BLOOM TAXONOMY USAGE AND PSYCHOMETRIC ANALYSIS OF CLASSROOM TEACHER MADE TEST

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ABSTRACT

The study investigated the proportion of Nigerian Junior Secondary School Mathematics teachers that used various instruments in the assessment of students in Mathematics. The study employed non-experimental design of survey research type, and a sample of 63 Mathematics teachers were selected through purposive sampling technique. A 27 items adapted questionnaire with content validity and reliability index of 0.82 and 0.76 respectively was used to gather data for the study. Frequency counts and percentages were used to analyse the data. Finding showed that majority of Mathematics teachers often use written test and assignment and neglect other assessment instruments. A few percentages (16.4%) of the teachers didn't construct their items themselves but rely on other sources. Also, it was remarked that about 80% of the teachers assessed items that covered Remembering and Understanding while Applying, Analyzing, Evaluating and Creating suffered neglect. Between 54% and 81% of the teachers failed to assess the item difficulty, item discrimination and distracter index during validation process of test instruments in mathematics class. Lastly, about 10% of the teachers botched to give feedback and remediation to students after diagnostic assessment. It is recommended that teachers should be encouraged to construct test items that emphasize higher level of cognate demand as determined by new Bloom's taxonomy.

***Keywords*:** *Assessment in Mathematics, Content Validity, Ordinal Alpha, Bloom's Taxonomy*

1.0 INTRODUCTION

Mathematics remains the bedrock of consistent source of support and stability in science and technology as no nation can boast of any scientific and technological advancement without proper foundation in school Mathematics (Ojo & Akinboboye, 2014). In order to realize the objectives of Mathematics at any level of educational system, there is need to maintain and monitor the quality of the educational processes and products. One of the outstanding ways of maintaining and monitoring the quality and standard of teaching and learning of Mathematics is through the assessment of the learning outcomes of the students. The essence of using tests and other evaluation instruments during instructional process is to guide, direct and monitor students' learning progress towards the attainment of the instructional objectives (Azuka, 2014). Of course, there is no doubt that the quality of any evaluating instrument could lead to decline in students' educational ability level. To the best knowledge of researchers, very few studies have emerged in the literature on the nature and quality of Mathematics testing items administered to students in junior secondary schools with emphasis on the areas of assessment instrument, sources of test items, levels of cognitive domains covered by the questions, validation and item analysis.

Before the introduction of continuous assessment in primary and secondary schools in 1977 following the adoption of National Policy on Education, assessment and performance of students' learning was solely based on one one-shot examination usually administered at the end of the school term or year. Also, promotion of students from one level of education to another was based on the result of the promotion examinations that usually came up at the end of each academic session (Atsumbe & Raymond, 2012) and teachers taught purely for the purpose of students passing these examinations. This made many students involved in examination malpractices of various types (Ipaye, cited in Awofala & Babajide, 2013). However, the introduction of continuous assessment in Nigerian schools has rendered assessment school-based, and summary judgments usually passed on child's learning and environment through the results of one-shot examinations became invalid (Awofala & Babajide, 2013; Atsumbe & Raymond, 2012). This has led to the improved evaluation of learners' achievement by ensuring that assessment is cumulative, systematic, comprehensive and guidance oriented (Awofala & Babajide,2013; Nneji, et al., 2012).Reintroduction of universal basic education (UBE) in 1999 and the expansion of its scope from six to nine years infuse a new dimension to continuous assessment in the form of School Based Assessment also known as assessment for learning (AfL) at primary and junior secondary school levels in Nigeria. Based on this system, teachers can assess and evaluate the students through tests, assignment and other evaluation and assessment instrument during and at the end of the term of session. The continuous assessment account for 30-40%, while the examination (end of the term assessment) accounts for 60-70% of students' score, thus enabling the teacher to assess and monitor the learning progression of students in the classroom. Oguneye (2002) cited in Gichuhi (2014) posits that one of the functions of a classroom teacher is to

evaluate the performance of the learners and to effectively carry out this function, assessment is requisite.

