



**INVESTIGATING THE COGNITIVE DEMAND OF
TEACHER - MADE MATHEMATICS TEST IN MISAU
LOCAL GOVERNMENT AREA, BAUCHI STATE
NIGERIA**

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ABSTRACT

The study investigated the cognitive demand of teacher-made Mathematics test in Misau Local Government, Bauchi State, Nigeria. The study adopted Causal comparative (Ex-post factor) design from total population of fifty-seven (57) Mathematics teachers consisting of 46 males and 11 females, A total of 174 sample of TMT was retrieve from teachers, and is restricted to mathematics teachers from public senior secondary schools, all the population was used for this research. The researcher developed a Test Investigation Guide (TIG) for TMT. One research question was answered and four hypotheses were formulated and tested at 0.05level of significant. The data collected were analyzed using descriptive statistic; frequency counts and percentages to answer research question, while Chi-square (cross-tabulation) was used to test the four hypotheses. The study revealed that, 56% teachers' in Misau Local government set their test item to measure higher cognitive demand whereas about 44% of their items measures low cognition. The frequency of cognitive level of test items found on TMT between experience and in-experience teachers is retained but rejected in-relation to qualification. Lastly, there is no significant differences among teachers' on placement of specific verbs in testing cognitive functioning of students with regard to working experience and qualification, the study recommended that teachers' level of awareness should be raised to the level that they expand the status of their test items to measure the remaining aspect of cognition. Regular workshop and seminars on Bloom's Taxonomy should be extended to the various levels of cognition. Teachers' should update their status regarding verb usage on the context of the item and the complexity of the action for testing different depth-of-knowledge levels. Doing this would help teachers in the development of instructional methods that efficiently uses student's limited cognitive processing capacity to stimulate their ability to apply acquired knowledge and skills to new situations.

Keywords: *cognitive demand, Mathematics teacher- Made Test, Test Investigation Guide, hypotheses, Bloom's Taxonomy*

INTRODUCTION

Mathematics remains the core 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 realization of this dream, The Federal Government of Nigeria, embarked on vigorous Mathematics curriculum reforms and the establishment of the National Mathematical Centre (NMC) and other similar unit or agencies to enable our educational system function effectively towards improving our Science and Technology, The major aim of making Mathematics compulsory in our primary and secondary schools is for skill acquisition and mastery of content taught so as to apply the knowledge of Mathematics in Science and technology, everyday life activities and for the growth and development of our nation. However, the relevance of Mathematics curriculum content notwithstanding, if there exists a weakness in instruction, its purpose and objectives will not be actualized. This can only be possible if teachers are well trained and equipped. Teachers are very important stakeholders in the educational system, as they drive whatever takes place within the classrooms in the school system. Apart from teaching, they generate assessments which are used to evaluate teaching efficacy and learning achievement within their classrooms. One critical component of the professional duties of classroom teachers at different tiers of education is the evaluation of pupils' progress, the instruments mostly used for evaluating secondary school students are the teachers' own tests, Teacher-made tests (TMT). TMT can be seen as more than assessment devices; they are fundamental parts of the educational process. Thus they can define instructional purposes, influence what students study, and help teachers to gain perspectives on their course. Bloom in his taxonomy has classified instructional objectives that guide teachers in assessing various level of student's cognition. The cognitive domain in this taxonomy is fashioned to know student's cognitive level from knowledge level which require student to draw out factual answer, testing recall and recognition of specific facts up to evaluation that require students to discriminate the value using definite criteria and make comparisons which is the highest, during test or examination. Stiggins (2001) opined that teacher developed tests are expected to concentrate on questions that allow students to perform and action or task within the six range of Bloom's Taxonomy. 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 higher thinking than the previous category (Vidakovic, et al., 2004). In addition, Fredricks (2005) opine that higher level questioning is one of the best way for strengthening student's brain. One major reason why teacher set questions from the lower level of cognitive domain (knowledge and comprehension) than the higher level (analysis, synthesis and evaluation) 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 for grading, teachers are expected to move the students up the taxonomy as they progress in knowledge. Frequent questions on lower level demand, especially knowledge level lead to frequent memorization of student book, (Othman, 2018). On contrary, Waxler (2005) said if students were trained on how to evaluate and judge (higher level demand), they are more likely to retain information and perform better on standard tests.

Bloom's six levels of cognitive demand with their verbs usage if appropriately use, will help in retrieving the required responses from students, this will enhance learning diagnoses in class.

