



## Estimation of item parameter indices of senior school certificate economics multiple choice items in Delta state

Daniel Nkeonye Ajabor<sup>1</sup>, Christiana Amaechi Ugodulunwa<sup>2</sup>

<sup>1</sup> Department of Educational Foundations, University of Delta Agbor, Agbor, Nigeria

<sup>2</sup> Department of Educational Foundations, Nnamdi Azikiwe University Awka, Awka, Nigeria

### Abstract

The study sought to estimate item parameter indices of NECO Senior School Certificate Economics multiple choice items in Delta State. Four research questions guided the study. This study adopted ex-post facto research designs. The population of this study comprised 66,632 Senior Secondary three (SS3) students in Senior Secondary Schools in Delta State. The sample consisted 677 using multi-stage procedure was used. The instruments for data collection were National Examinations Council (NECO) Senior School Certificate Economics 2022 and 2023 Multiple Choice Items which contain 60 items each for the two years. The researcher used Kuder-Richardson 20 formula to estimate the reliability of the instruments and a coefficient of .73 and .77 for 2022 and 2023 respectively were obtained as measures of internal consistency. Data were analysed using the Raju Area estimation technique of BILOG-MG software to determine the item parameter indices. Frequency count and percentage (%) were used to answer the research questions while chi-square statistics was used to test the hypotheses at 0.05 alpha level. The findings revealed that the NECO SSCE 2022 and 2023 Economics multiple choice tests contain items that have good discrimination indices, difficulty indices, guessing indices and distraction indices. Based on the finding, it was recommended that NECO SSCE Economics multiple choice questions that is constructed should be pilot tested every year to ensure that only items that fail should be either modified or discarded and the assistance of measurement and evaluators should be sought by NECO during item development to enhance fairness of test items.

**Keywords:** Economics, multiple choice items, item parameter indices

### Introduction

Economics is one of the senior secondary school subjects that equips students with basic knowledge, skills and understanding of the concepts, and the nature of economic problems in any society. According to the National Examinations Council (NECO) (2021) <sup>[8]</sup>, the general guiding principle of Economics is to equip graduates of Senior Secondary Schools (SSS) with the basic knowledge and skills that will enable them appreciate the nature of economic problems in the society. In the light of this, the Economics syllabus is aimed at exposing candidates to the knowledge of basic economic principles, concepts and the tools for economic analysis, knowledge of the structure and functioning of economic institutions.

Nevertheless, the performance of students in Economics has over the years been fluctuating. For instance, Salihu, Sabo and Akawu (2023) <sup>[11]</sup> in their study on trend analysis of Economics students' performance in NECO 2015-2022 in north-east geopolitical zone of Nigeria revealed that in NECO/SSCE in 2010 out of 1,351,557 candidates that registered in Nigeria only 33.55% were able to obtained credit level pass. In 2011, the population of registered students was 1,044,368 and only 38.79% obtained credit which does not qualify them to gain admission into universities to study Economics. The NECO Chief Examiner's report (2020) revealed that quite a good number of students showed great deficiency in the application of graphical presentations of economic analysis and failed to understand correct Economics terminologies in providing answers to the questions. These weaknesses resulted in poor performance. It is important to examine the nature of the Economics test items as one of the causes of failure in the examination.

A test is an assessment instrument used systematically to measure a sample of behaviour by posing a set of questions or to complete certain tasks for the students to react in order to gain mastery of a skill or knowledge in the curriculum content (Adom, Mensah & Dake, 2020) <sup>[1]</sup>. Tests are designed to measure the quality, ability, skill or knowledge of examinees. Tests can take the form of standardized and non-standardised. Standardized tests are carefully designed tests that have a consistent approach to evaluating, managing, and interpreting test results. Standardised tests are tests that have been carefully constructed by experts, usually with tryout, analysis, and revision. They are tests administered under uniform conditions and provided with tables of norms for score interpretation (Ugodulunwa, 2020) <sup>[13]</sup>. The main purpose of standardised tests is to achieve fairness of assessment of learning outcomes upon which significant decisions are based. The format of standardised tests can be essay or multiple choice or both.