Assessment can be defined as the systematic and ongoing method of gathering, analyzing and using information from measured outcomes to improve student learning in terms of knowledge acquired, understanding developed and skills and competencies gained (LIoyd, et al., 2008). The UK Higher Education Academy defines assessment as processes such as examinations or coursework through which a learner's achievements are measured. We tend to use the general term assessment to refer to all those activities undertaken by teachers, and by their students in assessing themselves, that provide information to be used as feedback to modify teaching and learning activities. Such assessment becomes formative assessment when the evidence is actually used to adapt the teaching to meet the needs of students (Black & William, 1998). Brookhart (2001); Shepard (2001); Stiggins (2001) maintained that students should be actively involved in assessment through self evaluation. They argued that students need to monitor their progress by applying ongoing meaningful feedback that is helpful so as to meet the learning targets. Nevertheless, self assessment will happen only if teachers help their students to develop assessment skills, because difficulties always arise for students to think and set learning targets (Black & William, 2004).The objectives of assessment, according to Bone (1999) are: (i) To grade or rank a student; (ii) To pass or fail a student (iii) To provide feedback to students; (iv) To provide feedback to teachers; (v) To provide feedback to professional bodies; (vi) To contribute to a student profile; (vii) To motivate students; (viii) To motivate teachers (ix) To predict success in research and/or professional courses; (x) To predict success in future employment organization; (xi) To provide a SWOT (Strengths, Weakness, Opportunities and Threats) analysis of students; (xii) To provide a SWOT analysis of teachers; and (xiii) To assist an institution in establishing quality in their provision of courses.

Bloom Taxonomy is a classification of instructional objectives that teachers want the students to know. The cognitive domain in this taxonomy is fashioned to know student's cognitive level during test or examination. Stiggins (2001) opined that teacher developed tests are directed by questions that allow students to recall facts and information which is the first level of Bloom's Taxonomy. Although, instructional objectives are expected to develop students thinking skills, on several occasion classroom tests fail to meet these desires. This means that poor quality assessment that fails to tap and reward higher thinking skills in Bloom's Taxonomy will hinder the development of those skills (Stiggins, 2001). Teachers are expected to ask questions that require thinking skills. This will enable the students to master previous level of thinking for that concept as they move from one level of thinking to another. Every new category requires more higher thinking than the previous category (Vidakovic, et al., 2004). Fredricks (2005) argued that higher level questioning is one of the best ways to strengthen student's brain. One major reason why teacher set questions from the lower level of cognitive domain (knowledge and comprehension) than the higher level is because, it is easier to grade and prepare marking scheme in the former than in the latter. Truly, the higher the levels of Bloom's Taxonomy, the

more difficult the grading. Teachers are expected to move the students up the taxonomy as they progress in knowledge.

The first level of thinking on Bloom's Taxonomy is explained as the behavior and test situation that emphasize remembering information, either by recognition or recall (Bloom et al, 1956). The second level is understanding. This is when given communication, you know what is communicated and able to use the information. This includes understanding of the actual information contained in the communication. Many times, people think comprehension only has to do with reading passage but it could be in any content. Applying is the third level of Bloom's Taxonomy. When student is given new problem and can apply the knowledge acquired to solve it without having to be shown how to go about it. With application, there is a transfer of knowledge to new situations (Aviles, 1999). Analysis is described as breaking down of a whole into parts and detection of relationship between parts. Synthesis is putting together parts to form a whole. This involves bringing the parts to form a pattern or structure that was not there before to produce something new. A task involves synthesis will demand the previous levels of knowledge, comprehension, application and analysis (Aviles, 1999). Evaluation includes making judgments about values of something (Bloom's et al., 1956). This highest level of thinking includes a combination of all levels of thinking on Bloom's Taxonomy. Waxler (2005) said if students evaluate and judge, they are more likely to retain information and perform better on standard tests. Table 1 summarizes each levels of Bloom's Taxonomy as outlined by Bloom, 1956.

Table 1: Summary of Categories in Bloom's Taxonomy

Bloom's Category	Definition	Sample Keywords/Verb
Knowledge	Draw out factual answer, testing recall and recognition of specific facts	Name, Recall, Tell List and State
Comprehension	Understand the meaning of the information	Arrange, Explain, Classify, Translate, Distinguish and Demonstrate
Application	Ability to apply knowledge to actual situation (new and concrete)	Modify, Apply, Operate, Illustrate and Prepare
Analysis	To break down into parts, or forms. Make a relation to the assumptions, classify and distinguish	Distinguish, Examine, Identify and Categorize
Synthesis	Rearrange component ideas into a new whole. Develop a pattern or structure from diverse elements	Develop, Create, Combine, Rewrite and Compile
Evaluation	Discriminate the value using definite criteria and make comparisons	Appraise, Critique, Decide, Evaluate and Judge

