IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388, p- ISSN: 2320-737x Volume 14, Issue 5 Ser. 2 (Sept. – Oct. 2024), 27-35
www.iosrjournals.org

Analysis Of The Dimensionality Of 2018 And 2019 West African Senior School Certificate Multiple-Choice Objective Tests In Chemistry In Gombe State, Nigeria

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Abstract
This study investigated and analyzed the dimensionality of the 2018 and 2019 May/June series of the West African Senior Secondary Certificate Examination (WASSCE) multiple-choice objective test items in chemistry. The study employed an exploratory research design. The population of the study consisted of 16,600 students in public senior secondary schools in Gombe State, while a sample of 400 students randomly selected via multistage sampling techniques participated in the study. In the years 2018 and 2019, the May/June series of the West African Senior Secondary Certificate Examination Multiple-Choice Objective Test items in Chemistry were adopted as instruments for the study. Two research questions were raised to guide the study. The data collected were analyzed via principal component analysis. The findings of this study revealed that the West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry for the year 2018 was unidimensional, whereas for 2019, it was multidimensional, and there was a difference between the dimensionality of the WAEC Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry for the years 2018 and 2019. On the basis of the findings of this study, it was concluded that the West African Senior School Certificate Examination Multiple-choice Objective Tests items in Chemistry for the year 2018 were unidimensional and that the WAEC Senior School Certificate Examination 2019 Chemistry Multiple-choice Objective Test items were multidimensional, and there was a discrepancy in the findings of this study, indicating that the 2018 WAEC Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry conform to the assumption of unidimensionality and reconmmendations.

Keywords: *Dimensionality, West African Senior School Certificate, Chemistry*

Date of Submission: 10-09-2024 Date of Acceptance: 20-09-2024

I. Introduction

Testing is an indispensable aspect of the teaching and learning process and is used as a basis for rating students at the end of the teaching and learning process. Evaluation or testing serves as a guide for teaching and learning that enhances the development and improvement of the curriculum, which includes the assessment of learners' needs, the identification of difficult areas, the level of mastery of the subject and the identification of differences among students (Ayanwale,2020).

Testing is one of the techniques used in carrying out the process of evaluation. Tests can be defined as a systematic procedure for measuring sample behavior (Joshua, 2005). A test, according to Nworgu (2011), is a structured item comprising a set of questions to which an individual is expected to respond, and each question in the test has a preferred answer. Nworgu (2011) noted that the behavior of an individual is quantified on the basis of his responses to the questions. Onuka and Durowoju (2011) described a test as an instrument that can be used to distinguish a few characteristics, traits, qualities, and attributes possessed by a person, an object or a thing.

Tests are crucial to the educational system because they provide a framework for achieving substantial educational goals (Hamafyelto, Hamman &Tukur 2015).

A basic concern in the design and evaluation of test items is validity. Brown (2000) defines validity as "the extent to which a test measures what it asserts, or purports be measure." Validity refers to the extent to which the evidence supports the inferences based on the test item scores. The significant impact that test results may have on the pertinent stakeholders makes validity crucial. According to Johann and Faans (2008), a test's validity can be determined only through the validation procedure, which should be carried out before the results are used for any specific purpose. Johann and Faans (2008) noted that to determine the validity of the test results' interpretation and use, a validation study must be conducted.

The recognized dimensions of test validity include content validity, criterion-related validity, and construct validity; nevertheless, data supporting the validity of a test are acquired in many ways. According to Brown (2000), content validity encompasses all validity techniques that concentrate on the test's subject matter. The extent to which a test is a representative sample of the content of whatever objectives or specifications it was designed to measure is another way to show content validity. Analyzing a test item's internal structure to ensure that it performs as intended is known as determining the test item's construct validity. Assessing the dimensionality of test items is a crucial part of item analysis because analysis of construct (dimension) validity includes correlations between items and the test, subgroup discrimination, factor analysis, and multitrait-multimethod approaches. Validity is an integrated and thorough evaluation of the extent to which empirical data support the sufficiency and appropriateness of test score interpretations.

