

Assessment of Basic Science Teacher's Competency in item Construction and item analysis in Junior Secondary School in Nasarawa State

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ABSTRACT

Vision 2020 by Nigeria government on science and technology development hinged on science which Basic Science at Junior Secondary School is the prerequisite subject to this development. The Basic Science replaced the teaching of introductory science, integrated science and Home economic. The theme covered at this level include environmental science, non-living things and energy. It is expected that the teachers teaching this subject should be versatile in the teaching and assessment of their students. Teacher is the knowledge giver and his role is very important in nation development. This study therefore assessed the Basic Teachers competencies in the area of item construction and item analysis. The study adopted survey research design and purposively sampled 290 teachers. Questionnaire tagged Teachers Competency with $r=0.89$ was used for data collection while the data was analysed using mean, standard deviation and ANOVA. Conclusion and recommendation were made based on the result.

Key words: Teachers, Basic Science, Assessment, and Competency.

INTRODUCTION

Basic science is one of the core subjects to be studied in the Junior Secondary Schools which is a prerequisite to the study of pure Sciences in Senior Secondary School (JSS) is the first three years of secondary education. It is preceded by primary school and before senior secondary school. The aim of JSS level of education according to the National policy on Education (FRN 2004) is to prepare the children for useful living within the society and higher education. This level is to raise a generation of people who can think for themselves, respect the dignity of labour and provide technical knowledge and vocational skills necessary for agricultural industrial, commercial and economic development. The JSS level is crucial to the development of the nation as the foundation of science and technology for the advancement of the country in this 21st Century. The principal actor in laying this foundation of science and technology is teachers because they are the king-pin of quality in education and they are the core of every educational system (Ogundengbe, 2004).

The goals of FRN (2004) can be achieved largely based on the competency of the teacher to tailor the learning activities to the learner. The teacher need to be knowledgeable, versatile, should be able to employ variety of techniques in carrying out teaching and assessment of the students. The issues of assessment by teachers has been a thing of concern in the area of using a valid and reliable instrument. This issues has engaged the attention of researchers according to Agu, Onyekuba and Anyichie (2013). The authors observed that most of these classroom-based tests in Nigeria lack validity and reliability because teachers seem to lack test construction skills and thus cannot construct good achievement tests.

Most tests used for continuous assessments and end of term examinations in the secondary schools contain ambiguous and mis-leading questions which may be the reason why some of the students fail these tests (Adeola and Fajonyimi, 1999). The implication of this is that most teachers lack competencies in test construction, test analysis and may be using poorly constructed tests to measure students' achievements in various school subjects. When students' achievement levels are not properly measured and interpreted, the teachers and school administrators will not be able to provide educational opportunities and support each individual student needs. (Agu, eta, 2013)

Nenty and Fetogang (2014) found out that teachers use past examinations to prepare classroom and school test. This is an indication that the teachers do not have understanding of how to develop a reliable and valid test. Nenty and Lusweti (2014) are of the opinion that teachers should be assessment literate i.e. having good and practical knowledge of testing procedure for valid result.

Quality classroom-based assessment means adherence to standard procedures for test construction and analysis. Every classroom teacher is expected to possess and apply requisite competences in construction and analysis of good items, for class assessments. A good test item must be both valid and reliable. A test is valid if it is suitable for the intended purpose. On the other hand, a test is reliable if it measures what it is supposed to measure consistently under all conditions (NTI Manual, 2006). Teachers today, perhaps more than ever before, have a need to be knowledgeable consumers of test information, constructors of assessments and protocols, and even teachers about testing (Rudner and Schafer, 2002 and Kolawole, 2006)

In the same vein, competency on the part of the teacher demands ability to effectively develop and analysed test items. It has been observed by Ohuche and Akeju in Nworgu (2003) that the qualities of the items that make up a test determine the quality of the test as a whole. Assessment of these essential qualities of the items in a test constitutes item analysis. Anastasi in Nworgu (2003) identified item analysis as qualitative and quantitative situation whereby the content and form of a test are addressed. Quantitative item analysis is concerned with the statistical properties of the items. For the effective assessment, which is the bedrock of effective teaching, demands that teachers should be very familiar with the item development.