A multiple-choice item format is designed for objective measurement and contains a stem and response options, one of which is the correct answer. The stem is the beginning part of the item that presents a problem to be solved, or a question which describes what the examinee must do, or an incomplete statement to be completed. It is meant to acquaint examinees with the problems that are being posed while the options are the possible answers that the examinees can choose from, with the correct answer called the key and the incorrect options referred to as distracters (Jimoh & Adediwura, 2020) <sup>[3, 4, 5]</sup>. Multiple-choice tests have been seriously criticised for disregarding testees' partial knowledge and for being highly susceptible to blind guessing. Another issue with multiple-choice test formats is

the fact that certain examinees may not attempt an item due to several reasons leading to item omission. Item omission refers to a situation in which an examinee does not respond to items either as a result of the fact that the examinee does not know the answer or the items are misleading.

Consequently, item parameter indices are used to determine the level of quality of a given test item. They are used to describe the quality of an evaluation instrument. According to Ugodulunwa (2020) [13], parameters are used in IRT to indicate characteristics of items of a test. The quality of tests, on the one hand, can be determined, at least in part, from the analysis of test items. As a result, it is critical to review and analyze the assessment items once they have been applied. The four parameters associated with an item in IRT are the item discrimination index (parameter a), item difficulty index (parameter b), item pseudo guessing or vulnerability to guessing index (parameter c), and distraction factor or inattention parameter (d-parameter).

The discrimination parameter is used to determine how well the items discriminate against different levels of the latent trait. The higher the discrimination of the item, the greater the difference in the probability of getting the correct answer between the high and low examinees will become. The theoretical value range of the parameter a is  $-\infty < a < +\infty$ . However, typical values are  $0.5 \leq a \leq 2.0$ . The difficulty parameter, denoted by b, is defined as the point on the ability scale at which the probability of correct response to the item is 0.5. The difficulty parameter is used to describe how difficult an item is to achieve a 0.5 probability of correct response at a given ability. The theoretical range of the values of the b parameter is  $-\infty < b < +\infty$ . However, typical values of the parameter b are  $-3 \leq b \leq 3$  (Nguyen, 2021). Pseudo guessing parameter c is the probability of correct response to an item from an examinee with low ability. It is the probability that an examinee of very low ability would respond to an item correctly through guessing (Ugodulunwa, 2020) [13]. Thus, theoretical range of the c parameter is (0,1), but in practice, the parameter c that should be used is  $0 \leq c \leq 0.35$ . The d parameter makes for a more detailed technique for testees' ability estimation than a, b, and c parameters logistic models. The d parameter is included when we want to account for situations where a testee may have answered incorrectly unintentionally. This could be attributed to reasons such as fatigue, accidentally clicking on the wrong response option, among others, with an arbitrary upper value of 0.8 (Loe, 2021) [6].

However, it is worthy of note that item parameter indices of tests are used to ascertain attributes inherent in tests upon which an assessment of candidates is based. Item parameter indices are probably the most important tools to increase tests' effectiveness. It is a scientific way of improving the quality of tests, and test items in an item bank. Therefore, since test items affect the vital psychometric properties for measuring quality of examinations, examination bodies are expected to construct test items in such a manner that items are free from writing errors to ensure that the items measure what it exactly want to measure without any ambiguity. It is therefore necessary to estimate the psychometric properties of examination items constructed by these examination bodies to ascertain its effectiveness. Hence, this study sought to estimate item parameter indices of National Examinations Council Senior School Certificate Economics multiple choice items in Delta State.

## Statement of the problem

Despite the importance attached to the teaching and learning of Economics in the educational system, the performance of students in secondary schools Economics in Nigeria has remained an issue of concern to all stakeholders. It has been observed over the years, that the fluctuation in performance of students in Economics has attracted a lot of concern amongst educators. If this trend is allowed to continue, academic performance in Economics will continue to dwindle as years progress. This makes stakeholders to continue to cast blames for the causes of mass failure of students in public examinations. Some people shifted the blame to government, parents, society, teachers and students. As accusations and counter-accusations on who to blame on the poor performance of students in Economics persist, the fact remains that all the questions set for students could also be responsible for the poor performance of students in public examinations. Items making up a test may be defective, and thereby unable to measure students' ability or traits satisfactorily as intended if proper attention is not paid to item parameters such as difficulty, discrimination, pseudo guessing, and distraction factor indices (power) of each item. The study is therefore designed to estimate item parameter indices of NECO Senior School Certificate Economics multiple choice items examination conducted in Delta State.

