A SCHEME FOR ASSESSING SCIENCE TEACHERS' COMPETENCIES IN CONSTRUCTING TEST TOOLS IN YOBE STATE SECONDARY SCHOOLS.

*[1]BADEJO BINTA IBRAHIM AND [2]ESTHER BUBA

Department of Remedial and Preliminary Studies

Umar Suleman College of Education Gashua Yobe State, Nigeria

Department of General Studies

Umar Suleman College of Education Gashua Yobe State, Nigeria

*Corresponding Author Information:-
E-Mail: bintabadejo@gmail.com
Phone: +2348067545106

Abstract

This study developed a scheme for assessing science teachers' competencies in constructing test tools in Yobe State senior secondary schools. The study employed descriptive survey research design. A simple random sampling technique was used to select 12 schools and 163 science teachers involved in the study. Instruments used for data collection were questionnaire 1 and 2 with validity and reliability indices of 0.86 and 0.88 respectively structured to elicit information on steps required to construct class-room base test tools and how often science teachers apply them. Data were analyzed with the mean, standard deviation and Analysis of Variance. It was concluded that science teachers construct assessment instruments without determining their validity, reliability and item parameters. There is therefore the need to design and approve in-service training on test tools construction skills by Yobe State Government and also to develop a guide for teachers to develop valid and reliable assessment instruments that will give dependable estimate of students' academic achievements.

Key Words: Competencies, Classroom-Base Assessment Instrument

Introduction

The process of assessment is one of the difficult tasks that teachers face in their work. Assessment includes all the process involved in making decisions about students learning progress (Adamu, Dawha & Kamar, 2015). It facilitates teachers in decision making about learning progress through systematic information gathering. Okoro (2005) stated that assessment is the process of ascertaining the decision areas of concern, selecting appropriate information and collecting and analyzing information in order to report in selecting among alternatives. It is the systematic collection, review, and use of information about educational programmes undertaken for the purpose of making educational decision. Educational decisions are made based on the feedback provided through classroom assessment process. These decisions may be the ones that require information about the success of learning programmes or about students who have reached particular levels of skill and knowledge (Izard, 2005). Whatever type of information needed, educational decisions depend upon valid and reliable assessment instruments to inform those who make the decisions.

Therefore, it is necessary for science teachers to frequently determine the extent to which set objectives are achieved and assessment is an important aspect of education that makes such exercise possible. When designing and assessing a science subject, it is vital to know and be able to clearly communicate to the students what that subject is intended to achieve, what the students should know and be able to do upon completing it, and what practical's they will have to demonstrate in order to pass. Assessment is congruent with the aims and learning outcomes and with the teaching/learning methods adopted (Alias & Gray, 2005). Construction of a classroom-base assessment instrument means the systematic design and development of items for measuring students' learning outcome. It involve identifying objectives of the subject taught and the programme, outlining the content to be covered, preparing table of specifications and writing items, item analysis and selection for inclusion into the instrument and trial-testing the instrument on representative sample of students to determine the reliability coefficient of the instrument (Aworefa, 2010). For efficient and effective assessment, Nworgu (2003) ascertained that science teachers and examiners should develop valid and reliable instrument.

Concept of Assessment Instruments' Construction

Assessment instrument is use to elicit from the student information that tells the teacher, examiner, school administrators, etc about student's achievement of educational objectives. It is a

well acceptable measuring device, appropriate to a given objective (Adewunmi, 2008). Assessment instruments can be developed in form of, tests, interviews, observations, projects, questionnaires, inventory, rating scale etc. Construction of assessment instrument is the process through which an assessment instrument is planned, developed, evaluated and modified, including consideration of content, format, administration, scoring, item properties, scaling, and technical quality for its intended purpose. Assessment instruments are used in the measure of students' levels of knowledge, skills and performance in any teaching-learning situation. Daramola (1990) viewed assessment instrument as standardized or non-standardized measures of an individual's response to a systematic sample of stimuli or behaviour from which inferences about the general behaviour can be made.