LITERATURE REVIEW

Assessing students learning is something that every teachers has to do, usually quite frequently too. This is why a typical teachers can spend more than one third of his class time engaged in one form or another type of measurement activity (Stiggins, 1994). However, despite the amount of time teachers spend assessing students learning, it is a task that most of them dislike and that only a few do well. One reason is that many teachers have little or no in-depth knowledge of assessment principles (Crooks, Stiggins, Griswold, & Wikelund, in Imam, Popoola and Egberouge, (2015). It is also believed that teachers with more training in assessment use more appropriate assessment practices than do teachers with less training (Bielher & Snowman, 1997)

Assessment in education is best described as activities to determine the importance size, or value of teaching and learning (Ojerinde 2014) while Anikweze, (2013) opines that assessment to include teacher, peer and self-assessment process. Stiggins and Chappins in Nenty and Lusweti (2014) emphasized on teachers having deep knowledge of why they

assess and hence what decisions are to be made, who will make the decision, and what kind of information will be helpful. Teachers should find ways through which they can enhance the learning aspects as well as how to assess the quality of learning and teaching exhibited. Classroom teachers must have a good mastery of achievement targets that their students are to achieve and such targets must be completely and clearly defined. It must be mastered by the teachers for him to be able to communicate them clearly to the students. This called competency in teaching. As noted by Akuto, Aduloju, Odeh (2012) competency in teaching involves a number of principles which include among others, aligning the three major components of instructions namely learning objectives, assessments and instructional activities. In other to accomplish these task, competency on the part of the teachers in the area of item construction, item analysis and utilization of teaching materials becomes critical.

Item construction is the ability of a teacher to write items that cut across all the content specified. While item analysis lies at the heart of evaluating the quality of tests developed. Item difficulty and discrimination are two statistic in an item analysis according to Ariyo and Lemut (2015). Item difficulty is the mean item score and item discrimination is the correlation between the item score and test scores. The authors are of the opinion that the statistics allow instructors to identify problematic items such as those that are too easy or too difficult for students and item that are unrelated to the overall score. This process will help eliminating poorly functioning items. This can be done by having the knowledge of measurement and evaluation. This cut across all the domains in educational objectives. Test construction has been found to be a major source of anxiety among many teachers in Nigerian schools, especially, less experienced ones (Ebinye cited in Agu eta, 2013). This why the author attributed anxiety majorly to lack of test and measurement knowledge by these teachers. This is surprising as the least qualified teacher in Nigerian secondary schools today have the Nigerian Certificate in Education (NCE) qualification.

In item construction, certain procedures are followed as highlighted by Enyi (2009) which include; Determine the purpose of testing, Building a table of specification, Selecting appropriate item types, Preparing relevant test items, Assembling the test, Administering the test, Appraising the test, and Using the results. To effectively do these, it calls for competency on the part of the teacher. Test blue print is one and most important aspect of this development. It takes competency on the part of the teacher to employ the use of a table of specification. The need for basic science teachers to acquire adequate knowledge of test development and continuous assessment practices to enable them make necessary improvement in teaching and evaluation was stressed by Okpala and Onocha (1985), Ipaye (1987) and Nwosu in Aduloju (2010).

Most achievement tests used in Nigerian secondary schools for continuous assessments are teacher-constructed tests. Teachers, therefore, need to apply some acceptable degree of test construction skills in order to be able to develop valid and reliable tests that will yield accurate feedback of students' achievement if we want to achieve the goals of FRN (2004).

The hindrances to the teacher made-test from close observation and analysis is the construction of a blue print. Kolawole (2006) argued that, in an idea situation, a teacher who constructs items without a blue print is just like a brick layer who is building a house without any plan. Teachers especially science teachers have been found wanting in the area of basic

contents determination and this call for concern if the nation is to move forward in science education

Qualitative item analysis involves consideration of content validity and the evaluation of items in terms of effective item-writing procedures (Nworgu, 2003). Competency of the teachers of science in doing this, will serve to improve the test by revising or discarding ineffective items as well as providing diagnostic information in what examinees know and what they do not know. Buttressing this view, Anastasi in Nworgu (2003) opined that it involves essentially the “systematic examination of the test content to determine whether it covers a representative sample of the behaviour domain to be measured. What is implied here is that, test items are analyzed to ascertain the adequate reflection of the major aspects of behaviour domain under consideration in relation to content and intellectual skills. This view is shared by Nworgu (2003,) Enyi (2009), and Akem (2011). A number of studies have suggested that faulty test items affect students’ comprehension and ability to provide accurate answers to the items, the inference drawn about what a student knows and understands may be compromised (Koksal, 2004; Leighton and Gokiert, 2005). Also Jatto in Agu et al (2013) observed that classroom teachers generally write poor items and that a typical classroom teacher in a secondary school cannot construct good multiple choice test items

