leon and Kao (2007) include; Mantel-Haenszel statistic, logistic regression, SIBTEST, the Standardization procedure, and various item Response Theory based approaches. Among these statistical procedures, the researchers employed logistic regression procedure. The choice of logistic regression procedure is based on the fact that it is widely used approach for detecting DIF which is commonly regarded as simple, robust and reasonably efficient, while being easy to implement (Scott et al, 2010). Meanwhile, despite the statistical procedures employed in determining DIF, DIF analyses sets to address equivalence across subgroups of examinees such as culture, religion, ethnicity, gender and location among others.

Location is a particular position, situation or geographical area. According to Orji (2013), school location means urban-rural setting. Urban schools are those schools in the municipalities or schools found within the towns and rural schools are those located in the villages or semi-urban areas. Educational opportunities vary from one location to another. While some places are known to have enough schools with facilities and teachers, other does not. The urban-rural influence is also expected in Economics just like any other social science subject because of the psychological influence it may have on the teachers and students resulting mainly from school location. This may even dictate their academic achievement in Economics which is an aspect of social science subjects. Therefore, the area in which a school is located can affect the educational achievement of a student. Alokan (2010) observed that schools in the urban areas are characterized by availability of enough quality teachers, good infrastructure, well equipped library and laboratories, good communication network, serene environment among others while schools in the rural settings are the quite opposite of the conditions available in the urban schools. This disparity in the living

and academic conditions of the urban and rural schools consequently affects students academic achievement in Economics.

Students’ achievement in relation to school location is crucial to educationists. There have been different research reports in literature; some agreeing that location affects achievement, while others do not. Location and achievement studies are inconclusive. For instance, a study carried out by Owoeye and Yara (2011) reported that that Economics student from rural areas perform better than their urban counterparts, which implies that school location is not a significant factor in students’ academic achievement in Economics. Meanwhile, Adesegun, Adekunle and Adu (2016) reported that school location is a significant factor on students’ achievement in Economics. The findings of Onuoha, Ifelunini, Ezeocha and Agah (2017) showed that location is a significant factor affecting students’ achievement in Economics. On these premises of conflicting reports therefore, the researchers investigated the differential item functioning in Economics multiple choice items administered by West African examination council using logistic regression procedure.

Methods

This study adopted causal comparative or ex-post facto research design. Causal comparative or Ex-post facto research design is the type of research design that establishes cause effect relationships and the researcher has no control over the variables of interest and cannot manipulate them (Nworgu, 2015). The design was considered appropriate because, the researchers examined non-manipulative independent variable known as location. The population of the study comprised 2563 Senior Secondary School (SSS) III Economics students in Nsukka Education Zone of Enugu State, Nigeria. The population of the study comprised 2563 Senior Secondary School 3 Economics students. The sample size of 444 SSS3 Economics students in Nsukka education zone of Enugu State, Nigeria was used for the study. The sample comprised 260 urban and 184 rural school students.

Instrument used for data collection was 2018 multiple choice Economics questions adopted from West African Examination Council (WAEC). The instrument consists of two sections; section A and section B. Section A focused on the demographic data of the respondent like school location, while section B of the instrument consists of 50-item multiple choice questions. Each item consists of a question and a list of possible answers lettered A - D of which only one option is the correct answer. The test items of the instrument were scored 1 for correct option and 0 for wrong option with maximum score of 50 and minimum of 0.

The construction and validation of the instrument were done by experts in the department of examinations and quality control of the West African Examination Council (WAEC) and therefore require no further validation since the instrument was adopted. In determining the reliability of the instrument, 25 copies of the instrument was administered to Senior Secondary Three (SS3) Economics students in Nsukka education zone of Enugu State who were not part of the study. The responses obtained from the trial testing were subjected to Kuder-Richardson 20 (KR-20) formula to determine the internal consistency of the instrument. A reliability coefficient of 0.93 was obtained. The choice of Kuder-Richardson (KR-20) was because the instrument was dichotomously scored.

To collect pertinent data needed for the study, instrument was administered to SSS3 Economics students in each of the sampled schools with the help of the Economics teachers in the sampled schools. These Economics teachers in the sampled schools served as the research assistants. The researchers through the students’ teacher informed the students ahead of time about the exercise and the need to be prepared because it will form part of their continuous assessment. This measure was to ensure that students put in their best during the examination. To answer the research question posed for the study, Logistic Regression Analysis was used to analyze the data obtained from the study.

Result

Research Question

What are the test items on standardized WAEC 2018 SSCE May/June multiple choice Economics questions function differentially with respect to school location?

Table 1: DIF Analysis detecting School Location Bias items on 50 Multiple Choice Economics Questions

Item	B	S.E	Wald	Sig.	Exp (B)	95.0% C.I. for Exp (B)	
						Lower	Upper
1	-.78	.20	15.89	.000*	.46	.31	.67
2	-1.03	.20	26.84	.000*	.36	.24	.53