An important purpose of evaluation in educational settings is to gauge how well testees are currently learning and how well prepared they are for the next learning experience (Zaman, Kashmiri, Mubarak and Ali, 2008). The performance depends on the characteristics of the test items to which the test-takers respond, and the inherent trait(s) being measured. Similarly, scoring frameworks that are unable to accurately reflect test takers' true performance ultimately led to abnormal test grades that do not accurately reflect test takers' actual ability. Test items that measure constructs other than what they are intended to measure will have a negative impact on students' performance. There are two modern theories for estimating the quality of test items and determining test-taker scores. These are item response theory (IRT) and classical test theory (CTT). The value assigned to the conduct in terms of numbers for evaluation can be quantified via the two theories. For many years, the sole measurement framework available to test developers and psychometricians was classical test theory (CTT), which is the bedrock of measurement theory. According to classical test theory, a test item's overall dependability is a concern. It acknowledges that the test items are drawn at random from a collection of relevant things for inspection (Nenty, 2004). It connects the observed test score (X) to the sum of two unobserved variables, the true score (T) and the error score (E), which are frequently referred to as latent variables (E).

The importance of the classical test theory (CTT) framework in the production of tests, given its capacity to identify subpar items through the calculation of item statistic values (difficulty index and discrimination index), cannot be overemphasized. It is true that a test item constructed via the CTT framework may accurately assess any test item's psychometric characteristics. Despite being widely used in standardized testing and measurement, classical test theory has many drawbacks. For example, true and error scores are not correlated, item difficulty and item discrimination are dependent on the test taker's group, and most importantly, it is assumed that all test takers will experience the same measurement errors. As a result, the degree of competency and the number of test-takers determine item difficulty and discrimination indices. In a similar vein, test takers' marks mostly depend on the quality of items, and the estimation of person statistics does not account for the difficulty and discrimination indices (observed grade). Under the designed response test items, the framework is unable to record item parametric values. Many public examination bodies in Nigeria still evaluate multiple-choice test items according to the traditional test theory paradigm. Approximately 60% of the test item grades are constructed answer test items, and it is entirely unknown how well-written they are in terms of parametric quantities. This circumstance might compromise the accuracy of the projected abilities of the candidates.

Over the past three decades, the subject of educational measurement has undergone modifications worldwide to meet the growing demand for credible interpretations of individual grades from educational tests or examinations (Adedoyin, 2012).

Item response theory is a testing theory that examines the correlation between test takers' performance on a particular item and their level of performance on a general indicator of the skill that the item was intended to evaluate. Item response theory is a set of models that relates the likelihood of a specific reaction by a participant with a given degree of trait to the characteristics of the item intended to elicit that testee's level of trait possession (Rupp, 2009). However, the model establishes the connection between a testee's latent talents and the likelihood that the testee would correctly react to a given item. It provides parametric quantity estimates, process explanations, and outcome predictions for such interactions (Nenty, 2000). IRT is less concerned with overall exam scores than with whether a test taker correctly answers a question. This is referred to as the item pattern scoring procedure. One of the assumptions of item response theory is unidimensionality. This assumption is that

most models assume that the items are part of a single dimension. In other words, they are one–dimensional. Thus, before these types of models are used, the data must comply with this one–dimensional approach. Unfortunately, many of the instruments that psychologists frequently use collect multidimensional data.

Dimensionality is a crucial factor in educational assessments, from those developed internally by schools or teachers to those that are externally standardized or certified, local exams administered by examination bodies, and assessments by international organizations in charge of certification, licensing, and benchmarking. The administration, scoring, data analysis, and reporting of the test results are all affected by dimensionality. For example, dimensionality assessment was used in the National Assessment of Educational Progress (NAEP) in the United States of America (USA) for subjects, including mathematics, science, and reading tests.

In fact, obtaining a thorough understanding of a test's internal structure and how test results establish human skills through dimensionality evaluation is the process of dimensionality. Dimensionality, as defined by Stevina (2011), is the association between test items and the latent proficiencies thought to be assessed by the test. According to Stevina, dimensionality in assessment refers to how many skills or constructs are evaluated by a test or a group of items. The assumption of local independence, which is based on the value of the conditional covariance between two items, is the basis of the working definition of dimensionality. Therefore, by looking at these conditional covariances, one can look into the dimensionality of a test.

In Nigeria, at the end of secondary school education, students are qualified to sit for certification examinations such as senior school certificate examinations (SSCEs), which are conducted by the West African Examinations Council (WAEC) and the National Examinations Council (NECO). These tests are designed to assess how well students have met the learning objectives for each subject. These examination bodies' respective credentials are formally acknowledged as being equal in Nigeria. The certifications can also be utilized for a variety of additional tasks, such as finding employment in the relevant public sector, private businesses, and corporations, as well as being admitted to a higher institution. When grades are low or insufficient to gain admission to a higher institution in Nigeria or overseas, these credentials can also be combined (Babatimehin, 2020).