Teachers’ competence has its aims at making the learner to cope with and contribute to scientific enterprises from day to day in world dominated by Science and Technology (Akindehin & Salem in Aduloju, 2010). However, the achievement of national goals through education is better enhance in the development of educational assessment instrument through competent teachers. Basic Science teachers need reliable instruments to evaluate the acquisitions of this noble and crucial educational goals. Literature revealed that instrument for test set by Basic science teachers tested especially the factual knowledge and not the basic element of Basic science and this implies that assessment instrument at JSS level are yet to witness the standard needed to meet up with changes in curriculum. Most of the items for evaluating students’ achievement in science as have been suggested by some authors (Okitan, and Ofo in Nkpono 2004) that these items were not validated or subjected to items analysis treatment and because of this limitations, these items rarely reveal to teachers the difficulty level, discriminative level, distractive level, or how reliable or consistent the items are. This problem according to Adikwu (2008) results from science teacher’s poor knowledge of test and measurement course. On this note Akem (2008) submitted that the teachers are not well equipped with the skills to handle evaluation of all abilities of students due to the late introduction of the course to the students. The author argued that the duration of the course which is only one semester is full of other activities like strike. Since decision are made based on the result of testing and the instrument used for this purpose, it is important that the teachers who developed this instrument should be assessed whether they are competent in the item construction and analysis. This study therefore sought to assess the teacher’s competence in this area.

THEORETICAL FRAMEWORK

Measurement of psychological constructs is based on two test theories. Classical Test Theory (CCT) and the Item Response Theory. Classical Test Theory assume that traits are constant and each testee has a true score that would be obtained if there are no errors in measurement. The true score reflect the true value of the respondent ability (Anikweze, 2010)

Item Response Theory is item centered and is concerned with the behaviours of items, therefore CTT is test centered while IRT is item centered.

CCT is the most popular test theory and revolves around concepts of true score, measurement error and index of test reliability (Asebh, 2016). It relates observable scores X to the latent trait T where $X = T + E$ and $E =$ measurement error.

Since CTT assumes that traits are constant and each student has a true score if there are no errors in measurement, it means that the teacher should avoid the sources of random error like guessing, cheap items and too difficult items. The teacher should endeavour to set parallel tests that score from the two tests have the same standard deviation, the same correlation with the true scores and variance on each test which is not explainable by true score is purely due to random error (Nenty, 2004). Also, the author examines IRT as a set of models which relates an individual with a given trait level to the characteristics of the item design to elicit the level to which the individual possesses the trait. IRT relates response to test items to latent traits through models that specify how both trait and items are related to a person's item response. However, when right instruments are used, there is a tendency that a student's true ability can be revealed. It can be possible to predict the examinee's performance. This is in line with the idea of IRT, performance can be predicted by defining an examinee's characteristic (traits) estimating score for examinees on these traits and using the score to predict or explain the test performance.

STATEMENT OF PROBLEM

The development of good items plays a very important role in the selection, placement and measurement of a student's achievement in school and classes. The greatest challenge faced by teachers has been the competency in development of reliable and valid items according to Ariyo and Lemut (2015). Students who perform well at various levels of teachers' classroom-based tests are expected to equally perform well in the standardized tests like Junior Secondary School Certificate Examination (JSSCE), West African Examination Council (WAEC) and National Examination Council (NECO). This has been a different issue entirely and a great concern because the same student that failed this standard examination has been doing well in the internal examination. It would seem, therefore, that some of these teacher-made achievement tests are invalid and unreliable and thus, fail to provide accurate assessment of students' knowledge and understanding of the various subject areas.

Quality in test development is a critical factor in Test, Measurement and Evaluation. The stages in writing a good test are many and varied which include items construction, items moderation, item trial testing, items analysis, item calibration, construction of equivalent items and items banking (Alonge 2000). For the purpose of this study, only item construction and analysis were considered.

Ariyo and Lemut (2015) in their study reveals that teachers (test developers) response to training needs assessment confirms their need in the area of test construction and modern test theory. This shows that teachers are not competent in developing a good item for a student's evaluation and when these students eventually presented for external examination which the items pass through the stages in test development, their performance becomes poor.