## Purpose of the study

The general purpose of this study was to estimate item parameter indices of NECO Senior School Certificate Economics multiple choice items examination conducted in Nigeria from 2022-2023. Specifically, the study sought to:

1. Estimate item discrimination indices of 2022-2023 NECO Senior School Certificate Economics multiple choice items.
2. Estimate item difficulty indices of 2022-2023 NECO Senior School Certificate Economics multiple choice items.
3. Estimate item guessing indices of 2022-2023 NECO Senior School Certificate Economics multiple choice items.
4. Estimate item distraction indices of 2022-2023 NECO Senior School Certificate Economics multiple choice items.

## Research questions

The following research questions guided this study.

1. What are the discrimination indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items?
2. What are the item difficulty indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items?
3. What are the guessing indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items?
4. What are the distraction indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items?

## Methods

This study adopted ex-post facto research designs in the estimation of item parameter indices of NECO Senior School Certificate Economics multiple choice items in Delta

State. The population of this study comprised 66,632 Senior Secondary three (SS3) students in Senior Secondary Schools in Delta State. There are 1,447 Secondary Schools in Delta State made up of 489 public secondary schools and 958 private secondary schools. The total population of SS3 students in both public and private secondary schools is 66,632 students with 25,372 and 41,260 in public and private secondary schools respectively. The sample for this study consists of 677 Senior Secondary three (SS 3) using multi-stage procedure was used. The instruments for data collection were National Examinations Council (NECO) Senior School Certificate Economics 2022 and 2023 Multiple Choice Items which contain 60 items each for the two years. The National Examinations Council (NECO) Senior School Certificate Economics 2022 and 2023 Multiple Choice Items were retyped to include the demographic data of the respondents. Hence, the instrument was divided into two sections of A and B. Section A contains the demographic data while Section B contains the NECO Senior School Certificate Examination Economics Multiple Choice Items. Each question is followed by five options lettered A-E in which the students were asked to circle the alphabet that bears the correct answer. The

reliability of the instrument was estimated by National Examinations Council but was not provided to the researcher. Hence, 2022-2023 NECO Senior School Certificate Economics multiple choice items were administered to a sample of 30 senior secondary school three students in Edo State who were not part of the study. The researcher used Kuder-Richardson 20 formula to estimate the reliability of the instruments and a coefficient of .73 and .77 for 2022 and 2023 respectively were obtained as measures of internal consistency. The responses of the students were scored dichotomously, (that is, 1 for students that passed an item and 0 for students that failed an item). Data were analysed using the Raju Area estimation technique of BILOG-MG software to determine the item parameter indices. Frequency count and percentage (%) were used to answer the research questions while chi-square statistics was used to test the hypotheses at 0.05 alpha level.

**Results**

**Research question 1:** What are the discrimination indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items?

**Table 1:** Percentage distribution of discrimination indices of NECO 2022-2023 senior school certificate economics multiple choice items

Raju Discrimination Indices	Level of Discrimination	2022		2023	
		No. of Discriminating items	%	No. of Discriminating items	%
Negative Value	Poor	12	20	8	13.33
Between .00 & .34	Low	15	25	5	8.33
Between .35 & 1.34	Moderate	14	23.33	10	16.67
Between 1.35 & 1.69	High	5	8.33	7	11.67
1.70 & & above	Very High	14	23.33	30	50
Total		60	100	60	100

Table 1 showed that in 2022, 12 items which represents 20% had poor discrimination indices while 15 items which represents 25% had low discrimination indices. It also showed that 14 items which represented 23.33% indicates moderate discrimination indices while 5 items which represents 8.33% indicates high discrimination and 14 items which represents 23.33% indicated very high discrimination indices. It also showed that in 2023, 8 items which represents 13.33% indicated poor discrimination indices while 5 items which represents 8.33% indicates low

discrimination indices. It also showed that 10 items which represented 16.67% indicated moderate discrimination indices while 7 items which represents 11.67% indicated high discrimination indices and 30 items which represents 50% indicates very high discrimination indices.