Chemistry is one of the core aspects of basic sciences, and it plays a vital role in the advancement of science and technology, which is one of the aims of the Nigerian Education Programme. Chemistry is one of the prerequisites for admission to any Nigerian tertiary institution to study any of the sciences and science-related courses. It is therefore necessary that a student obtain at least a credit level in Chemistry in the West African Senior School Certificate Examination (WASSCE) to qualify one to read courses such as Medicine, Pharmacy, Engineering, Industrial Chemistry, Technology and other Applied Science courses in tertiary institutions.

Statement of the problem

One of the objectives of educational measurement is to precisely estimate a testee's ability in a specific subject and utilize the results of the measurement to make pivotal decisions about the testee. Such a decision may be for placement, promotion, scholarship awards and certification. Achievement tests at the senior secondary school level for science students are administered in chemistry, physics, mathematics and other related science subjects by public examination bodies. Chemistry is a compulsory subject for all science candidates who enroll in examinations at that level. The central position given to Chemistry might be because of the roles it plays in the career pursuits of the testees. The subject is a prerequisite for admission to study many science courses, such as medicine, pharmacy, engineering and others, at the postsecondary school level.

Test dimensionality assessment is crucial in the gathering of empirical evidence to support the validity of interpretations based on total scores, especially in achievement tests. Determining the dimensionality of the test item helps to strengthen the quality of the test and identify good- or bad-performing test items and helps improve the test items toward the production of valid tests for future use. Most achievement tests constructed in Nigeria for public examinations are founded on classical test theory (CTT), and as a result, they encounter issues such as low precision, sample dependence, and an excessive emphasis on aggregate results, which prevent test developers from learning how test takers perform on a particular item. The use of item response theory (IRT) in the principal component analysis model can be used to solve or resolve this issue.

Many researchers (Li, Jiao & Lissitz (2012), Ozbekbastug (2012), Wilson (2000), Eleje, Onah and Abanobi (2018), Alade, Aletan and Sokenu (2020)) have conducted studies on the assessment of dimensionality in different subjects, which include validation of the test structure and dimensionality of Michigan K-12 Science Assessment with the application of multidimensional item response theory (IRT) models by Li, Jiao & Lissitz, 2012). Ozbekbastug (2012) assessed the dimensionality of test items in the Social Science subtest of the Turkish Secondary School Student selection and placement Tests of 1999, 2000 and 2001. Wilson (2000) equally assessed the dimensionality of Listening and Reading Comprehension test items in the TOEIC (Test of English for International Communication), in which the study involved native speakers of Japanese and Korean. Eleje, Onah and Abanobi (2018) investigated test item parameters and test statistics of economics via the classical test theory approach and item response theory. The data analyzed confirmed the unidimensionality, local independence and

model-data fit assumptions. Alade, Aletan and Sokenu (2020) assessed the dimensionality and local independence of WASSCE 2018 mathematics objective test scores.

On the basis of the available literature, none of the studies were conducted on the West African Senior School Certificate Multiple-choice Objective Test in Chemistry using the IRT model in Gombe State. Therefore, there is a need to fill these gaps. Thus, this study sought to analyze the dimensionality of the 2018 and 2019 West African Senior School Certificate Multiple-choice Objective Tests in Chemistry.

Purpose of the study

This research sought to investigate and analyze the dimensionality of the West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry of the years 2018 and 2019. Specifically, this research study aimed to analyze the following:

a. the dimensionality of West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry in the years 2018 and 2019.
b. the variance in the dimensionality of the West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry in the years 2018 and 2019

Research Questions

This study specifically sought answers to the following research questions:

a. What are the dimensionalities of the West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry in the years 2018 and 2019?
b. Is there any difference in the dimensionality of the West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry between 2018 and 2019?

II. Methods

An exploratory survey was adopted for this study. Jupp (2006) stated that a methodological approach that is primarily concerned with discovery and generating or building theory is called exploratory research design. This study's design was chosen because it allowed the researcher to gather the necessary information and draw reliable conclusions that would be useful to other researchers who may be interested in this study area.