3	.28	.19	2.09	.148	1.32	.91	1.93
4	.65	.20	11.04	.001*	1.92	1.31	2.81
5	-.36	.20	3.31	.069	.70	.48	1.03
6	.55	.19	8.02	.005*	1.73	1.18	2.52
7	.47	.20	5.29	.021*	1.59	1.07	2.37
8	-.37	.19	3.72	.054	.69	.47	1.01
9	-.85	.21	16.93	.000*	.43	.29	.64
10	-1.59	.25	41.91	.000*	.20	.13	.33
11	-.69	.21	11.30	.001*	.50	.33	.75
12	-.43	.20	4.37	.037*	.65	.44	.97
13	-.41	.20	4.30	.038*	.67	.45	.98
14	-1.11	.22	26.10	.000*	.33	.21	.50
15	.30	.19	2.35	.125	1.35	.92	1.97
16	.11	.19	.34	.562	1.12	.77	1.63
17	-.18	.19	.84	.359	.84	.58	1.22
18	.00	.20	.00	.998	1.00	.68	1.47
19	-1.36	.21	41.11	.000*	.26	.17	.39
20	-1.62	.25	41.29	.000*	.20	.12	.33
21	.20	.19	1.09	.296	1.22	.84	1.78
22	-1.23	.21	28.02	.000*	.32	.21	.49
23	-.15	.20	.57	.450	.86	.59	1.27
24	.08	.19	.18	.672	1.09	.74	1.58
25	-.35	.20	3.28	.070	.70	.48	1.03
26	-.06	.19	.10	.748	.94	.65	1.37
27	.21	.20	1.15	.283	1.24	.84	1.82
28	-.90	.20	19.38	.000*	.41	.27	.61
29	-.10	.21	23.36	.000*	.37	.25	.55
30	-.40	.19	4.21	.040*	.67	.46	.98
31	-.55	.20	7.95	.005*	.58	.39	.85
32	-.54	.20	7.19	.007*	.58	.39	.87
33	-1.44	.22	41.08	.000*	.24	.15	.37
34	-.16	.19	.70	.401	.85	.58	1.24
35	-1.07	.21	27.23	.000*	.34	.23	.51
36	1.23	.22	30.20	.000*	3.43	2.21	5.32
37	-.41	.19	4.40	.036*	.67	.46	.97
38	-.35	.19	3.38	.066	.70	.48	1.02
39	-1.11	.21	28.66	.000*	.33	.22	.50
40	.02	.19	.01	.94	1.02	.70	1.48
41	-.52	.19	7.11	.008*	.60	.41	.87
42	-1.97	.24	66.82	.000*	.14	.09	.22
43	-1.30	.21	38.02	.000*	.27	.18	.41
44	-.57	.19	8.78	.003*	.56	.39	.82
45	-.15	.19	.59	.441	.86	.59	1.26
46	-.54	.20	7.02	.008*	.58	.39	.87
47	.14	.19	.57	.451	1.16	.79	1.68
48	-.42	.19	4.52	.034*	.66	.45	.97
49	.02	.19	.01	.912	1.02	.70	1.49
50	-.50	.19	6.52	.011*	.61	.42	.89

Result on Table 1 revealed that 31 items that identified significant DIF in school location. These items include items 1, 2, 4, 6, 7, 9, 10, 11, 12, 13, 14, 19, 20, 22, 28, 29, 30, 31, 32, 33, 35, 36, 37, 39, 41, 42, 43, 44, 46, 48 and item 50. These items revealed significant DIF between urban and rural students with significant level less than 0.05. Among the 31 items identified as having significant DIF as regards to school location, 27 items (1, 2, 9, 10, 11, 12, 13, 14, 19, 20, 22, 28, 29, 30, 31, 32, 33, 35, 37, 39, 41, 42, 43, 44, 45, 48 and item 50) representing 54% were identified to exhibit significant location DIF in favour of urban school students while only 4 items (4, 6, 7 & 36) representing 8% differentially functioned in favour of rural school students.

Discussion of Findings

WAEC Economics Multiple Choice Test Items of the Senior School Certificate Examination that Function Differentially in terms of School Location

The finding of the study revealed that out of 50 items in 2018 WAEC Economics questions, 31 items which represent 62% of the test items displayed significant location DIF at 0.05 level of significant. Among the 31 items, 27 items representing 54% were identified to exhibit significant location DIF in favour of urban school students while only 4 items representing 8% differentially functioned in favour of rural school students. This may arise from difference in the amount of instructions received by the examinees which could be attributed to school-to-school variability in content coverage and emphasis. The rural school students on these items were disadvantaged. The findings of the study indicated that differential performance of urban and rural students in Economics examination could be attributed to school location.

The findings of the study is in agreement with the finding of Igomu and Fan (2013) who reported that out of 60 items in NECO biology objective questions, 8 items are biased in relation to school location. Also in consonance with the findings of the study, was the study conducted by Inyang (1991) whose study reported that 6 out of the nine items identified by the item discrimination method all favoured the urban school students over the rural school students. The findings of Umoinyang, Ndifon and Idiku (2014) was in agreement with the findings of the present study when the researchers reported that one item detected functioned differentially against students in urban schools.

Conclusion

Based on the findings of the study, the study concludes that Economics multiple choice questions used by WAEC in 2018 are location biased as they functioned differentially for examinees in Nsukka education zone of Enugu State, Nigeria. The conclusion was based on the fact that majority of the items showed evidence of location differential item functioning.

Recommendations

The following recommendations were made based on the findings of the study;

1. Examination bodies such as West Africa Examination Council, National Examination Council among others should use DIF for their pilot study using school location and other possible groupings like gender to ensure fairness in their test items.
2. Test item writers especially in area of Economics should analyze students' responses to test items for differential functioning before administering them to the examinees.
3. Examination bodies should construct test items in such a manner that there items should be free from writing errors such as wordiness, irrelevancy, offensiveness among others, so that when an inadequacy or bias exists between groups' examination scores, the disparity will be attributed to true differences in whatever the test purports to measure in the examinees.
4. Logistic regression procedure should be employed in detecting DIF since it is simple, robust and reasonably efficient and easy to implement

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