It is pertinent that TMT is more frequently used in educational settings than any other type of test. One is then tempted to wonder if the frequent and regular use of TMT automatically implies that they are of high quality, if that is the case, then there is a need for competency in test development regardless of being professional or not. Ololube (2008) evaluated competencies of professional and non-professional teachers in Nigeria. He reported that professional teachers tend to construct various effective evaluative instruments more than the non-professional teachers. 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). . The quality of a test given by a teacher is closely linked with its ability to provide the kind of information needed regarding students' performances. A well-written test allows the teacher to accurately and consistently measure students' mastery of specific contents taught in class. The tests allow teachers to measure to some degree how effective their instructions have been assimilated. On the contrary, poorly designed test items may lead to inaccurate measurements of learning and provide false information regarding students' performances as well as instructional effectiveness with regards to cognitive demand. It is observed that any characteristic of a test item which distracts the examinee from the major point or focus reduces the effectiveness of that item. The outcomes of TMT provide vital feedback to important

stakeholders such as parents or guardians of the pupils and the community in general. The marks entered on the term reports at primary and secondary school levels are usually the pupil's scores on classroom tests. Hence, it is clear that teachers need to be extremely careful in designing the test that measures the skill it intends to measure. Mpofu (2011). Evaluating learner progress is a fundamental purpose of TMT. Therefore, TMT enables the teachers to determine whether the performance of each student is declining, relatively stable or improving. Vehemently, the use of poorly designed Mathematics achievement test is a major problem that hinders student's interest even at early schooling, as it affects students' interest and achievement in Mathematics. It has already been pointed out that poorly designed tests could make the students loose interest in a particular subject (Osadebe, 2001).

It was specifically highlighted in the Nigerian teacher education programme, be it teachers' grade two certificates or Nigeria Certificate in Education (NCE) or Degree in education B.Sc. ed or BA ed. and B tech ed, that each student must have an idea or procedures for evaluating students' achievements in relation to cognitive demand. These concepts were taught under Test and Measurements as a course on its own, before obtaining the prescribed certificate. Teachers from Misau Local Government and Bauchi State, in general, are not an exception regarding this issue.

It is against this background that the researcher will investigate the quality or otherwise of TMT, bearing in mind Teachers qualification and working experience and the verb usage in relation to tests' development at public secondary schools level in Misau Local Government Area of Bauchi State.

PURPOSE OF THE STUDY

The study is aimed to determine:

1. The type of cognitive processes of Blooms' Taxonomy teachers frequently used when developing TMT in Misau local government area of Bauchi State.
2. whether there is difference in the type of cognitive dimension processes of Bloom taxonomy teachers frequently used when developing TMT with regards to working experience in Misau local government area of Bauchi State
3. whether there is difference in the type of cognitive dimension processes of Bloom taxonomy teachers frequently used when developing TMT with regards to qualification in Misau local government area of Bauchi State

4. whether there is difference in placement of specific verbs in testing cognitive functioning by Mathematics teachers with regards to working experience in Misau local government area of Bauchi State
5. Whether there is difference in placement of specific verbs in testing cognitive functioning by Mathematics teachers with regards to qualification in Misau local government area of Bauchi State.

RESEARCH QUESTIONS

The following research question was posed to guide this study:

The research findings sought to answer the following question:

1. What type of cognitive dimension processes of Bloom taxonomy do teachers frequently used in developing TMT in Misau local government area of Bauchi State?

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance:

1. HO₁- The types of cognitive dimension processes frequently used on TMT do not differ significantly between experience and in-experience teachers' in Misau local government area of Bauchi State
2. HO₂- The frequency of cognitive dimension processes frequently used on TMT do not differ significantly between qualified and un-qualified teachers' in Misau local government area of Bauchi State
3. HO₃- The placement of specific verbs in testing cognitive functioning of students do not differ significantly between experience and in-experience teachers' in Misau local government area of Bauchi State
4. HO₄- The placement of specific verbs in testing cognitive functioning of students do not differ significantly between qualified and un-qualified teachers' in Misau local government area of Bauchi State

METHODOLOGY

The research design employed for the study was Causal comparative (ex-post facto) design. The populations of the study are all the fifty seven (57) Senior Secondary Schools Two (SS2) Mathematics teachers that taught at the twelve senior secondary schools within the two districts consisting of Day and Boarding public Schools in Misau Local Government Area Bauchi State. Their educational qualifications encompass those with NCE, HND, BSC ED, BSC, BED.TECH and B ENG and few with higher degrees, their working experience varied from one to thirty-two years. Their ages approximately range between

twenty-two to fifty-five years, most of them belong to low socio-economic status, and few were of moderate class.