The population of this study consists of sixty-three thousand, two hundred and twenty-three (63,223) students in one hundred and fifty-four (154) public senior secondary schools in Gombe State, Nigeria, whereas the target population for this research study comprises 18,584 senior secondary three (SS3) students in public schools in Gombe State, Nigeria. A total of four hundred (400) students out of 16,600 students who registered for Chemistry in the final senior school certificate examinations were randomly selected from three senatorial zones of Gombe State and participated in this study. This sample size was deemed appropriate, as proposed statistically by Taro Yamane (1976). A multistage sampling technique was used. First, a proportionate sampling technique was used to select the required number of schools from each of the three study zones in the state, which were chosen via the proportionate random sample technique. Sambo (2008) suggested that the proportionate sampling technique is the best method for choosing a sample from an unequal population. Second, a representative sample of schools was chosen via a systematic random sampling technique. The sampling method, known as systematic random sampling, involves moving down a list of the working population and choosing every k^{th} individual or item to be included in the sample (Hassan, 1995). Researchers generated lists of senior secondary schools for each of the three (3) Senatorial zones in Gombe State, comprising Gombe North (5 local governments), Gombe Central (2 local governments) and Gombe South (4 local governments), from the lists of schools already collected from the state ministry of education during the second term in the 2022–2023 academic session and selected the required number of schools from the generated list for each of the three (3) Senatorial zones of Gombe State of Nigeria; thus, a total of twenty (20) senior secondary schools participated in this study. Third, a systematic random selection technique was used to choose the respondents from the selected schools. The researcher compiled a list of SSS3 students who registered for Chemistry in each of the chosen schools' final senior school certificate examinations. The researcher then randomly selected the required number of students to partake in the study.

In the years 2018 and 2019, the May/June series of the West African Senior School Certificate Examination (WASSCE) Multiple-Choice Objective Tests in Chemistry was adopted and used as instruments in this study. In the years 2018 and 2019, the May/June series of the WAEC Senior School Certificate Multiple-choice Objective Tests in Chemistry consisted of 50 items each. These instruments are standardized achievement tests developed by the West African Examination Council (WAEC). The instruments adopted were past question items from the May/June series of the West African Senior School Certificate Multiple-choice Objective Tests in Chemistry in 2018 and 2019 and the tagged Chemistry Achievement Test (CAT), which was categorized as Paper 1 or Paper 2. The answer sheet was subdivided into two (2) sections (A and B). Section A contains the personal data of the respondents/students, such as the name of the school, the age of the student, and the gender of the

students, whereas Section B contains fifty (50) questions with four options (A to D) for responses to the items on the past questions compiled. An answer sheet was also prepared for the responses of the students.

The West African Senior Certificate Multiple–choice Objective Tests in Chemistry in 2018 and 2019 are standardized achievement tests developed and validated by relevant units of the West African Examination Council. Given that the reliability of these test items might have been determined by the relevant unit of the West African Examination Council, the adopted Chemistry Multiple-choice Objective Tests are considered reliable for the study.

All the selected senior secondary schools were visited, and the permission of the school authority was sought for the administration of the instrument. The dates and times of administration of the treatments were also fixed. The researchers and trained research assistants administered the instruments to the selected senior secondary school three (SSS.3) students in each of the selected schools on the scheduled dates. The participants were guided to respond independently to Sections A and B of each instrument. A duration of 1 hour was allocated to each instrument, and each instrument was administered each week. Two weeks were used for the administration of the two (2) instruments.

Following the administration of the instruments, the responses were marked and transformed dichotomously, the data were analyzed via principal component analysis (PCA), and SPSS software version 21 was adopted for the analysis.

III. Results

Two research questions were raised and answered via exploratory principal component analysis (PCA) in this study.

Research Question 1: *What is the dimensionality of the West African Senior School Certificate? Examination of Multiple-choice Objective Tests in Chemistry in 2018 and 2019?*

To answer research question 1, the adequacy of the test item samples was determined.
And is presented in Table 1.

Table 1: KMO and Bartlett tests

Kaiser–Meyer–Olkin Measure of Sampling Adequacy	.830
Approx. Chi-Square	1639.271
Bartlett's Test of Sphericity Df	1225
Sig.	.000

Table 1 presents the results of the analysis conducted to assess the adequacy of the data for exploratory factor analysis. The Kaiser–Meyer–Olkin (KMO) sampling adequacy statistic yielded a value of 0.830, indicating that the data were highly suitable for factor analysis. This signifies a strong level of sampling adequacy. Additionally, the chi-square statistics for Bartlett's test of sphericity yielded significant results, with a p value less than 0.05. These findings indicate that the data exhibited adequate correlation patterns and followed a normal distribution. Consequently, these findings support the appropriateness of conducting exploratory factor analysis on the test data. The purpose of exploratory factor analysis is to determine the number of dimensions or factors present in the data.

