



Analysis of Item Parameters of the 2022 National Business Certificate examination of ... Aniaiko, O. V., Et. al. (2026)

Analysis of Item Parameters of the 2022 National Business Certificate Examination of Geography Multiple Choice Test Items in Katsina State, Nigeria

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Abstract

The study analyse Item Parameters of the 2022 National Business Certificate Examinations of Geography Multiple Choice Test items in Katsina State Nigeria. Five research questions guided the study. The researcher adopted survey research design for the study. The population of the study consists of one thousand, nine hundred and seventy-one students selected from six schools in Katsina state who offers Geography as a subject that will leads to the award of National Business Certificate (NBC). The sample size used for the study comprised of four hundred and Nineteen SSS III students drawn from the population using simple random sampling techniques. The instrument for the study was National Business Certificate (NBC) examination Geography multiple choice test items conducted in 2022. The instrument was re-validated by two experts, in Educational Measurement and Evaluation in the Department of Educational Psychology and Counseling, Federal University Dutsin-Ma. The reliability of NBCE Geography multiple choice test items was carried out using Kuder Richardson Formula-20 with reliability co-efficient of 0.796. Data obtained were subjected to statistical analysis using Scheuneman statistic. The findings revealed that the 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items has high psychometric properties in terms of validity. The fit statistic of the multiple-choice Geography test items apart from item 18, 33, 46, 48 and 49 indicate that all the items are perfectly valid. Also, the 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items has high reliability index estimated to be 0.796. Based on the findings, it was recommended that developed multiple choice Geography test items should be used by Geography teachers in assessment of students as the items are perfectly valid and reliable.

Keywords: Item Parameters, National Business Certificate Examination, Geography, Multiple Choice Test, Items

Introduction

Geography is one of the school subjects offered in secondary schools that require assessment. As a discipline, it was derived from two Greek words (GEO & GRAPHO). Geo means earth, while “grapho” means description. Thus, Geography is a description of the earth. Geography as a school subject is vital in providing a solid knowledge-base about the environment, while developing positive attitudes and hands-on skills in preserving the beauty of it. Akintade (2022) described Geography as a subject that endows students with vast knowledge for increased functionality and relevance in a fast-changing world, being a versatile, expressive and intellectually stimulating subject. The career opportunities from studying Geography are not limited to teaching and research alone. In recent times, Geography graduates have taken up job roles related to Town Planning, Meteorology, Journalism, Climate Change, Surveying, Consultancy, Environmental Advocacy and Engineering. The contents of the Geography curriculum at the senior secondary level provide foundational exposure to environmental concepts in these fields. In other words, the study of Geography at secondary schools exposes the students to environmental courses such as Urban and Regional Planning, Geology, Environmental Education and Environmental Sciences. According to Greiner, Cornea, et al (2022), the study of Geography avails students with opportunities to make career choices among Environmental science course in the higher education. Geography gives us important clues about the people and places that came before us. Much emphasis is placed on the teaching of Geography at the secondary school level because of its classification as a vocational subject in the National Policy on Education (FRN, 2013). So many strategies are used in the teaching and learning of Geography, some of these strategies as put by (Akut, 2023). Since geomorphology study landforms like valleys, mountains, weathering, mass wasting and things like that, fieldwork and demonstration technique as well as presentation or seminar would be beneficial techniques, demonstration and practical Geography teaching and provision of adequate text books to students. In addition to these strategies, seminar and workshops have been organizes by several bodies such as science Teachers’ Association of Nigeria in the use of modern teaching Geography science at secondary school level of education (Yakubu, (2023). The geography is construct with number of options which consist of multiple