Nazliaet'al (2011), observed that to create thinkers as opposed to students who simply recall information, we must incorporate the higher levels into lesson plan, test and assessment. It is also felt that the application of Blooms Taxonomy system will enable the teachers to set assessment items that are well balanced, testing the different cognitive skills without a tilt towards a tough or easy paper perception. In the end, it is supremely important that teachers will help their students become critical thinkers. Building on knowledge and helping students begin to apply, analyze, synthesize and evaluate is the key to helping them grow and prosper in school and beyond (Sivaraman & Krishna, 2015). In the teacher education training programmes in Nigerian Colleges of Education and Universities, prospective teachers are exposed to courses on measurement and evaluation, methods of test construction, types of test, tests validation calculating reliability and item analyses (Azuka, 2014). The students on graduation are expected to put these techniques into practice in assessment of students in classroom. But how much of these techniques do the teachers practice in the classroom and how well do they use assessment techniques to aid students learning process?

Moreover, for any teacher to construct good test items, test validation and item analyses are very important. Research has shown that many secondary school teachers depend on test items provided by Mathematics textbooks, publishers test items and past examination questions (Azuka, 2014). Validity is the extent to which a test measures what it purports to measure while reliability refers to how consist test scores are. The construction of a good rubric can help improving the reliability of the test score (Moskal& Leydens, 2000). It is sufficed to state here that if the processes of test construction and validation are not properly carried out, then the outcome of such test is not reliable and useable. Item analysis includes examining the item difficulty, item discrimination and effectiveness of the distracter. As discussed by Niko and Brookhart (2007), there are six reasons to conduct an item analysis. The first is to examine if your item functions as intended. Did it assess the desired concepts? Was it the correct level of difficulty? Does it distinguish between those who know the material and those who do not? If it was a multiple-choice item, how well did the distracter function? How much of these processes are being carried out by the junior secondary school Mathematics teachers?

Research questions for this study were in fivefold; what is the pattern of mathematics teacher's usage of various instruments in assessing their students? What are the sources of generating mathematics items by the teachers? what is the extent of cognitive domain covered by the test items? Do psychometric properties of test items established by classroom teachers? And how do teachers use the outcomes of the formative tests in Mathematics?

2.0 METHODOLGY

The study population comprised of junior secondary school Mathematics teachers in Federal Capital Territory, Abuja, Nigeria. The target population was JSS 1 and II teachers teaching Mathematics in FCT. Junior Secondary School three teachers were not included in the study because

JSS 3 examinations were on going and the teachers were much involved in supervision during data collection stage. Three Mathematics teachers from each of 21 schools (7 schools from each area council Gwagwalada, Abaji and Bwari) making a total of sixty-three (63). Mathematics teachers were purposively sampled from the three area councils of FCT, Abuja. Although, only sixty-one (61) questionnaires were returned. The instrument for data collection was a twenty-seven (27) items questionnaire of four-point Likert scale ranges from very often to never adapted from Azuka (2014) tagged "Mathematics Assessment Construction Scale (MACS)" with original reliability coefficient of 0.79. The instrument was re-validated by experts in Measurement and Evaluation and subjected to content validity and ordinal alpha method of reliability. It was found to possess 0.82 and 0.76 content validity index and coefficient of reliability respectively. The instrument was administered to the teachers through research assistants. All analyses were performed using frequency counts and percentages.

3.0 FINDINGS

Table 2: Teachers Responses to Assessment Instruments used in Mathematics Class

Instrument	Regularity of the use of Instrument			
	Very Often	Often	Not Often	Never
Written Test	42 (68.9%)	16 (26.2%)	3 (4.9%)	-
Assignment	50 (82.0%)	10 (16.4%)	1 (1.6%)	-
Group work	10 (16.4%)	33 (54.1%)	17 (27.9%)	1 (1.6%)
Project work	5 (8.2%)	14 (23.0%)	40 (65.6%)	2 (3.2%)
Observation	18 (29.5%)	27 (44.3%)	14 (23.0%)	2 (32.0%)
Oral Presentation	8 (13.8%)	16 (26.2%)	31 (50.8%)	6 (9.8%)
Peer Group Assignment	1 (1.6%)	14 (23.0%)	38 (62.3%)	8 (18.1%)
Oral Examination	12 (19.7%)	6 (9.8%)	16 (26.2%)	27 (44.3%)

Table 2 remarked that virtually all the teachers employed written test and assignment to assess students in Mathematics class. About 29.5% didn't use group work, 68.8% of teachers did not use project work, 55% never use oral presentation, about 80.4% teachers didn't often use peer group assignment and 70.5% teachers always failed to use oral examination.