Ascertaining the assumption of unidimensionality

To address Research Question 1, an exploratory principal component analysis (PCA) was conducted to verify the assumption of unidimensionality in item response theory (IRT). The Kaiser–Guttman rule, which involves selecting factors with eigenvalues greater than 1, was employed to determine the number of factors. This criterion ensures that the selected factors account for more variance in the items than the average. The results of the PCA, indicating the factors that meet the Kaiser–Guttman rule, are presented below:

Table 2: Principal component analysis - Eigenvalue and percentage of variance explained

Component	Eigenvalue	Variance Explained (%)	Cumulative (%)
1	4.008	27.016	27.016
2	3.120	4.240	31.256
3	3.088	5.177	36.433
4	2.494	3.987	40.420
5	2.311	3.622	44.042
6	2.080	3.160	47.203
7	2.078	3.156	50.359

8	1.938	2.876	53.235
9	1.920	2.840	56.075
10	1.759	2.518	58.593
11	1.695	2.390	60.983
12	1.563	2.125	63.108
13	1.476	1.951	65.059
14	1.443	1.885	66.944
15	1.278	1.556	68.500
16	1.229	1.457	69.958
17	1.154	1.309	71.267
18	1.119	1.238	75.505
19	1.061	1.122	73.627

Table 2 displays the Eigenvalues obtained from the analysis, revealing that nineteen components met the Kaiser–Guttman rule, with the first component having an Eigenvalue greater than 1. According to Reckase (1979), a factor that indicates unidimensionality should explain more than 20% of the variance. In this study, the first factor accounted for 27.016% of the total variance, surpassing the criterion and demonstrating the unidimensional nature of the data. The remaining components had eigenvalues below 1. To visually depict the pattern of the PCA, Figure 1 presents the corresponding scree plot of the West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry in 2018.

Figure1. Scree plot for West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry in year 2018.

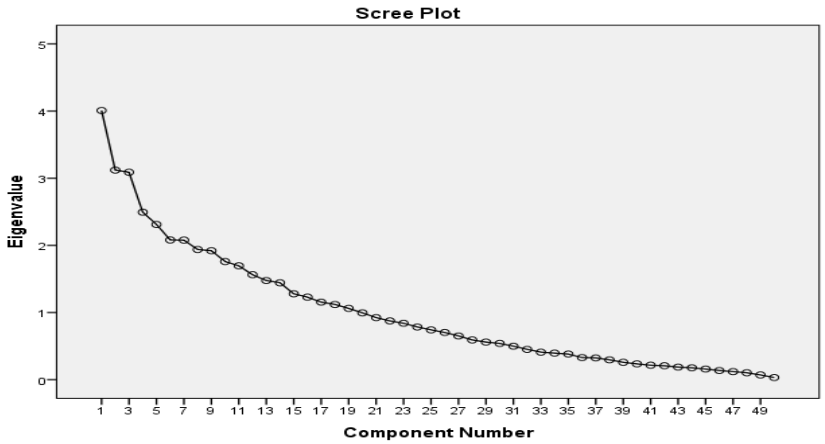


Table 3 displays the results of the KMO test and Bartlett's test of sphericity conducted for the 2019 West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry. These tests were performed to assess the normality and sample adequacy of the data.

The KMO test evaluates the sampling adequacy by measuring the proportion of variance among variables that may be caused by underlying factors. It provides a value between 0 and 1, with higher values indicating better sample adequacy. Bartlett's test of sphericity, on the other hand, examines whether the correlation matrix of the variables is significantly different from an identity matrix. A significant result indicates that the variables are sufficiently interrelated for factor analysis. The specific results of the analysis for normality and sample adequacy are presented in Table 3.

Table 3: KMO and Bartlett's Test

Kaiser–Meyer–Olkin Measure of Sampling Adequacy		.760
Approx. Chi-Square		1639.271
Bartlett's Test of Sphericity	Df	1225
Sig.		.000

Table 3 presents the results of the analysis conducted to assess the sampling adequacy and normality of the 2019 West African Senior School Certificate Examination multiple-choice objective test in chemistry. The KMO sampling adequacy statistic yielded a value of 0.760, indicating a relatively good level of sample adequacy.