**Research question 2:** What are the item difficulty indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items?

**Table 2:** Percentage distribution of item difficulty indices of NECO 2022-2023 senior school certificate economics multiple choice items

Raju Difficulty Indices	Level of Difficulty	2022		2023	
		No. of Difficult items	%	No. of Difficult items	%
Below -2	Easy	9	15	5	8.33
Between -2 & +2	Moderate	40	66.67	46	76.67
Above +2	Difficult	11	18.33	9	15
Total		60	100	60	100

Table 2 showed that in 2022, 9 items which represents 15% indicates easy difficulty items indices while 40 items which represents 66.67% indicates moderate difficulty items indices and 11 items which represents 18.33% indicates difficulty items indices. More so, in 2023, 5 items which represents 8.33% indicates easy difficulty items indices while 46 items which represents 76.67% indicates moderate

difficulty items indices and 9 items which represents 15% indicates difficulty items indices.

**Research question 3:** What are the guessing indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items?

**Table 3:** Percentage distribution of guessing indices of NECO 2022-2023 senior school certificate economics multiple choice items

Raju Guessing Indices	Level of Guessing	2022		2023	
		No. of Guessing items	%	No. of Guessing items	%
Below .25	Low	33	55	39	65
Above .25	High	27	45	21	35
Total		60	100	60	100

Table 3 showed that in 2022, 33 items which represents 55% indicates low guessing indices while 27 items which represents 45% indicates high guessing indices. More so, in 2023, 39 items which represents 65% indicates low guessing indices while 21 items which represents 35% indicates high

guessing indices.

**Research question 4:** What are the distraction indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items?

**Table 4:** Percentage distribution of distraction indices of NECO 2022 senior school certificate economics multiple choice items

Raju distraction indices	Level of distraction	2022		2023	
		No. of Distraction items	%	No. of Distraction items	%
Below -.05	Poor	26	43.33	22	36.67
Above -.05	Good	34	56.67	38	63.33
Total		60	100	60	100

Table 4 showed that in 2022, 26 items which represents 43.33% indicates poor distraction indices while 34 items which represents 56.67% indicates good distraction indices. It also showed that in 2023, 22 items which represents 36.67% indicates poor distracters indices while 38 items which represents 63.33% indicates good distracters indices.

study on item parameter estimates of unified tertiary matriculation mathematics examination using item response theory 3-parameter logistic model revealed that a very high percentage (95% in 2017, 95% in 2018 and 85% in 2019) of the items discriminated adequately among high and low performing students.

**Discussion of findings**

**Discrimination indices of NECO 2022-2023 senior school certificate economics multiple choice items**

The results from research question 1 of the study on discrimination indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items revealed that in 2022, 12 items which represents 20% had poor discrimination indices while 15 items which represents 25% had low discrimination indices. It also showed that 14 items which represented 23.33% indicated moderate discrimination indices while 5 items which represents 8.33% indicates high discrimination and 14 items which represents 23.33% indicated very high discrimination indices. The results also showed that in 2023, 8 items which represents 13.33% indicated poor discrimination indices while 5 items which represents 8.33% indicated low discrimination indices. It also showed that 10 items which represented 16.67% indicated moderate discrimination indices while 7 items which represents 11.67% indicated high discrimination indices and 30 items which represents 50% indicated very high discrimination indices. The result of the study corroborated with the finding of Jimoh and Adediwura (2022) [3, 4, 5] who carried out a study on estimation of item parameter indices of NECO mathematics multiple choice test items among Nigerian students revealed that only 21.7% of 2016 NECO Mathematics test items had a very good discriminating power. The findings disagreed with the finding of Ukah, Ebere and Ursula (2022) [15] who carried out a study titled distracter effectiveness and discriminatory index of agricultural science mock senior secondary school certification examination in Abia State revealed that the items of the Mock SSCE Agricultural Science multiple choice objective test items had no satisfactory distracter effectiveness and discriminatory indices. The findings also disagreed with Ugodulunwa, Mbelede, Ezeugo, Eleje and Metu (2022) [14] who in their