The instrument could be either teacher-made, standardized or both and could take the form of oral, writing essay, multiple choice items, or observation of the student's performance, etc. Assessment instruments in public examinations are designed to measure students' present level of knowledge, skills or performance and to also elicit information on what a student has learnt to do thereby indicating the degree of success in some past learning activities. From the foregoing comments, it should be noted that teachers, examiners and public examination bodies such as West African Examinations Council (WAEC), National Examinations Council (NECO) and NABTEB conduct examination after students have undergone some training on specified curriculum and use assessment instruments in the measure of students' educational outcomes. Instrument therefore, is design and constructed appropriately for a given assessment based on specified curriculum.

Basic Steps in the Development of Assessment Instruments

Instrument must meet some essential criteria in order for it to accurately assess students' educational outcomes. Systematic and adequate planning is required on the part of the teachers and instrument developers if they must have appropriate and trustworthy instrument. This is why, according to Aworefa (2010), psychologists accept that in developing any assessment instrument, it is important to ask these questions:

i. Is the instrument valid? I.e. does it really measure what it claims to measure? Or is the instrument providing information that is relevant to the decision that is to be made?
ii. Is the instrument reliable? I.e. is it an accurate, consistent and stable measuring instrument? Or does it consistently measure whatever it measures?

With these questions at the back of the mind and other relevant factors like convenience, appropriateness, usability, storability and interpretability of a measuring instrument, whatever decisions taken as a result of information collected from the use of it is regarded as being

objective. Aworefa further outlined the following major steps teachers or instrument developers should note in developing assessment instrument:

1. Obtaining a List of Instructional Objectives

The major purpose of developing and administering assessment instrument is to determine the extent to which instructional objectives have been achieved by the students. An instructional objective is simply a statement of expected learning outcomes. Therefore, teachers should identify the instructional objectives, which is essential in the effort to develop assessment instrument's items.

2. Outlining the Content to be Covered

In order to ensure that assessment instrument adequately samples the subject matter included in the instruction, it is essential to make an outline of the content to be covered by the instrument. The content is the means through which objectives are to be achieved. It is usually made up of the topics and sub-topics within the subject.

3. Preparing a Table of Specifications

A table of specifications should be prepared before items of the instrument are written. This is because instrument developers must follow a systematic procedure to arrive at a representative sample of the instructional objectives and the content to be measured. Preparing a table of specifications is the most crucial aspect in assessment instrument development. This is because all subsequent decisions such as the form of the instrument and types of items to be used follow from the table of specifications (Imandoyemu, 2001). In preparing a table of specifications, Osunde (2003) stated that it is customary to combine the instructional objective and the content to give essentially a two dimensional table that is the content spread along the horizontal dimension and process objectives along the vertical dimension.

4. Writing Items for the Instrument

At this stage, teacher writes the items that measure the sample of students' behaviour specified in the table of specifications. In writing the items, teacher should take note of the guidelines which are highlighted in the table of specifications.

5. Item Analysis

This is done by trying out the instrument to a group or sample students to obtain data and analyzed to acquire empirical information about the adequacy of each item of the instrument or the instrument as a whole. The development of valid and reliable assessment instrument therefore, requires consideration of quantitative information regarding the difficulty and discrimination power of each item. Whatever may be the purpose of an assessment instrument, whether it is

educational or psychological, its adequacy depends on the care with which each item of the instrument has been selected. The item analysis is usually discussed under:

i. Discrimination power of each item and
ii. Item difficulty

6. Determination of validity and reliability coefficients of each item of the instrument and the instrument as a whole.

Statement of Problem

It is expected that students who perform well in teachers' classroom-based assessment instruments should equally perform well in the standardize assessment instruments like National Business and Technical Examination Board (NABTEB), West African Examination Council (WAEC) and, National Examination Council (NECO). However, it appears not to be so. It is observed that the performance of secondary school students that performed well in classroom-based assessments revealed a 75% failure rate in the standardize assessment instruments (Agu, Onyekuba & Anyichie, 2013; Adamu et'al, 2015). Most of the classroom-based assessment instruments in Nigeria lack validity and reliability because teachers lack assessment instrument construction skills and thus cannot construct good assessment instruments (Baker, 2003; Dosumu, 2002; Alele-Williams, 2002). Adeola and Fajonyimi in Agu et'al, (2013) observed that most of the assessment instruments used for continuous assessments and end of term examinations in the secondary schools contain ambiguous and misleading questions which may be the reason why some of the students fail. The implication of this is that teachers and school administrators will not be able to provide educational opportunities and supports each individual student needs as well as the programme at large. Koksal (2004) and Leighton and Gokiert (2005) affirmed that faulty assessment instrument items affect students' comprehension and ability to provide accurate answers to the items and the inference drawn about what a student knows and understands will be compromised. Since most of the assessment instruments used in senior secondary schools are teacher-constructed (Adamu et'al, 2015), there is therefore, need for science teachers to apply some acceptable degree of assessment instrument construction skills in order to be able to develop valid and reliable assessment instrument that will yield accurate feedback of students' achievement. There is a need therefore, to assess science teachers' assessment instruments construction skills in senior secondary schools in Yobe State.

Purpose of the Study

The purpose of this study was to determine science teachers' competencies in constructing classroom-base test tools in Yobe State senior secondary schools. Specifically, the study determined the steps of constructing classroom-base test tools.

Research Questions

1. What are the steps of constructing classroom-base assessment instruments?
2. Do science teachers apply the steps required for constructing classroom-base assessment instruments?

Hypotheses

1. The differences in the mean responses of science teachers in Government Senior Secondary Schools in Yobe State on the steps of constructing classroom-base assessment instruments are not significant.
2. There are no significant differences in the mean responses of math, physics, chemistry and biology teachers in Government Senior Secondary Schools in Yobe State on the steps of constructing classroom-base assessment instruments.

Methodology

The study employed descriptive survey research design. The study was carried out in all the Government Senior Secondary Schools in Yobe State. The target population for the study was all the basic science teachers in all the Government Senior Secondary Schools in Yobe State. Below is the distribution of the schools randomly selected and the number of the science teachers involved in the study.

Table 1: Distribution of Schools and Number of Basic Science Teachers involved in the Study

Zone	School	Math	Physics	Chemistry	Biology	Number of teachers	
A	GSTC Geidam	2	1	1	2	6	
	GGC Damaturu	6	6	6	6	24	
	GSS Damaturu	6	5	3	4	18	
	GSTC Gujba	2	2	1	1	6	**54**
B	GGSS Ngelzarma	5	4	3	4	16	
	GSTC Damagum	4	3	2	3	12	
	Fika GSS Potiskum	6	6	6	6	24	
	GGSTC Potiskum	6	6	6	5	23	**75**
C	GSS Jakusko	2	2	2	1	7	
	GSS Machina	2	2	1	1	6	

	GSS Nguru	4	3	2	3	12	
	GSTC Asbak, Gashua	3	2	2	2	9	**34**
Total	**12**	**48**	**42**	**35**	**38**	**163**	

The researchers, after detailed review of relevant literature, identified and outlined 21 steps in constructing assessment instrument which were further developed to form a structured questionnaire 1 used as an instrument for collecting data to answer research question 1 for the study. The questionnaire 1 was arranged in two parts: A and B. Part A sought personal data about science teachers such as discipline and location of their school while part B had 21 items on steps in constructing assessment instrument. A four-point scale of Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD), were written against each of the item with a corresponding assigned values of 4, 3, 2, and 1 respectively. The questionnaire 1 was further modified to form questionnaire 2 to answer research question 2, whereby a three-point scale of Always Applied (AA), Sometimes Applied (SA) and Not Applied (NA) were writing against each item with corresponding assigned values of 3, 2, and 1 respectively was used. The questionnaire 1 and 2 were face and construct validated by two experts in Technology Education Department of Modibbo Adama University of Technology Yola. The questionnaires were pilot tested in six senior secondary schools in Gombe State and the data obtained were analyzed to yield a reliability index of 0.86 and 0.88 for questionnaire 1 and 2 respectively which were acceptable (Gay, 1996).