A face to face interview was used in collecting the demographic information of Teachers for this research work. Similarly, Test Investigation Guide (TIG) which was designed by the researcher was used for investigating the recent test items (question papers), bearing in mind the general information regarding test item format and cognitive level target from individual question papers. At this juncture, three people including the researcher participated as judges for the investigation purpose; they had post-graduate experience in test and measurement.

RESULTS

Research Question one: What type of cognitive dimension processes of Bloom taxonomy do teachers frequently used in developing TMT in Misau local government area of Bauchi State?

Table 1.0: Summary of Descriptive Statistics for Types of Cognitive Processes'

<i>Types of Cognitive Dimension Processes</i>	<i>Frequency</i>		<i>Percentage of Those Applying</i>
	<i>Not Applying</i>	<i>Applying</i>	
<i>Remembering</i>	00	57	39%
<i>Understanding</i>	20	37	26%
<i>Applying</i>	27	30	21%
<i>Analyzing</i>	46	11	07%
<i>Evaluating</i>	49	08	06%
<i>Creating</i>	55	02	01%
<i>Total</i>			100%

Table 1.0 depicts the cognitive dimension process of Bloom taxonomy teachers frequently used in developing TMT at Misau local government. From the table, it can be observed that remembering is the most frequently used representing 39% of the entire frequency count. This might be connected with students' belief that mathematics has to do with memorization instead of understanding and applying. The table also indicated that understanding is the second in frequency count use having 26% and creating is the list having only 1 % as it frequency count respectively.

Hypotheses Testing

HO₁- The types of cognitive dimension processes frequently used on TMT do not differ significantly between experience and in-experience teachers' in Misau local government area of Bauchi State

Table 2.0: Summary of Chi- Square Cross Tabulation Analysis of Types Cognitive Dimension Processes by Teacher’s Working Experience

<i>Working Experience</i>	<i>Frequency</i>	<i>Chi square</i>	<i>Df</i>	<i>P-value</i>	<i>Decision</i>
<i>Experienced</i>	32	.022	1	.882	Accepted
<i>Inexperienced</i>	25				
<i>N of Valid Cases</i>	57				

Table 2.0 above presented the analysis for chi-square on cognitive dimension processes between experience and in-experience teacher’s ; the result shows the calculated X^2 value was found to be .022 with a degree of freedom 1 and p-value of .882. It can be observed that the p-value which is .882 is greater than *alpha* value of 0.05. Thus, the null hypothesis which states that, the types of cognitive dimension processes found on T.M.T will not differ significantly by the teachers’ working experience is retained. The chart below further explains the scenario.

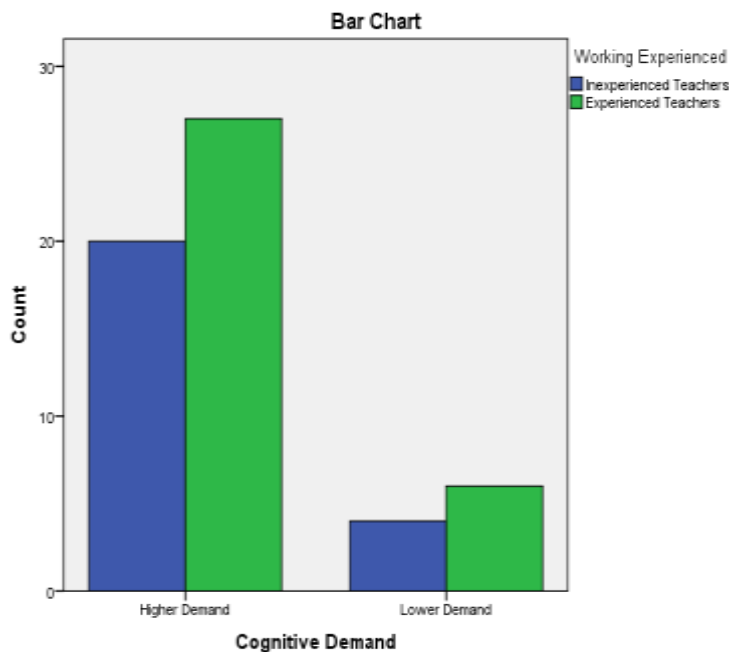


Figure 1: Cognitive Processes VS Teacher's Working Experience

HO₂- The types of cognitive dimension processes frequently used on TMT do not differ significantly between qualified and un-qualified teachers’ in Misau local government area of Bauchi State

