



Construction And Validation Of Chemistry Achievement Test For Senior Secondary Schools In Bayelsa State

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Abstract

The issue of test planning for senior secondary schools for the determination of students' level of academic achievement is a major problem in the Nigerian educational system. This is due to the lack of professional skills in test construction by those (teachers) who have the responsibility of directly carrying out assessment of the students on a daily basis. This study was therefore aimed at constructing and validating Chemistry Achievement Test for Senior Secondary Schools. The items for the study were drawn from topics in the first two levels of the Senior Secondary School Chemistry curriculum. In developing the instrument, a table of specification was drawn in order to cover all the content areas and the behavioural objectives of the learner. The design for the study was instrumentation as Chemistry Achievement Test was developed. The validity was established using table of specifications while Kuder Richardson formula 20 was used to establish the reliability. Coefficient of 0.85 was obtained. The Standard Error of Measurement of the test is 3.34. The sample for the study was 380 SS2 science students in Bayelsa State. The simple random sampling was used to select students for the test. The constructed achievement test would be useful to students, teachers, public examination bodies and education policy makers. Based on the results, it was concluded that the constructed Chemistry Achievement Test is valid, reliable, cover a wide spectrum of achievement and has a good precision of item measurement.

Keywords: Construction, achievement, test, validity, reliability

INTRODUCTION

The term test is a set of questions or statements which have been structured and graduated to elicit and measure responses about an attribute in an individual (Odili & Ajuar, 1995). It also connotes a set of tasks or a presentation of a standard set of questions to be answered. Based on the answers provided to the series of questions, we obtain a measure that is subject to evaluation. Therefore, a test can be defined as any kind of device or procedure for measuring achievement, aptitude, interest, ability and any other traits or personal attributes.

Testing serves the purpose of selecting students into educational programmes, classification of students, certification of students, promotion from one level of education to another, prediction of future performance or potentials, verification and evaluation of academic programmes as well as provision of significant data and information for counseling diagnoses (Kenneth, 2000; Stump, 1996).

Chemistry lays a sound foundation for further studies of medicines, engineering, micro-biology and biochemistry at higher level. This is why chemistry is considered as a major requirement for admission into the above disciplines in institutions of higher learning. Chemistry further contributes immensely in the process of manipulation, assimilation and abstract and creative thinking. It is therefore, required that a student should obtain at least a credit in chemistry in the examinations conducted by WAEC and NECO to qualify as student of medicine, engineering and other related disciplines in colleges of Education, Polytechnics and Universities. In spite of the aforementioned importance of chemistry a poor performance has been recorded for the subject over the years.

One of the major techniques used in evaluating the academic performance of students is achievement test. The scores which students obtain in an achievement test should be the representative of the extent to which the characteristics being measured by the test are present in the test-takers. A score in an achievement test is meaningful and relevant if and only if, it actually present the levels of understanding and attainment of the test-takers in the tasks presented by the test items.

The test items are supposed to reflect the entire topics, which are expected to be covered in a subject by the students. This test is designed to assess how much of the content of a course an individual has learned over a period of time (Adeniji and Ilorah, 2018). It should cover the scope of the topic in the syllabus or scheme of work and the behavioural objective it claims to achieve in a proportional manner. This is possible by the use of table of specifications or test blue print (Onunkwo, 2002). Consequently, any examination or test which possesses this quality is said to possess content validity. Chemistry Achievement Tests constructed and administered by teachers for classroom assessment has questionable or low validity due to the inability of the teachers to understand the guidelines for the construction of test. The test constructed by these inexperienced teachers either over-emphasizes objectives of the lower levels or under-emphasizes objectives of the high levels of the cognitive domain of the human behaviour. In some cases, all the items only centered on two or three levels with a total neglect of the rest. Sometimes they set questions only on the immediate or most recent weeks or term's work and ignore the rest.