The data collected from the sampled senior secondary schools were analyzed using mean and standard deviation. For answering research question 1, any item with a mean rating that is equal to or more than 2.50 was agreed while a mean rating that is less than 2.50 was not agreed to be a step in constructing classroom-base assessment instrument by the teachers. For answering research question 2, an item with a mean rating ranging from 0.00-1.49 was considered to be Not-Applied (NA), an item with mean rating ranging from 1.50-2.49 was considered Sometimes Applied (SA) while an item with mean rating ranging from 2.50-3.50 was considered Always Applied (AA) by the teachers in constructing classroom-base assessment instrument. For analysis of data related to the null hypotheses, if P-value is less than the level of significance ($P<0.05$), then reject null hypothesis but if otherwise, accept the null hypothesis.

Results

Research Question 1: What are the steps of constructing classroom-base assessment instruments?

Table 2: Science Teachers Mean Responses on Steps of Constructing Classroom-Base Assessment Instrument

S/n	Steps in constructing assessment instrument	$\overline{X}$	δ	Remark
1.	State the target class to be assessed	3.05	0.881	Agreed
2.	Outlined the content covered before setting items from them	3.02	0.906	Agreed
3.	Write down specific objectives to be determined	3.04	0.880	Agreed
4.	State the type of assessment instrument required to achieved the Objectives	2.64	0.673	Agreed
5.	Review standard text books in the subject area for guide	2.50	0.502	Agreed
6.	Review previous instruments and adapt questions from them	2.75	0.432	Agreed
7.	Prepare table of specification as a guide for the instrument Construction	2.99	0.707	Agreed
8.	Develop items for the instrument	3.74	0.439	Agreed
9.	Include items that both high and low achievers can understand	3.24	0.665	Agreed
10.	Include sufficient items to cover all the levels of requisite domain of educational taxonomy	3.16	0.628	Agreed
11.	Prepare a marking guide while constructing the instrument	3.74	0.538	Agreed
12.	Ascribe scores for each item	3.36	0.495	Agreed
13.	Avoid items that measures opinion outside the determined objectives	3.35	0.614	Agreed
14.	Set items that elicit creative and imaginative answers	3.01	0.694	Agreed
15.	Organize items in a logical manner	3.05	0.881	Agreed
16.	Validate the assessment items	3.67	0.472	Agreed
17.	Determine the reliability of the instrument items	3.58	0.637	Agreed
18.	Subject assessment items to item analysis	3.11	1.122	Agreed
19.	Submit the items for vetting to the school administration	3.05	0.881	Agreed
20.	Give instruction to the students	3.49	0.811	Agreed
21.	Keep a resource bank of items	3.30	0.589	Agreed

Table 2 indicated the result of science teachers' responses on the steps of constructing classroom-base assessment instruments with mean ($\overline{X}$) responses ranging from 2.50 to 3.74. This shows that all the 21 steps are rated above the cut-off point of 2.50, hence they are required stages for constructing good assessment instruments. The standard deviation (δ) of the science teachers responses ranged from 0.432 to 1.122. This implies that the teachers were close in their ratings.

Research Question 2: Do science teachers apply the steps required for constructing classroom-base assessment instruments?

Hypothesis 1

There are no significant differences in the mean responses of science teachers in Government Senior Secondary Schools in Yobe State on the steps of constructing classroom-base assessment instruments.