Table 3.0: Summary of Chi- Square Cross Tabulation Analysis of Types of Cognitive Dimension Processes by Teacher’s Qualification

<i>Qualification</i>	<i>Frequency</i>	<i>Chi square</i>	<i>Df</i>	<i>P-value</i>	<i>Decision</i>
<i>Qualified</i>	29	4.626	1	.031	Rejected
<i>Unqualified</i>	28				
<i>N of Valid Cases</i>	57				

Table 3.0 above depicts the analysis for chi-square on types of cognitive processes in relation to teacher’s qualification; the result shows the calculated X^2 value was found to be 4.262 with a degree of freedom 1 and p-value of .031. It can be observed that the p-value which is .031 is less than *alpha* value of 0.05. Thus, the null hypothesis which states that, the types of cognitive dimension processes found on T.M.T will not differ significantly by the teachers’ teaching qualification is rejected. The chart below further explains the differences.

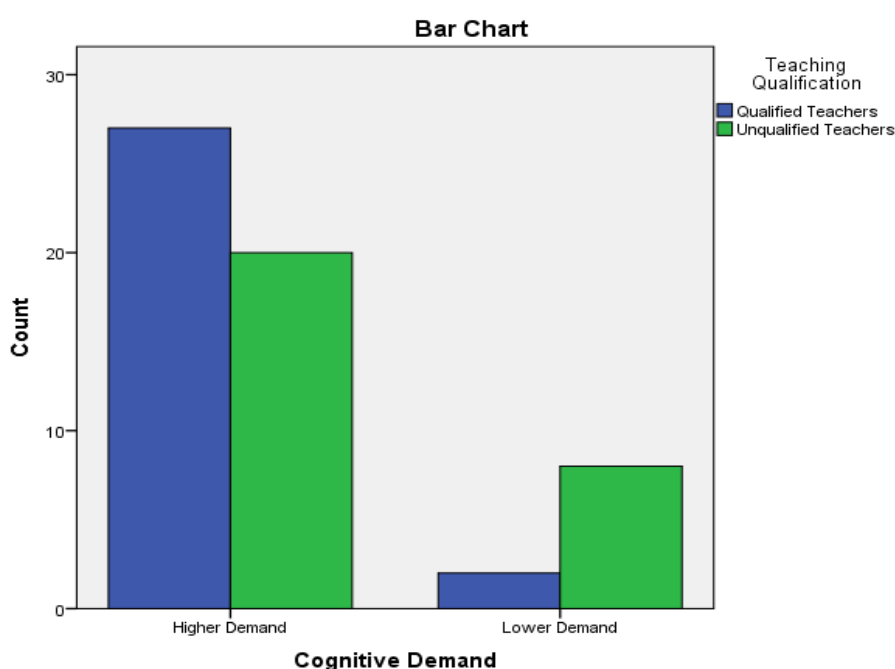


Figure 2: Cognitive Processes VS Teacher's Qualification

HO₃- The placement of specific verbs in testing cognitive functioning of students do not differ significantly between experience and in-experience teachers’ in Misau local government area of Bauchi State

Table 4.0: Summary of Chi- Square Cross Tabulation Analysis of Placement of Verbs by Teacher’s Working Experience

<i>Working Experience</i>	<i>Frequency</i>	<i>Chi square</i>	<i>Df</i>	<i>P-value</i>	<i>Decision</i>
<i>Experienced</i>	32	2.241	1	.134	Accepted
<i>Inexperienced</i>	25				
<i>N of Valid Cases</i>	57				

Table 4,0 above shows the result of chi-square on the placement of specific verbs in relation to teachers’ working experience. From the result, it can be observed that X^2 value is 2.241 with a degree of freedom 1 and P-value of .134. Since .134 is greater than α level of 0.05 the null hypothesis which states that, the placement of specific verbs in testing cognitive functioning of students will not differ significantly by teachers’ working experience in Misau local government is retained. Thus, the chart below further confirmed the result of the analysis.