Researchers (Kolawole 2006, Njoku 2006, Ugwu 2008) argued that a teacher's incompetence in item construction, analysis and evaluation of students at each stage of learning contribute to the poor performance of students in sciences since the usefulness of science as a basis for personal comfort and national survival cannot be over-emphasized and science is acknowledged as the bedrock of national development, this calls for quality

education. To achieve this quality education in line with the federal ministry of education (FME, 2012) in overall objectives of the new Basic Science curriculum, there is need for teachers in the area of item construction and analysis to be competent. The study assessed the competence of basic science teachers in identified variables of item construction and item analysis. This study was guided by three research questions and one hypothesis.

Research Questions

1. What are the mean rating scores of Basic Science Teachers competency in item construction?
2. What are the mean rating score of Basic Science Teachers competency in item analysis?

Hypothesis

This hypothesis was formulated and tested at $\alpha=0.05$ level of significance.

H_{01} : Basic Science Teachers Qualification do no significantly influence their competencies

Method

The study adopted a survey research design that describe the existing problem of teachers in Nasarawa State. Nasrawa state comprised of 13 local government area in which all the junior secondary school in the state public school made up the population. All the teachers teaching Basic Science were purposively selected from all the government approved schools and UBE schools which was 290 in number. One instrument named Teachers Competency (TC) was developed by the researchers and used for data collection. This instrument consisted of 2 sections A and B. Section A solicited information on teacher's qualification while section B has 3 sub sections that asked questions on the variables of the study. The response format was on 5 point Likert scale and weight as thus; Highly competent (HC=5pts) Competent (C=4pts), Moderately competent (MC=3pts) Low competent (LC=2pts) and Not competent (NC=1pts). A measure of internal consistency using Cronbach alpha was determined and reliability coefficient of 0.89 was obtained which showed high degree of reliability of the instrument. Content validity of the instrument was ensured by Measurement and Evaluation experts. The data was collected by research assistants with the permission of the principals of each schools. Research questions were answered using percentage, mean and standard deviation and the decision rule based on the grand mean of 3 was accepted as competent while mean below 3 was low and not competent.

RESULTS

Demographic data of Teachers' Qualification

Table 1: frequency and percentage of Teachers Qualification

Qualification	N	%
M.Sc	-	-
M.Ed	-	-
B.Sc	15	5.17
B.Ed	25	8.62
B.Sc (Ed)	09	3.10

HND	14	4.82
NCE	165	56.9
OND	43	14.82

Table 1 shows the qualification of teachers. Those with B.Sc. are 15 in number (5.7%), B.Ed. are 25 (8.65%), B.Sc. (Ed) are 9 (3.10%), HND are 14 (4.8%), NCE are 165 (56.9%) while OND are 43 (14.82%).

Research question 1: What are the mean rating scores of Basic Science Teachers on their level of competency in item construction?

Table 2: Mean and S.D scores of the Basic Science Teacher Competencies in Item Construction

S/No	Competencies	HC	C	MC	LC	NC	\bar{X}	S-D	DECISION
1	Competency in constructing with specific behavior	29	20	48	86	107	2.23	1.28	Not competent
2	Competency to construct items that will elicit same ability from all examines	58	20	60	89	63	2.72	1.40	Not competent
3	Competency in developing an item bank that meet the specific requirement of a particular test	40	40	92	56	62	2.79	1.30	Not competent
4	Competency in arraying items in order of difficulty	27	34	56	84	89	2.40	1.28	Not competent
5	Competency to construct a test that spans evenly bot the course content and cognitive of the course	54	42	28	90	80	2.68	1.46	Not competent
6	Ability to adequately sample items from the universe of all	62	42	34	102	50	2.86	1.42	Not competent
Grand mean							2.61	1.36	Not competent

Table 2 reveals the Mean and S.D scores of teachers in the items as follows: Item 1, \bar{x} = 2.23 & S.D = 1.28, item 2 has \bar{x} = 2.27 and S.D 1.40 while item 3 has a \bar{x} of 2.79 & S.D = 1.30. Also, item 4 has a \bar{x} of 2.40 and S.D of 1.28, Item 5 has a \bar{x} of 2.6 and S.D = 1.46, Item 6 has a \bar{x} of 2.86 and S.D of 1.42 while the grand mean is 2.61 and S.D = 1.36

Research question 2: What are the mean rating scores of Basic Science Teachers' competency in item analysis?