**Item difficulty indices of NECO 2022-2023 senior school certificate economics multiple choice items**

Findings from research question 2 of the study on item difficulty indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items showed that in 2022, 9 items which represents 15% indicates easy difficulty items indices while 40 items which represents 66.67% indicated moderate difficulty items indices and 11 items which represents 18.33% indicated difficulty items indices. More so, in 2023, 5 items which represents 8.33% indicates easy difficulty items indices while 46 items which represents 76.67% indicates moderate difficulty items indices and 9 items which represents 15% indicated difficulty items indices. This is related to a study carried out by Galle, Alaku and Samuel (2020) [2] on the investigation of psychometric properties of English language West African Senior School Certificate Examination (WASSCE) in Borno State, Nigeria revealed that some items had moderate difficulty. In the same vein, Sulaiman and Hussaini (2023) [12] who in their study on items analysis of mathematics basic education certificate examination in junior secondary schools before and after covid-19 lockdown in Sokoto State. Revealed that the 2019 basic education certificate examinations Mathematics objective test items had adequate difficulty indices.

**Guessing indices of NECO 2022-2023 senior school certificate economics multiple choice items**

The results from research question 3 of the study on guessing indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items revealed that in 2022, 33 items which represents 55% indicated low guessing indices while 27 items which represents 45% indicates high guessing indices. More so, in 2023, 39 items which represents 65% indicated low guessing indices while 21 items which represents 35% indicated high guessing

indices. This is in line with the study of Jimoh, Daramola, Oladele and Sheu (2020) <sup>[3, 4, 5]</sup> who assessed items prone to guessing in SSCE Economics multiple-choice tests among students in Kwara State, Nigeria revealed that that items prone to guessing in WASSCE and NECO were the same. The finding also revealed that no significant difference existed in items guessed in WASSCE and NECO. Jimoh and Adediwura (2022) <sup>[3, 4, 5]</sup> also in their study on estimation of item parameter indices of NECO mathematics multiple choice test items among Nigerian students revealed that the 2016 NECO test items were not vulnerable to guessing (that is, 86.7% of items were good in terms of guessing).

### **Distraction indices of NECO 2022-2023 senior school certificate economics multiple choice items**

Findings from research question 4 of the study on distraction indices of NECO 2022-2023 Senior School Certificate Economics multiple choice items revealed that that in 2022, 26 items which represents 43.33% indicated poor distraction indices while 34 items which represents 56.67% indicates good distraction indices. It also showed that in 2023, 22 items which represents 36.67% indicated poor distraction indices while 38 items which represents 63.33% indicates good distraction indices. This study aligns with the findings of Mahjabeen, Alam, Hassan, Zafar, Butt, Konain and Rizv (2018) <sup>[7]</sup> in their study on difficulty index, discrimination index and distractor efficiency in multiple choice questions revealed that out of total 260 distractors, 72% were functional and only 28% were non-functional. Sharma (2021) <sup>[10]</sup> who carried out a study on analysis of difficulty index, discrimination index and distractor efficiency of multiple choice questions of speech sounds of English revealed that out of 60 distractors, 5 (8.34%) distractors were non-functional and 55 (91.66%) distractors were functional.

### **Conclusion**

Based on the findings of the study, it was concluded that the NECO SSCE 2022 and 2023 Economics multiple choice tests contain items that have good discrimination indices, difficulty indices, guessing indices and distraction indices. It revealed that in 2022, 12 items which represents 20% had poor discrimination indices while 15 items which represents 25% had low discrimination indices. It also showed that 14 items which represented 23.33% indicated moderate discrimination indices while 5 items which represents 8.33% indicates high discrimination and 14 items which represents 23.33% indicated very high discrimination indices. The results also showed that in 2023, 8 items which represents 13.33% indicated poor discrimination indices while 5 items which represents 8.33% indicated low discrimination indices. It also showed that 10 items which represented 16.67% indicated moderate discrimination indices while 7 items which represents 11.67% indicated high discrimination indices and 30 items which represents 50% indicated very high discrimination indices. It further revealed that in 2022, 9 items which represents 15% indicated easy difficulty items indices while 40 items which represents 66.67% indicated moderate difficulty items indices and 11 items which represents 18.33% indicated difficulty items indices. More so, in 2023, 5 items which represents 8.33% indicated easy difficulty items indices while 46 items which represents 76.67% indicates

moderate difficulty items indices and 9 items which represents 15% indicated difficulty items indices.