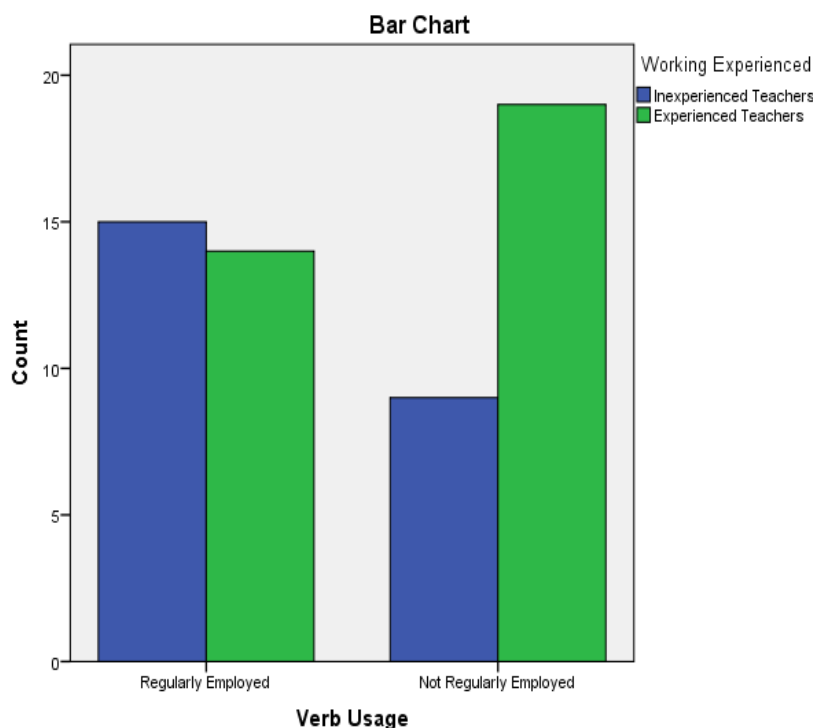


Figure 3: Placement of Verbs VS Teacher's Working Experience

HO₄- The placement of specific verbs in testing cognitive functioning of students do not differ significantly between qualified and un-qualified teachers’ in Misau local government area of Bauchi State

Table 5.0: Summary of Chi- Square Cross Tabulation Analysis of placement of Verbs by Teacher’s Qualification

<i>Qualification</i>	<i>Frequency</i>	<i>Chi square</i>	<i>Df</i>	<i>P-value</i>	<i>Decision</i>
<i>Qualified</i>	29	.436	1	.509	Accepted
<i>Unqualified</i>	28				
<i>N of Valid Cases</i>	57				

Table 5.0 presented the result of chi-square analysis on the placement of specific verbs in relation to teachers’ qualifications. From the result, it can be observed that X^2 value is .436 with a degree of freedom 1 and P-value of .509. Since .509 is greater than α level of 0.05 the null hypothesis which states that, the placement of specific verbs in testing cognitive functioning of students will not differ significantly by teachers’ qualification in Misau local government is retained. Thus, the chart below further confirmed the result of the analysis.

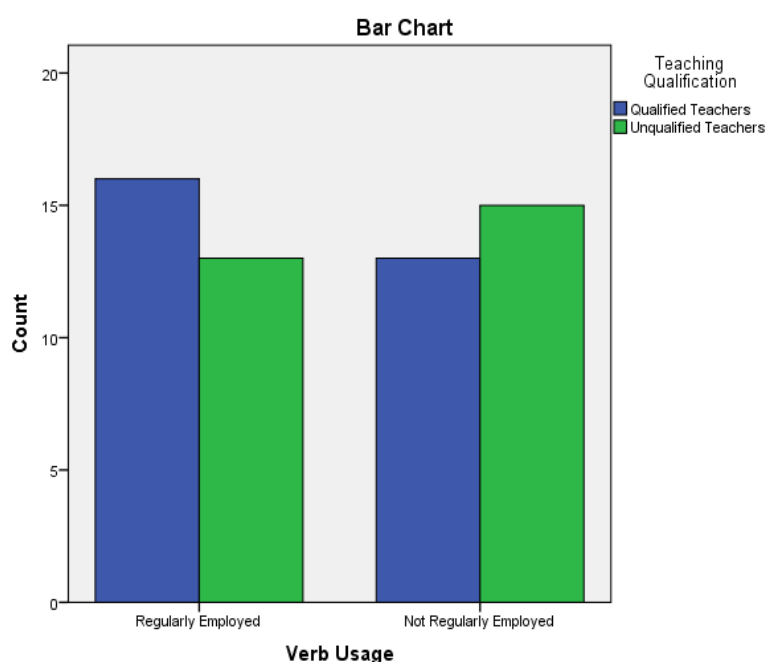


Figure 4: Placement of Verbs VS Teacher's Qualification

Summary of Findings

Based on the analysis, the findings are summarized as follows:

1. The first finding is on the cognitive dimension process of Bloom taxonomy teachers frequently used in developing TMT at Misau local

government?. It was found that remembering is the most frequently used representing 39% of the entire frequency count. This might be connected with the belief that mathematics has to do with memorization instead of understanding and applying. Understanding is the second in frequency count use having 26% and creating is the list having only 1 % as it frequency count respectively.