Table 3: Mean and S.D score of BST on their Competency in Item Analysis

S/No	Competencies	HC	C	MC	LC	NC	\bar{X}	S-D	DECISION
1	Ability to determine the difficulty level of items	40	57	90	87	16	3.06	1.12	Moderate
2	Ability to determine discriminatory power of item	36	39	80	80	55	2.72	1.26	Not competent
3	Ability to determine the distractive index of items	24	31	72	85	78	2.44	1.22	Not competent
4	Ability to use rules of thumb for discriminating index	30	37	48	95	80	2.45	1.29	Not competent
5	Ability to recognize item that need revision through item analysis	10	4	68	104	107	1.99	.98	Not competent
Grand mean							2.53	1.17	Not competent

The result shows that teachers are only competent in ability to determine the difficulty level of item with $\bar{x} = 3.06$ and S.D = 1.12 while not competent in the remaining items with the following mean and S.D respectively; Item no 2 ($\bar{x}= 2.72$ & S.D = 1.26) item No 3 ($\bar{x}= 2.44$ & S.D = 1.22), item no 4 ($\bar{x}=2.45$ & S.D = 1.29) and item No 5 ($\bar{x}=1.99$ & S.D = .98). The grand mean and S.D = 2.53 & 1.17

Hypothesis Qualification of Basic Science Teachers do not significantly influence their Competency in Item construction, Analysis and use of instructional material.

Table 4: Analysis of Variance (ANOVA) of Basic Science Teachers qualification and Competencies in Item Construction, Item Analysis and Instructional Materials.

Source	Ss	Df	Ms	f cal	significant
Between groups	1912.835	3	637.612	.584	.627
Within groups	97123.896	286	1091.280		
Total	99036.731	289			

*p (.627) >.05

The result in table 5 reveals that F-cal value = **.584** at P (sig) = **.627**, **df**_{3,286} and P set value at **.05**. Since P>**.05**, therefore the hypothesis of no significant is thus rejected

Discussion

Finding revealed that most of the teachers teaching Basic Science are holders of NCE. This result support Mari (2008) who argued that most of the science teachers found in schools have requisite academic and professional qualification but Dangbin in Aduloju (2010) negate this finding. In addition, Olorunge in Abe eta (2013) in their study revealed that teachers are

becoming qualify in terms of profession. Also, Agu, eta (2013) found out that the least qualified teachers in Nigeria Secondary schools today have the Nigerian Certificate in Education (NCE) Qualification, This result could be as a result of clarion call for professionalism.

Table 2, 3, and 4 revealed that teachers in each of the components of the competency identifies has a mean less than three which shows they are not competent. This study corroborates with Akem (2005), Adikwu (2008), Nwogu in Aduloju (2010), Udo (2014) and Denga (2000) that stressed the need for teachers to acquired adequate knowledge of test development and continuous assessment practice to enable them make necessary improvement in developing instrument for evaluation

Also, Akem (2008 and 2011) was of the opinion that teachers have poor knowledge of the course of Test and Measurement and that most of the test set by these teachers were not validated or subjected to item analysis. This result could be as a result of late introduction of students to test and measurement course which only lasted for two months in most schools. In addition, some of these teachers are not educationally inclined, no wonder that Akindehin (1999) revealed that most of the test set by these teachers tested only factual knowledge which is an evidence of non- standardize instrument and Aduloju and Obinne (2011) said most teachers are into teaching since they cannot get job in their speciality

Table 4: Showed a significant influence of Basic Science Teachers' Qualification on their competencies and the hypothesis of significant influence was rejected. This result negates the studies of Ada (2004), and Adejoh (2006) and Tobih (2014) who expressed that teachers qualifications do not responsible for their competences in teaching and evaluation while Criffit in Abe et al (2013) suggest that the potentials for an educational system is related to the ability of the teachers. The result may due to what stinggen (2000) as inadequate training receive by the teachers during their professional training.

The result is also in consonant with study of Nenty and Fetogang (2014) who found out that teachers use past examinations to prepare classroom and school test. This is an indication that the teachers do not have understanding of how to develop a reliable and valid test. Nenty and Lusweti (2014) are of the opinion that teachers should be assessment literate i.e. having good and practical knowledge of testing procedure for valid result.

Conclusion, Implication and Recommendation

The finding of the study has shown that the Basic Science Teachers in JSS in the study area are not competent in the identified variables.

The implication of this findings on nation development is that if Nigerians will achieve her set educational objectives there is a need for teachers of JSS to improve in the mention areas. This development of nation depends on the products of good quality education and the teachers are the foundation of this development. Also, when a wrong instrument is used, it obvious that the information elicited would be invalid and unreliable and this fail to provide accurate assessment of students' knowledge and understanding.

Based on the findings of this study, there should be a retraining program for teachers to develop their competencies in the identified areas. Also, the curricula of teachers in training need to be reviewed to cover more area of assessment tools development

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