Table 3: Teachers responses to Source of Test Items for assessing Students in Mathematics

Sources of Items	Regularity of usage			
	Very Often	Often	Not Often	Never
Text-book Publisher's Questions	33 (54.1%)	14 (23.0%)	6 (9.8%)	8 (13.1%)
Past Question	17 (27.9%)	24 (39.3%)	19 (31.1%)	1 (1.6%)
Question and Answer Book	14 (23.0%)	33 (54.1)	10 (16.4)	4 (6.6%)
Question constructed by Teacher	31 (50.8%)	20 (32.8%)	9 (14.8%)	1 (1.6%)

Table 3 shows that substantial number (77.1%, 67.2%, 77.1% and 83.6%) of teachers use text-book publisher's questions, past question, question and answer book and question constructed by teachers respectively as sources of test items for assessing students in Mathematics class. However, cursory examination of Table 3 depicts that few numbers (16.4%) of teachers didn't construct their items themselves.

Table 4: Teachers responses to Levels of Cognitive Domains covered by Test Instruments

Level of Questions	**Regularity of the use of levels of questions**			
	Very Often	**Often**	**Not Often**	**Never**
Knowledge	43 (70.5%)	13 (21.3%)	5 (8.2%)	-
Comprehension	24 (39.5%)	28 (45.9%)	9 (14.8%)	-
Application	20 (12.2%)	14(8.54%)	76(79.26%)	-
Analysis	-	-	-	100(100%)
Synthesis	-	-	-	100(100%)
Evaluation	_	_	_	100(100%)

From Table 4, 91.8% of the teachers covered knowledge, 85.4% of them covered comprehension and only 20.74% teachers covered application in their classroom made test while no teacher set questions that covers analysis, synthesis and evaluation respectively.

Table 5: Teachers Responses to Validation Process of Test Items

Validation Processes	**Regularity of validation**			
	Very Often	**Often**	**Not Often**	**Never**
Content validity	30 (49.2%)	24 (39.3%)	7 (11.5%)	-
Face Validity	21 (34.4%)	26 (42.6%)	10 (16.4%)	4 (6.6%)
Reliability	17 (27.9%)	32 (52.5%)	11 (18.0%)	1 (1.6%)
Item Difficulty	11 (18.0%)	18 (29.5%)	30 (49.2%)	2 (3.3)
Item Discrimination	5 (8.2%)	23 (37.7%)	28 (45.9%)	5 (8.2%)
Distracter Index	1 (1.6%)	11 (18.0%)	25 (41.0%)	24 (39.3%)

Table 5 shows that 88.5% teachers carried out content validity regularly, 77% teachers conducted face validity often, about 80% teachers conducted reliability always, only 47.5% assesseditem difficulty often, less than 46% teachers assessed item discrimination and only 19.6% assessed distracter index during validation process of test instruments in mathematics class.

Table 6: Use of the Outcomes of Formative Assessment Tests in Mathematics Class

Use of Formative Test	Regularity of Use			
	Very Often	Often	Not Often	Never
Give formative test	29 (47.5%)	28 (45.9%)	1 (1.6%)	3 (4.9%)
Give formative test and feedback to students	21 (34.4%)	36 (59.0%)	4 (6.6%)	-
Give formative test, Feedback and Remediation lesson to students	20 (32.8%)	35 (57.4%)	5 (8.2%)	1 (1.6%)

Considering Table 6, one can observe that majority 93.4% of the teachers give formative test often, 93.4% teachers often see it necessary to give formative test and feedback while 90.2% teachers regularly give formative test, feedback and remediation to students in Mathematics class. In order words, about 6% didn't give formative test to students, almost 7% teachers did not give feedback to students and 10% teachers did not deem it fit to give remediation to students in Mathematics class.

4.0 DISCUSSIONS

The first research question sought to know the assessment instruments used by teachers in Mathematics class, which according to the results of the study showed that majority of them often use written test and assignment and neglect other assessment instruments. This might due to teachers' work load and large class size that need to be reduced and adjustment on lesson time table duration and periods of lesson to accommodate the usage of other assessment instruments. This corroborate submission of (Azuka 2014; Dandis, 2013) that teachers are expected to use class tests and assignments and other assessment instruments such as group work, observation, oral presentation and oral examination to assess and grade the students in Mathematics class. Teachers should note that assessment based on assignment and written test only is not comprehensive and valid because it does not measure all it expected to measure to achieve the goals of Mathematics education.