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choice to assess the academic performance of students'. Multiple choice tests are becoming more and more popular particularly in public examinations. Multiple choice tests are not only popular in external examinations; they also play a crucial role in assessment processes in the school system (Olutola, 2016). Multiple choice items consist of a stem and several alternative answers. In a test that has items formatted as multiple-choice questions, a candidate would be given a number of set answers for each question and the candidate must choose which answer or group of answers is correct (Kolawole, 2015). The *stem* is the opening a problem to be solved, a question asked, or an incomplete statement to be completed. The options are the possible answers that the examinee can choose from, with the correct answer called the *key* and the incorrect answers called *distractors*. Only one answer may be keyed as correct. This contrasts with multiple response items in which more than one answer may be keyed as correct. The multiple-choice test type is regarded as the most applicable, flexible and useful type of objective test items. It can be used to measure the level of achievement of all the kinds of objectives that are measured by paper and pencil test (Olutola, 2016). In a multiple choice the numbers of options help the students or testees to select a choice on the options given as the other incorrect options serve as distracters. The options are the possible answers that the examinee can choose from, with the correct answer called the key and the incorrect answers called distractors. Only one answer may be keyed as correct. On the desirable number of options for a multiple-choice test item reveal that options may be suitable for most ability and achievement tests. The options are the possible answers that the examinee can choose from, with the correct answer called the key and the incorrect answers called distractors. Only one answer may be keyed as correct. This contrasts with multiple response items in which more than one answer may be keyed as correct. The usefulness of multiple-choice tests (MCT) for achieving objectives of testing depends on its quality and properties (Olutola, 2011 & Olutola, 2015)

Multiple choice items consist of a stem and several alternative answers. The *stem* is the opening a problem to be solved, a question asked, or an incomplete statement to be completed. The options are the possible answers that the examinee can choose from, with the correct answer called the *key* and the incorrect answers called *distractors*. Only one answer may be keyed as correct. End of the term and end of semester examination or test constructed with multiple choice can involve examinations Examination is designed to meet the requirements of assessing intelligent quotient of an individual learner and was administered to determine whether students could advance from one class to another. Examination is also test of knowledge acquired, or generally a means of assessing Intellectual capacity or ability of an individual (Dunlosky, 2013). (NABTEB) is the one of the major examination bodies in Nigeria that have mandate to award Technical Certificate. NABTEB as examination bodies conducting NABTEB in various subjects, such as Geography, Mathematics, English Language, Biology, Economics. Psychometric properties of examination refers to certain attributes in a tests upon which an assessment of candidates is based. In this study, these properties or parameters include the difficulty index, the discrimination index, validity and reliability indices of test items. Test items used for examination should be fair to the examinees irrespective of the groups, management supervision, and class size. The concept of item parameters is central to Item Response Theory (IRT), a framework used in psychometrics and educational measurement to assess and model the relationship between latent traits (like ability or proficiency) and responses to test items. In IRT, each test item is characterized by a set of parameters that describe its difficulty, discrimination, and sometimes its guessing behavior. These parameters allow for more precise and individualized measurement of a respondent's abilities. The item difficulty parameter, often denoted as *b*, represents the level of ability required for a respondent to have a 50% chance of answering the item correctly (Embretson & Reise, 2020). Items with higher *b*-values are more difficult, while those with lower *b*-values are easier. The *b*-parameter is crucial because it allows Difficulty index tells us how easy the item was for the students in that particular group (Olutola, 2015). Item difficulty tries to estimate how easy or difficult is the item, the higher the value, the easier the item or lower the difficulty. These include, finding the difference in the proportion of high and low achieving students who score the item correctly. Therefore, it is necessary to know the psychometric properties of examination items constructed by these examination bodies to ascertain its effectiveness. Oshkosh (2022) stated that Item Analysis is probably the most important tool to increase test effectiveness, it is a scientific way of improving the quality of tests, and test items in an item bank. An item analysis provides three kinds of important information about the quality of test items. Item difficulty is a measure of whether an item was too easy or too difficult. In addition, Item discrimination is a measure of whether an item discriminated between candidates who knew the test well and candidates who did not. The item discrimination parameter, denoted as *a*, reflects how well an item differentiates between respondents who have low



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versus high ability levels. A higher value of **a** indicates that the item is better at distinguishing between individuals with different levels of the latent trait (Baker, 2020). Items with low discrimination are less effective in differentiating abilities. The ability of an item to discriminate between higher ability examinees and lower ability examinees is known as item discrimination.