The study revealed that in 2022, 33 items which represents 55% indicated low guessing indices while 27 items which represents 45% indicated high guessing indices. More so, in 2023, 39 items which represents 65% indicated low guessing indices while 21 items which represents 35% indicated high guessing indices. The study showed that in 2022, 26 items which represents 43.33% indicated poor distraction indices while 34 items which represents 56.67% indicated good distraction indices. It also showed that in 2023, 22 items which represents 36.67% indicated poor distraction indices while 38 items which represents 63.33% indicated good distraction indices.

### **Recommendations**

Based on the findings of this study, the following recommendations were made.

1. NECO SSCE Economics multiple choice questions that is constructed should be pilot tested every year to ensure that only items that fail should be either modified or discarded.
2. Ministry of Basic Education should ensure that Economics multiple choice test developed at classroom level should be adequate to enhance items that have good discrimination indices, difficulty indices, guessing indices and distraction indices.
3. The assistance of measurement and evaluators should be sought by NECO during item development to enhance fairness of test items.

### **References**

1. Adom D, Mensah JA, Dake DA. Test, measurement and evaluation: Understanding and use of the concepts in education. *International Journal of Evaluation and Research in Education (IJERE)*,2020:9(1):109-119. <http://ijere.iaescore.com>.
2. Galle SA, Alaku EM, Samuel J. Analysis of psychometric properties of English language West African senior school certificate examination in Borno State, Nigeria. *World Journal of Innovative Research (WJIR)*,2020:9(6):01-07. <https://www.wjir.org>.
3. Jimoh K, Adediwura AA. Assessment of reliability and distractor efficiency of Three, Four and Five options Economics multiple-choice items using confidence scoring procedure. *Journal of Evaluation*,2020:5(1):77-79.
4. Jimoh K, Adediwura AA. Estimation of item parameter indices of NECO mathematics multiple choice test items among Nigerian students. *Journal of Integrated Elementary Education*,2022:2(1):43-54. <https://journal.walisongo.ac.id/index.php/jieed>.
5. Jimoh MI, Daramola DS, Oladele JI, Sheu AL. Assessment of items prone to guessing in SSCE Economics multiple-choice tests among students in Kwara State, Nigeria. *Anatolian Journal of Education*,2020:5(1):17-28. <https://doi.org/10.29333/aje.2020.512a>.
6. Loe A. Introduction to item response theory, 2021. Retrieved from <https://www.bsl28@cam.ac.uk>.
7. Mahjabeen W, Alam S, Hassan U, Zafar T, Butt R, Konain S, *et al.* Difficulty index, discrimination index and distractor efficiency in multiple choice questions. *Annual Pakistan Institute of Medical Science*, 2018, 310-315. <https://www.researchgate.net/publication/323705126>.

8. National Examination Council. Regulations and syllabus for senior school certificate examination, revised edition. Otuson Nigeria Limited, 2021.
9. National Examinations Council. NECO Chief Examiners' Report. NECO Publication, 2020.
10. Sharma LR. Analysis of difficulty index, discrimination index and distractor efficiency of multiple choice questions of speech sounds of English. *International Research Journal of MMC*,2021:2(1):15-28. <https://www.mmchetauda.edu.np>.
11. Salihu AG, Sabo ES, Akawu GA. Trend analysis of Economics students' performance in NECO 2015-2022 in North-East geopolitical zone of Nigeria. *International Journal of African Sustainable development*,2023:12:1-12.
12. Sulaiman HA, Hussaini A. Items Analysis of Mathematics Basic Education Certificate Examination in Junior Secondary Schools Before and After Covid-19 Lockdown in Sokoto State. *African Journal of Humanities & Contemporary Education Research*,2023:11(1):243-257. <https://www.afropolitanjournals.com>.
13. Ugodulunwa CA. Fundamentals of educational measurement and evaluation 2<sup>nd</sup> edition. Fab Education Books, 2020.
14. Ugodulunwa CA, Mbelede NG, Ezeugo NC Eleje LI, Metu IC. Item parameter estimates of unified tertiary matriculation mathematics examination using item response theory 3-parameter logistic model. *Asian Journal of Advances in Research*,2022:5(1):682-692.
15. Ukah PN, Ebere C, Ursula NA. Distracter Effectiveness and Discriminatory Index of Agricultural Science Mock Senior Secondary School Certification Examination in Abia State. *Propellers Journal of Education*,2022:1(1):9-20. <https://www.vinpublishing.com>.