Table 3: ANOVA of the Mean Responses of Science Teachers in Government Senior Secondary Schools in Yobe State on the Steps of Constructing Classroom-Base Assessment Instruments

Source of variation	Sum of square	df	Mean square	F-cal	P	Remark
Between groups	0.229	11	0.021			
				0.214	0.996	Accepted
Within groups	14.678	151	0.097			
Total	14.908	162				

Data in Table 3 revealed that the p-value of Government Senior Secondary Schools in Yobe State science teachers' responses on the steps of constructing classroom-base assessment instruments is 0.996. This value is greater than the p-value of 0.05 (level of significance) indicating there are no significant differences in the mean responses of science teachers in Government Senior Secondary Schools in Yobe State on the steps of constructing classroom-base assessment instruments. Therefore, the null hypothesis was accepted.

Hypothesis 2

There are no significant differences in the mean responses of math, physics, chemistry and biology teachers in Government Senior Secondary Schools in Yobe State on the steps of constructing classroom-base assessment instruments.

Table 4: ANOVA of the Mean Responses of Math, Physics, Chemistry and Biology Teachers in Government Senior Secondary Schools in Yobe State on the Steps of Constructing Classroom-Base Assessment Instruments

Source of variation	Sum of square	df	Mean square	F-cal	P	Remark
Between groups	0.126	3	0.042			
				0.451	0.717	Accepted

Within groups	14.782	159	0.093
Total	14.908	162	

Data in Table 4 revealed that the p-value of math, physics, chemistry and biology teachers' responses on the steps of constructing classroom-base assessment instruments is 0.717. This value is greater than the p-value of 0.05 (level of significance) indicating there are no significant differences in the mean responses of math, physics, chemistry and biology teachers in Government Senior Secondary Schools in Yobe State on the steps of constructing classroom-base assessment instruments. Therefore, the null hypothesis was accepted.

Discussion

The result in Table 2 indicated that science teachers in Government Senior Secondary Schools in Yobe State, in answering research question 1, agree with the 21 steps of constructing good classroom-base assessment instruments. This finding shows that science teachers are aware with the necessary steps required for constructing a good assessment instrument. Hence this finding is in line with Baker (2003) and Agu et'al (2013) who found that teachers are aware of a variety of test construction skills.

The findings, on the other hand, revealed how often science teachers in Government Senior Secondary Schools in Yobe State apply the steps in their test tools construction. The finding shows that science teachers sometime apply the steps in their stating the type of assessment instrument to be construct in order to achieved the stated objectives; review standard text books in the subject area for guide, review previous instruments and adapt questions from them, include sufficient items to cover all the levels of requisite domain of educational taxonomy, submit the items for vetting to the school administration and keep a resource bank of items. However, they do not apply the steps in the area of preparing table of specification, validating the assessment items, determining the reliability of the instrument items, nor subject assessment items to item analysis. This finding agrees with Sakiyo (2009) and Adamu (2015) that the current method of assessing students is done through the use of teacher-made assessment instrument that lack item analysis, validity and reliability. Egunsola, Denga and Pev (2014) stated that teacher-made assessment instruments are still used as instruments of assessment for placement, continuous assessment, prediction and educational guidance in Nigeria. The implication of this is that teachers and school administrators will not be able to provide educational opportunities and supports each individual student needs as well as the programme at large.

The findings in Tables 4, 5, 6 and 7 related to null hypotheses 1, 2, 3 and 4 revealed that were accepted. This implied that science teachers in Government Senior Secondary Schools have common knowledge of how to construct assessment instruments regardless of their discipline. The study further revealed that they commonly apply that knowledge and skills in their construction of class-room base assessment instruments in their various discipline.

Conclusion

The major findings of this study serves as a basis for drawing conclusion that science teachers in Government Senior Secondary Schools in Yobe State construct assessment instruments without determining their validity, reliability and item parameters. And these instruments are use in assessing students' knowledge and skills in science subjects. In so doing, the teachers will not be able to show proof of the scores and grades that they award. Hence the findings of this study also have some implications for science teachers. The study revealed that teachers lack skills of assessment instrument construction in the area of finding validity, items reliability and parameters and as such form the basis for designing and approving in-service training on assessment instrument construction skills. Yobe State Government should develop a guide for teachers to develop valid and reliable assessment instruments that will give dependable estimate of students' academic achievements.

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