Additionally, the chi-square statistics for Bartlett's test of sphericity yielded significant results, with a p value less than 0.05. This suggests that the test data exhibited adequate interrelatedness among the variables and followed a normal distribution. Therefore, it was deemed appropriate to proceed with principal component analysis on the test data.

Principal component analysis was performed to determine the number of dimensions present in the data.

Table 4: Principal component analysis - Eigenvalue and percentage of variance explained

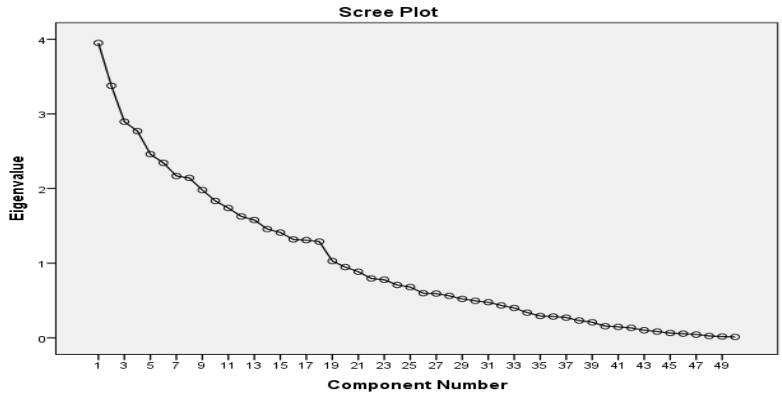
Component	Eigenvalue	Variance Explained (%)	Cumulative (%)
1	7.901	7.901	7.901
2	6.754	6.754	14.655
3	5.791	5.791	20.447
4	5.538	5.538	25.985
5	4.921	4.921	30.906
6	4.687	4.687	35.593
7	4.336	4.336	39.929
8	4.283	4.283	44.213
9	3.960	3.960	48.172
10	3.667	3.667	51.839
11	3.476	3.476	55.316
12	3.251	3.251	58.567
13	3.156	3.156	61.723
14	2.914	2.914	64.637
15	2.821	2.821	67.458
16	2.635	2.635	70.093
17	2.617	2.617	72.711
18	2.579	2.579	75.289
19	2.056	2.056	77.346
20	1.893	----	------

The findings presented in Table 5 confirm that the 2019 West African Senior School Certificate Examination Multiple-choice Objective Test in Chemistry is a multidimensional assessment. To explore the underlying dimensions, a factor analysis was conducted via principal component analysis (PCA). The analysis revealed that the first nineteen factors had eigenvalues greater than 1, indicating the potential presence of multiple dimensions within the test. However, the variance associated with the first factor, which had an eigenvalue of 3.950, accounted for only 7.901% of the total variance. This falls below the 20% threshold proposed by Reckase for considering it as indicative of unidimensionality.

Figure 2, the scree plot, provides a visual representation of the total variance associated with each factor. The steep slope at the beginning of the plot represents the larger factors associated with loadings greater than the eigenvalue of 1. The gradual trailing off (scree) following the steep slope corresponds to the remaining factors with eigenvalues lower than 1.

Figure 2. Scree plot of WAEC SSCE Chemistry (2019) Based on these findings, it can be concluded that the WAEC 2019 Senior School Certificate Examination Multiple-choice Objective Test in Chemistry, comprising 50 items, is indeed a multidimensional assessment.

Figure2. Scree plot for West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry in year 2019.



Research Question 2: *Is there any difference in the dimensionality of the West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry in years 2018 and 2019?*

To address research question 2, the dimensionality of the West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry for the years 2018 and 2019 was analyzed via exploratory principal component analysis (PCA). The results of these analyses are presented in Tables 2 and 4. Upon examining the outcomes obtained through the PCA method, it becomes evident that a significant discrepancy exists between the results of the two tests. Therefore, it can be concluded that there is a difference in the dimensionality of the West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry for the years 2018 and 2019.