A test which is considered to possess content validity is expected to measure the attributes of the learner consistently. If this is so, then the test or examination is said to be reliable. But over the times teacher-made achievement tests are seen to have low reliability. Scores of students are not consistent. For instance, a student who scored 70% in a chemistry test could only score 40% in a second test of similar difficulty. In other cases, for a particular item, at most three out of a total of fifty students will get it right while the rest fails the item. The range of the scores obtained by students in a test is usually very high. Scores between testees also have high standard deviation. These issues make the teacher-made achievement test to have low reliability.

In this study, achievement test questions in chemistry are valid in content and reliable when the questions or items makes a fair coverage of the topic and performance objectives emphasized in the curriculum for chemistry. It is only with this that the students' achievement in the test or examination will be meaningful and relevant. This can be achieved when the Chemistry teacher has a good knowledge of test construction and validation.

Statement of the Problem

Chemistry Achievement Test (CAT) for Senior Secondary School should cover all the content areas taught within a period of teaching and learning. It should also cover the behavioural domain of the learners as they are stated in the curriculum for Chemistry proportionately.

The problem investigated in this study therefore is; how well does the constructed Chemistry Achievement Test (CAT) covers the content and behaviour processes of the Senior Secondary School curriculum in Chemistry.

Purpose of the Study

The purpose of the study is to construct and validate Chemistry Achievement Test (CAT) for Senior Secondary Schools. Specifically, the study attempted to:

1. establish the validity of Chemistry Achievement Test for Senior Secondary Schools.
2. establish the reliability of the Chemistry Achievement Test for Senior Secondary Schools.
3. identify the measurement error of the Chemistry Achievement Test for Senior Secondary Schools.

Research Questions

The following research questions were formulated to guide this work.

1. What is the validity of the Chemistry Achievement Test for Senior Secondary Schools?
2. What is the reliability of Chemistry Achievement Test for Senior Secondary Schools?
3. What is the measurement error of Chemistry Achievement Test for Senior Secondary Schools?

METHODOLOGY

The design of this study is instrumentation. There are 174 public secondary schools in Bayelsa State with a total population of 39,507 in Junior Secondary School and 38,069 in Senior Secondary Schools. Out of this population, about 3843 students offers Chemistry in SS2 (Source: Bayelsa State Ministry of Education). The purposive or judgmental method of non-probability random sampling technique was used to select three schools from each senatorial district, making a total of nine schools. Subsequently, the simple random sampling technique was used to select the students, from the nine schools. A total of 380 students was used for the chemistry achievement test. A total of 100 questions were constructed but after trial testing, 50 were used for the research. Each item has four options lettered A - D. Out of the four options, one is correct while the other three are treated as distractors. In order to establish the content validity of the instrument, a table of specifications was drawn.

Moreover, to establish the reliability of the test items, Kuder-Richardson formula 20 was used. The Kuder-Richardson formula 20 can be applied for binary type of data i.e. true/false or dichotomously scored data where the responses are scored either right or wrong, pass or fail. In the binary-type of data the correct answer or option was treated as one (1) while the incorrect or wrong option was treated as zero (0). The research questions were answered with percentages. The first research question addressed the level of validity of the Chemistry Achievement Test by using table of specifications. The content areas and the behavioural domains presented in the test blue print are presented in percentages.

RESULTS

Research Question 1: *What is the validity of the Chemistry Achievement Test for Senior Secondary Schools?*

In a view to determine the validity of the Chemistry Achievement Test (CAT) for Senior Secondary Schools, the table of specifications had to be drawn or constructed. This helped in determining the content validity of the Chemistry Achievement Test (CAT) for Senior Secondary Schools.