Statement of the Problem

Geography is fundamental in exposing the students to nature and its beauty, and it is also indispensable for national economic development and growth. In a developing country such as Nigeria, performance of student in Geography which is bedrock of nation's sustainable development and growth should be given complete attention. The quality of test constructed to evaluate students' performance in NBC conducted by NABTEB determines the public acceptability and confidence of such examinations. In both the 2020 and 2021 NABTEB NBC examinations, the performance of students in technical subjects, including geography, show signs of decline. This was primarily attributed to the disruption caused by the COVID-19 pandemic, which affected school operations, teaching, and student preparation for examination (NABTEB, 2021). Again, the 2020 NABTEB NBC results indicated that only around 40% of students who sat for Geography examinations passed at credit level or above (NABTEB, 2020). Geography was one of the subjects where performance was considered below expectations, with many students struggling to meet the minimum pass mark (NABTEB, 2021). Furthermore, the NABTEB Chief Examiner's Report (2022) noted that students' performance in Geography generally was slightly poorer than those of previous years and the candidates did not perform as well in certain topics as in previous years. Students' trend of poor performance in Geography in NBC has also led to public lack of confidence in the examination body thereby decreasing the number of students' enrolment in NABTEB examinations, especially in Geography (Abanobi, 2023). It is probable that some technical weaknesses exist in the tests developed and administered by the NABTEB. Thus, it is necessary to examine the quality of the test items constructed by NABTEB.

However, many people have attributed the poor performance to teachers' laxity, poor parental guidance. Students' poor studying habit. The psychometric properties of the test items have not been investigated to determine whether it contributes to student's failure. Thus, this study intends to investigate whether the test items have the desired psychometric properties of the NABTEB Geography multiple choice test examination 2022 as regards students' poor performance. Therefore, the study sought to analysis the item parameters of multiples choice Geography test item of National Business Certificate Examination in Katsina States.

Objectives of the Study

The main objective of this study is to analyse the Item Parameters of the 2022 National Business Certificate Examinations of Geography Multiple Choice Test items in Katsina State, *Nigeria*. Specifically, the study sought to:

1. find out the validity of Multiple-Choice Geography test items of the 2022 National Business Certificate Examination in Katsina State in Nigeria,
2. determine the reliability of Multiple-Choice Geography items of the 2022 National Business Certificate (NBC) examinations in Katsina State.
3. Find out item difficulty index of Multiple-Choice Geography items of the 2022 Business Certificate (NBC) examinations in Katsina State.
4. Examine the Discrimination power of Multiple-Choice Geography items of the 2022 National Business Certificate (NBC) examinations in Katsina State Nigeria.

Research Questions

In order to achieve the objectives of the study, the following research questions were answered to guide the study:

1. How valid is the 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items in Katsina State Nigeria?
2. How reliable is the 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items in Katsina State, Nigeria?
3. What is the item difficulty index of 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items in Katsina State, Nigeria?
4. What is the discrimination power of the 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items in Katsina State, Nigeria?



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Methodology

The study adopted survey research design. This is because survey research design deals with systematic setting of worthwhile goals for passing value judgment based on the set goal to ascertain whether the objective should be maintained, modified, or improved on. The population of the study is one thousand, nine hundred and seventy-one (1971). The sample size for the study is four hundred and nineteen (419) and was selected from the population using proportional sampling technique, based on Krejcie and Morgan's (1971) formula for determining sample size from a known population of one thousand, nine hundred and seventy-one (1971). It was drawn from the six (6) selected senior secondary school that constituted the population of the study. This consisted of six public secondary school that offer Geography Science in Katsina State. The instrument used for data collection was NABTEB 2022. The instrument was re-validated by two experts from Measurement and Evaluation in Department of Educational psychology and counseling, Faculty of Education, Federal University Dutsin-Ma. The instrument was administered once in the area that was part of the sample. The data obtained was analyzed using Kuder Richardson Formular 20 with reliability co-efficient of 0.796. Data obtained for the study were also subjected to statistical analysis. Wink Statistical Data Analysis (WSDA) Scheuneman statistic was used to answer all the research questions.