Research question two was formulated to know the sources of test items used by teachers for assessing students in Mathematics. Based on the findings majority of the teachers use test book publisher's questions, past question, question and answer book and question constructed by teachers respectively as sources of test items for assessing students in Mathematics class. Surprisingly, a substantial percentage (16.4%) of the teachers didn't construct their items themselves which may be due to lack of adequate knowledge and understanding on how to construct test items. This implies that these teachers solely depend on other sources to draw their items and justify the belief of many people that majority of teachers copy questions from past questions and answer books. Even those that construct their questions themselves, do they really follow the test blueprint? This calls for proper

training and guidance on principles of test item construction. These findings support the findings of Azuka (2014) and Sharon et al (1997).

The third research question sought to know the levels of cognitive domains covered by test instruments in Mathematics class. The results revealed that majority of the teachers test items only covered Knowledge and Comprehension while Application, Analysis, Synthesis and Evaluation suffered neglect. This implies that teachers only set questions that emphasize the use of lower levels of cognitive demand in Mathematics class and totally neglect the use of higher levels of cognitive demand as highlighted by Bloom's taxonomy. This agrees with the findings of Azuka (2014); Sharon et al., (1997). Thus, Mathematics items should require more of students than simple memorization of ideas and steps. Test items should be written to elicit complex cognition including application, analysis, synthesis and evaluation. As a teacher, you should attempt to move students up the taxonomy as they progress in their knowledge.

Research question four investigated the validation processes of test items used by test instruments in Mathematics class. The results of this study indicated that some Mathematics teachers about 23% didn't regularly carry out content validity, face validity, and reliability. While majority of them between 54% and 81% didn't always dim it fit to carry out item difficulty, item discrimination and distracter index during validation process of test instruments in mathematics class. This may be due to lack of the knowledge of item analysis. This agrees with the findings of Azuka (2014). Any test items constructed in which these analyses are not conducted, such items cannot be said to be valid, reliable, and useable. It is very bad that most teachers of this important subjects lack the knowledge of this technique. It also calls for proper training of Mathematics teachers on item analyses.

The fifth research question examined how Mathematics teachers use the outcomes of formative test in Mathematics class. The finding revealed that some Mathematics teachers didn't give feedback and remediation to students in Mathematics class. The implications are no opportunities for class discussion, the strength, weakness, opportunity and threat (SWOT) analysis of both teachers and students are unrealizable. Teachers deprived the students the following: quality information about their learning, peer dialogue in understanding the feedback, positive motivational beliefs, opportunities to close the gap between current and desired performance. This supports the findings of Azuka, (2014). It is expected that teachers give test, mark and give feedback to the students to see their performances, identify areas of weakness, strength and improvement. It can be sometimes difficult for students to succeed, carry out and complete project, and redefine themselves. The more supported they feel through feedback the better equipped they are, also the more effective they can be, the more likely are they to succeed in their project, group work and assignment both at school work and society.

5.0 CONCLUSION

In conclusion, the findings of this study have shown that majority of the Mathematics teachers often use written test and assignment and neglect other assessment instrument. A substantial percentage of the teachers didn't construct their test items themselves but rely on other sources like publishers' textbooks, past questions and answers. The results revealed that about many Mathematics teachers test items only covered Knowledge and Comprehension while Application, Analysis, Synthesis and Evaluation suffered neglect. Also, many teachers didn't always dim it fit to carry out item difficulty, item discrimination and distracter index during validation process of test instruments in mathematics class. Finally, few teachers didn't consider it necessary to give feedback and remediation to students in Mathematics classroom.

Therefore, based on the outcomes of this study, the authors' recommended that teachers should be encouraged to use other forms of assessment instruments such as observation, project work, group work, oral presentation and oral examination apart from written test and assignment in the assessment of their students in Mathematics class; Regular training and retraining workshops, seminars and courses should be organized to help the teachers gain competence in construction of tests in order to ensure quality assessment in schools; Mathematics teachers should be encouraged to use Bloom's Taxonomy to construct questions. This will enable them to set questions that are well balanced, testing the different cognitive skills without a tilt towards a tough or easy paper perception; and mathematics teachers should be trained on how to carry out item analysis such as reliability, item difficulty, discrimination and distracter index to determine each item's effectiveness in measuring students' understanding of the content and to assist in further development of test items.

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