IV. Discussion Of The Findings

This study revealed that the West African Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry of the year 2018 was unidimensional, whereas that of 2019 was multidimensional. The findings of this study for the year 2018 were in agreement with those of Adewuni et al. (2017), Chinelo (2019) Ayanwale, Oloniyo and Abayomi (2020) and Adeyemi and Kasali (2022) Adewuni, el.ta. The findings of this study showed that 56 items, or 93.33% of the total 60 items in the Nigerian Senior School Certificate Examination June/July, formed one dimension. The 2013 and 2014 Nigerian Senior School Certificate Examination June/July Multiple-choice Objective tests in Government were unidimensional, and no discernible difference was found between the two tests. Adeyemi and Kasali (2022) reported that the 2016 NECO mathematics test was essentially unidimensional. However, the findings of this study for 2019, which revealed the multidimensionality of the data, agreed with those of Busari and Adewuni (2018). Busari and Adewuni (2018) find multidimensionality of the West African Senior School Certificate Examination June/July 2013/2014 Objective Tests in Financial Accounting.

However, the findings of this study contradict the findings of Li, Jiao and Lissitz (2012), Ozbekbastug (2012), Ozbekbastug (2012) and Ubi (2012) and Alade, Aletan and Sokenu (2020) and Busari and Busari (2020). Li, Jiao and Lissitz (2012) reported violations of the assumptions of the unidimensional IRT model. Ozbekbastug (2012) reported the multidimensionality status of the Social Science subtest of the Turkish Secondary School Student selection and placement Tests of 1999, 2000, and 2001. The study suggested that the social science subtest was multifaceted and that it would be beneficial to define the multidimensionality structure of the dataset, and Ubi's (2012) findings equally violated unidimensionality. As well. Similarly, Aletan and Sokenu's (2020) findings indicated that the 2018 WASSCE mathematics objective items did not meet the assumption of unidimensionality and that there is more than one dimension that accounts for the variation observed in the examinee's responses to the mathematics test items. Busari and Busari (2020) findings revealed that the use of an interitem correlation matrix and principal component analysis for testing dimensionality has consistent evidence of multidimensionality. Ayanwale, Oloniyo and Abayomi's (2020) findings on the assessment of the dimensionality of the 2018 Osun state unified multiple-choice mathematics achievement test items demonstrated that the unidimensionality assumption of the test items was violated.

Finally, the findings of this study indicated that there was a difference between the dimensionality of the WAEC Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry for the years 2018 and 2019. The findings of this study are in agreement with those of Busari and Adewuni (2018). Busari and Adewuni (2018) confirmed a substantial difference in the dimensionalities of the West African Senior School Certificate Examination June/July 2013/2014 Objective Tests in Financial Accounting; thus, the dimensionalities of the two tests were different. However, the findings of this study contradict the findings of Adewuni, el.ta. (2017), which claimed that the 2013 and 2014 Nigerian Senior School Certificate Examination June/July Multiple-choice Objective tests in Government were unidimensional; thus, there is no difference between the dimensionality of the 2013 and 2014 Nigerian Senior School Certificate Examination June/July Multiple-choice Objective tests in Government.

V. Conclusion

Considering the findings of this study, it was concluded that the West African Senior School Certificate Examination Multiple-choice Objective Test items in Chemistry for the year 2018 were unidimensional and that the WAEC Senior School Certificate Examination 2019 Chemistry Multiple-choice Objective Test items were multidimensional and that there was a discrepancy in the findings of this study, indicating that the 2018 WAEC Senior School Certificate Examination Multiple-choice Objective Tests in Chemistry conform to the assumption of unidimensionality.

VI. Recommendations

On the basis of the findings and conclusions of this study, the following is recommended:

a. The West Africa Examinations Council (WAEC) should intensify its efforts to improve the standards of test items. This can be accomplished by implementing the item response theory (IRT) model in test construction, validation, and dimensionality assessment. Compared with the classical test theory (CTT) approach, the IRT model analyzes students' responses item by item, providing a more accurate evaluation of their knowledge and skills.
b. Test practitioners should prioritize conducting dimensionality assessment analysis of their tests before administering them. This practice ensures that the tests are designed with a clear focus on a single dimension, resulting in the generation of high-quality test items.
c. Furthermore, the adoption of the IRT model and the emphasis on dimensionality assessment analysis will contribute to the production of high-quality test items and accurate interpretation of test scores, ultimately benefiting both students and the educational system as a whole.
d. Teacher training institutions should expose pre-service teachers to test developments that meet IRT assumptions, which are particularly unidimensional. This would give them opportunities to be in the best position to produce valid, reliable and fair assessment tools that are bias free.

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