Answering of Research Questions

Research Question One: How valid is the 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items in Katsina State Nigeria?

Table 1: Validity of 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items Based on IRT Model

Items	Infit	Outfit	Items	Infit	Outfit
1	0.67	1.06	26	0.71	0.75
2	0.83	1.09	27	0.83	0.84
3	0.55	1.71	28	0.86	0.93
4	0.78	1.23	29	0.83	0.81
5	0.76	0.96	30	0.91	0.95
6	0.83	0.87	31	0.92	1.97
7	1.01	1.43	32	0.52	0.54
8	1.22	1.28	33	1.89	2.48
9	0.53	0.65	34	1.31	1.33
10	0.98	1.07	35	1.44	1.67
11	1.05	0.87	36	1.06	1.56
12	0.92	1.32	37	0.91	1.03
13	1.08	1.86	38	0.82	1.61
14	1.07	1.35	39	0.51	0.91
15	0.85	2.04	40	1.38	2.21
16	1.01	1.08	41	0.65	0.87
17	1.32	1.43	42	0.62	0.66
18	1.61	1.68	43	1.09	1.21
19	0.71	0.92	44	0.75	1.22
20	1.04	1.09	45	0.71	0.84
21	0.61	1.03	46	1.86	2.44
22	1.04	1.05	47	0.78	0.96
23	0.79	0.93	48	1.71	1.98
24	0.87	0.91	49	1.61	1.71
25	0.82	0.93	50	1.03	1.35
Mean	0.96	1.21			
SD	0.49	0.74			

Table 1 shows the result of the fit statistic of the Geography multiple choice test items for the years under study. The result showed that the multiple-choice test items had the infit statistic ranging from 0.51 to 1.86; and outfit statistic range from 0.54 to 2.48 respectively. In the items of Geography, it is only item numbers 18 (that has infit of 1.61 and outfit of 1.68), 33(that has infit of 1.89 and outfit of 2.48), 46 (that has infit of 1.86 and outfit of 2.44), 48 (that has in fit of 1.71 and outfit of 1.98) and 49 (that has infit of 1.61 and outfit of 1.71), beyond the accepted range of 0.7 – 1.5. The fit statistic of the



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Geography multiple choice test items apart from item 18, 33, 46, 48 and 49 indicate that all the items are perfectly valid. The mean of the in fit and outfit are 0.96 and 1.21 respectively. The spread of the in fit and outfit and their mean indicate highly valid items (since their mean are sufficiently close to one). This is also an expression of uni-dimensionality- a situation where all the items asses one latent ability, that is, cognitive ability achievement in Geography. Therefore, apart from items 18, 33, 46, 48 and 49, all other items of Geography multiple choice test are valid and showed uni-dimensionality.

Research Question Two: How reliable is the 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items in Katsina State, Nigeria?

Table 2: Reliability of 2022 National Business Certificate Examinations (NBCE) multiple choice Geography test items in Katsina State, Nigeria

Method of Establishing the Reliability	N	Reliability Co-efficient of 2022 NBCE MC Geography Test Items
Kuder-Richardson Formula – 20	50	0.796

The reliability index of the multiple-choice Geography test items was estimated to be 0.796 using Kuder-Richardson Formula- 20 (KR-20). This shows that the multiple-choice Geography test items developed is highly reliable.

Research Question Three: What is the item difficulty index of 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items in Katsina State, Nigeria?

Table 3: Item threshold values (difficulty estimates) of the items of the multiple-choice test in Geography based on IRT model.