Table 1: Table of Specifications for Chemistry Achievement Test

	Content Area	COGNITIVE LEVEL (BEHAVIOURAL OBJECTIVES)						
		KNO 30%	COMP 20%	APP 20%	ANA 10%	SYNT 10%	EVA 10%	TOTAL 100%
1.	Section 1 11%	2	1	1	0	1	0	5
2.	Section 2 10%	1	1	1	1	0	1	5
3.	Section 3 13%	2	0	2	0	1	0	7
4.	Section 4 10%	1	1	1	1	1	0	5
5.	Section 5 12%	2	1	1	1	0	1	6
6.	Section 6 11%	2	1	1	0	0	1	5
7.	Section 7 11%	2	1	1	1	1	0	6
8.	Section 8 12%	2	1	1	1	0	1	6
9.	Section 9 10%	1	1	1	0	1	1	5
	Total 100%	15	10	10	5	5	5	50

The table of specifications above clearly reflect the various content areas in chemistry that were considered in this research. It also helps to determine the content validity of the Chemistry Achievement Test in terms of the various aspects of the cognitive domain of the learner's behaviour as classified by the Bloom's taxonomy.

Research Question 2: *What is the reliability level of Chemistry Achievement Test for Senior Secondary Schools?*

The table 2 below shows the Chemistry Achievement Test (CAT) estimate of reliability using Kuder-Richardson Formula 20 i.e.

$$R_{20} = \frac{n}{n-1} \left[1 - \frac{\sum pq}{SD^2} \right]$$

Table 2: Analysis of the Reliability of Chemistry Achievement Test

No of students	No of items	$\sum pq$	\bar{x}	SD	SD ²	R	SEM	Decision
380	50	12.24961	24.58	8.61	74.1321	0.85	3.34	High reliability

The table 2 above shows an estimate of the Chemistry Achievement Test (CAT) reliability using Kuder-Richardson Formula 20. A reliability index of 0.85 was obtained. The result is significant at 0.05 level of significance which made the instrument; Chemistry Achievement Test (CAT) very suitable for the study. Research Question 3: What is the measurement error of the Chemistry Achievement Test (CAT) for Senior Secondary Schools?

The table 2 above also shows the SEM of the Chemistry Achievement Test (CAT). A SEM of 3.34 was obtained. The SEM is low and this confirms that the Chemistry Achievement Test (CAT) is highly reliable.

DISCUSSION

In test construction and validation, it is paramount to ascertain first of all, if the constructed test meets laid down standards that is having the qualities expected of a good test items. One of these qualities is content validity. A test cannot be a good test unless it is valid. Content validity is concerned with the extent to which the test items are the representative sample of all the possible items that measure the subject matter in any curriculum area (Chase, 1978). In order to ensure that the constructed test is content-valid, a test blueprint was drawn which clearly reflects the various content areas and the behavioural process covered in the test. The test blueprints in Table 1 shows the weights of the various content areas covered by the test proportionately. That is, the weights are assigned and number of items drawn in accordance with the way each topic appears relative to others in the scheme of work. The constructed test blue print also shows an unbiased distribution of weights across all the various behavioural processes as classified by the Bloom's taxonomy. This is also in accordance with the way they are presented by the Chemistry curriculum and the scheme of work.

For a test to be valid, it must also measure consistently what it claims to measures. Hence, the reliability of the Chemistry Achievement Test (CAT) for Senior Secondary Schools was also determined to be 0.85 using Kuder-Richardson Formula 20. As demonstrated by Gronlund (1976), an easy test has an approximate reliability coefficient of about 0.50. This figure is also applicable to a difficult test while an ideal test has a reliability coefficient of 0.90 approximately. The 0.85 reliability coefficient of the Chemistry Achievement Test is also in line with the Jayanthi (2014) valid and reliable achievement test in Mathematics for high school students of Standard 10 in Chennai District which has a reliability coefficient of 0.888. This shows that the Chemistry Achievement Test (CAT) is highly reliable.

CONCLUSIONS

Based on the results of the item analysis, the conclusions for the study are as follows:

- a. The test possesses high content validity and reliability.
- b. The test has high degree of internal consistency with a low standard error of measurement.

RECOMMENDATIONS

The Chemistry Achievement Test (CAT) should be used by secondary school teachers for assessment of their students, either prognostic, diagnostic, formative or summative purposes.

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