Items	Threshold	Items	Threshold	Items	Threshold
1	1.62	21	0.76	41	-1.68
2	0.51	22	0.05	42	0.44
3	-0.31	23	-0.22	43	1.51
4	-0.57	24	1.56	44	0.09
5	0.32	25	-0.45	45	-0.41
6	1.61	26	-0.34	46	-1.22
7	-1.21	27	0.93	47	1.86
8	0.52	28	1.06	48	-1.04
9	1.22	29	-0.71	49	0.35
10	-1.44	30	1.07	50	0.84
11	0.88	31	-0.52		
12	1.76	32	-1.91		
13	-0.43	33	1.24		
14	-1.86	34	-1.31		
15	0.77	35	0.71		
16	1.36	36	-1.33		
17	0.24	37	1.71		
18	-0.85	38	-0.25		
19	0.36	39	0.63		
20	1.38	40	-1.31		
Mean			0.98		
SD			0.49		

Table 3 showed the item difficulty estimates or difficulty measures of Geography Multiple Choice test items. The results revealed that twenty one (21) items (42%), that is items 3, 4, 7, 10, 13, 14, 18, 23, 25, 26, 29, 31, 32, 34, 36, 38, 40, 41, 45, 46 and 48 within the b-value range of -3 to +3 had negative difficult estimates while twenty eight (28) items (56%), that is items, 1, 2, 5, 6, 8, 9, 11, 12, 15, 16, 17, 19, 20, 21, 22, 24, 27, 28, 30, 33, 35, 37, 39, 42, 43, 44, 47 and 49 within the b-value range of -3 to +3 had positive difficulty estimates. The negative estimates imply that 21 items are easy while 28 items are difficult. Based on this information, none of the items were rejected in terms of difficulty levels.

Research Questions Four: What is the discrimination power of the 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items in Katsina State, Nigeria?



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Table 4: Item parameters (discrimination power) of the items of the multiple choice test in Geography based on IRT model.

Items	Slope	Items	Slope	Items	Slope
1	0.25	21	1.11	41	0.32
2	0.11	22	0.54	42	0.21
3	0.23	23	0.22	43	0.17
4	0.33	24	1.31	44	0.85
5	0.45	25	1.52	45	1.31
6	0.21	26	1.33	46	0.11
7	0.42	27	0.71	47	2.04
8	0.53	28	0.62	48	1.22
9	0.62	29	2.21	49	0.73
10	0.25	30	1.82	50	0.69
11	0.11	31	1.43		
12	0.91	32	1.21		
13	0.45	33	0.12		
14	0.21	34	0.95		
15	0.12	35	1.05		
16	0.11	36	1.13		
17	0.50	37	0.22		
18	0.82	38	0.15		
19	0.72	39	3.29		
20	0.21	40	0.91		
Mean			0.72		
SD			0.42		

Table 4 revealed that nineteen (19) items (38%), that is items 1, 2, 3, 4, 6, 10, 11, 14, 15, 16, 20, 23, 33, 37, 38, 41, 42, 43 and 46 within the value range of .01 - .34 indicated very low discriminating values, while eight (8) items (16%), that is items 5, 7, 8, 9, 13, 17, 22 and 28 within the value range of .35 - .64 indicated low discriminating values. Also, seventeen (17) items (34%), that is item 12, 18, 19, 21, 24, 26, 27, 32, 34, 35, 36, 40, 44, 45, 48, 49 and 50 within the value range of .65 - 1.34 indicated moderate discriminating values and (25, 29, 30, 31, 39, & 47) items (12%) had values of 1.52, 2.21, 1.82, 1.43, 3.29, and 2.04 respectively, meaning that the six items had a very high discriminating attributes.

Discussion of Findings

The discussion of findings was done according to the research questions and objectives that guided the study as follows: The study showed that the multiple-choice test items had the infit statistic ranging from 0.51 to 1.86; and outfit statistic range from 0.54 to 2.48 respectively. In the items of Geography, It is only item numbers 18 (that has in fit of 1.61 and outfit of 1.68), 33(that has in fit of 1.89 and outfit of 2.48), 46 (that has in fit of 1.86 and outfit of 2.44), 48 (that has in fit of 1.71 and outfit of 1.98) and 49 (that has in fit of 1.61 and outfit of 1.71), beyond the accepted range of 0.7 – 1.5. The fit statistic of the Geography multiple choice test items apart from item 18, 33, 46, 48 and 49 indicate that all the items are perfectly valid. The mean of the infit and outfit are 0.96 and 1.21 respectively. The spread of the infit and outfit and their mean, indicate highly valid items (since their mean are sufficiently close to one). This is also an expression of uni-dimensionality- a situation where all the items asses one latent ability, that is cognitive ability achievement in Geography. Therefore, apart from items 18, 33, 46, 48 and 49, all other items of Geography multiple choice test are valid and showed uni-dimensionality. The finding is similar with the finding of Ajeigbe (2022) who revealed that the NECO Biology Paper III was consistently stable in terms of validity, reliability and parameter estimates.

The study showed that the 2022 National Business Certificate (NBC) Examinations multiple choice Geography test items has high reliability index estimated to be 0.796. The finding is in agreement with the finding of Ajeigbe, (2022) who showed high coefficients of reliability using Split-Half yielded 0.94 (94%), 0.91 (91%), 0.95 (95%) and Cronbach's Alpha yielded 0.92 (92%), 0.91 (91%) and 0.93 (93%) for the three years respectively. The test was found to be of good quality, valid and highly reliable. The study revealed the item difficulty estimates or difficulty measures of Geography Multiple Choice test items. The results revealed that twenty one (21) items (42%), that is items 3, 4, 7, 10, 13, 14, 18, 23, 25, 26, 29, 31, 32, 34, 36, 38, 40, 41, 45, 46 and 48 within the b-value range of -3 to +3 had negative difficult estimates while



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twenty eight (28) items (56%), that is items, 1, 2, 5, 6, 8, 9, 11, 12, 15, 16, 17, 19, 20, 21, 22, 24, 27, 28, 30, 33, 35, 37, 39, 42, 43, 44, 47 and 49 within the b-value range of -3 to +3 had positive difficulty estimates. The negative estimates imply that 21 items are easy while 28 items are difficult. Based on this information, none of the items were rejected in terms of difficulty levels. The findings is in agreement with the findings of Aborisade and Fajobi (2020) who showed that the difficulty and guessing indices of the mathematics items constructed by the two examination bodies are comparable while the discriminating powers not comparable. The study revealed that nineteen (19) items (38%), that is items 1, 2, 3, 4, 6, 10, 11, 14, 15, 16, 20, 23, 33, 37, 38, 41, 42, 43 and 46 within the value range of .01 - .34 indicated very low discriminating values, while eight (8) items (16%), that is items 5, 7, 8, 9, 13, 17, 22 and 28 within the value range of .35 - .64 indicated low discriminating values. Also, seventeen (17) items (34%), that is item 12, 18, 19, 21, 24, 26, 27, 32, 34, 35, 36, 40, 44, 45, 48, 49 and 50 within the value range of .65 - 1.34 indicated moderate discriminating values and (25, 29, 30, 31, 39, & 47) items (12%) had values of 1.52, 2.21, 1.82, 1.43, 3.29, and 2.04 respectively, meaning that the six items had a very high discriminating attributes. The finding is in agreement with the finding of Galle, Alaku and Samuel, (2020) who revealed that the examination has low content validity but has reliability coefficient of 0.73, which was moderate. The finding is similar with the finding of Ogunbamowo, Adediwura and Diyan (2019) who showed that the difference in difficulty indices of NECO and WAEC Economics test items was not significant with the use of CTT ($U=0.138, P > 0.05$), the difference was significant when IRT was used ($U=2.095, P > 0.05$).

Recommendations

Based on the findings of the study the following recommendations were made:

1. Developed multiple choice Geography test items should be used by Geography teachers in assessment of students as the items are perfectly valid.
2. Psychometric and measurement expert should organize workshops to educate teachers on the implications of quality tests so as to ensure the reliability of the developed items.
3. Examination bodies and teachers should be encouraged to adopt (IRT) in developing test items used, as it is effective in estimates item difficulties.
4. Education ministry and universities should try and assist students who are interested to study a research on Item Response Theory to get software and necessary computer packages that are effective in estimating item discrimination power.

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