2. The frequency of cognitive dimension processes frequently uses on TMT do not differ significantly from experience and in-experience teachers' in Misau local government is retained,
3. The frequency of cognitive dimension processes frequently used on TMT **differs** significantly between qualified and un-qualified teachers' in Misau local government in Misau local government.
4. The placement of specific verbs in testing cognitive functioning of students do not differ significantly between experience and in-experience teachers' in Misau local government .
5. The placement of specific verbs in testing cognitive functioning of students do not differ significantly between qualified and un-qualified teachers' in Misau local government

DISCUSSION OF FINDINGS

The first finding of the study shows the frequency of cognitive level of item use regarding Blooms' taxonomy by teachers in Misau Local Government Bauchi State. From table 1.0, the most frequently used is remembering representing 39% of the entire frequency count, followed by understanding which has 26% and creating is the list having only 1%. This might be connected with students' belief that mathematics has to do with memorization instead of understanding and applying.

This finding shows that most teachers in Misau Local Government set their question at lower level demand which consists of remembering, understanding and part of applying.

The above research is in line with that of Emaphor & Oribhabor (2016), likewise that of Azuka & Festus (2014). This shows that teachers normally set their question at the lower level of cognition.

-The second finding is on the frequency of cognitive level of test items found on TMT do not differ significantly from the teachers' working experience in Misau local government, Table 2.0 shows the result for chi-square for The frequency of cognitive level of test items in relation to working experience (experience and in-experience). After analysis, the result shows the calculated Exact Sig of .882 tested at *a* level of 0.05 with a degree of freedom 2. Since the Exact Sig of .882 is greater than *a* level of 0.05 the null hypothesis which states that, the frequency of cognitive level of test items found on TMT do not differ

significantly by the teachers' working experience in Misau local government is retained.

-The above research is in line with that of Emaphor & Oribhabor (2016), likewise that of Azuka & Festus (2014). This shows that teachers normally set their question at the lower level of cognition

-The third finding is on The frequency of cognitive level of test items found on TMT will not differ significantly from the teachers' qualification in Misau local government. Table 3.0 shows the result for chi-square for the frequency of cognitive level of test items in relation to teachers' qualification (with and without educ. qualification). After analysis, the result shows the calculated Exact Sig of .031 tested at *a* level of 0.05 with a degree of freedom 1. Since the Exact Sig of .031 is less than *a* level of 0.05 the null hypothesis which states that, The frequency of cognitive level of test items found on TMT do not differ significantly between qualified and un-qualified teachers' in Misau local government is rejected. This indicated that the frequency of cognitive level of test items found on TMT differ significantly between qualified and un-qualified teachers'.

-The above research contradicts that of Azuka & Festus (2014), likewise that of Emaphor & Oribhabor (2016) which revealed that teachers normally set their question at the lower level of cognition.

- The fourth finding is on the placement of specific verbs in testing cognitive functioning of students will not differ significantly by teachers' working experience in Misau local government. The result for chi-square for the placement of specific verbs in relation to teachers' working experience (above 5 years & below 4 years), After analysis, the result at Table 4.0 shows the calculated Exact Sig of .134 tested at *a* level of 0.05 with a degree of freedom 2. Since the Exact Sig of .134 is greater than *a* level of 0.05 the null hypothesis which states that, the placement of specific verbs in testing cognitive functioning of students do not differ significantly by teachers' working experience in Misau local government is retained.

- The fifth finding is on the placement of specific verbs in testing cognitive functioning of students do not differ significantly by teachers' qualification in Misau local government. The result for chi-square for the placement of specific verbs in Table 5.0, display a result in testing cognitive functioning of students in relation to qualification, after analysis, the result shows the calculated Exact Sig of .509 tested at *a* level of 0.05 with a degree of freedom 4.9 Since the Exact Sig of .509 is greater than *a* level of 0.05 the null hypothesis which states that, the placement of specific verbs in testing cognitive functioning of students do not differ significantly between qualified and un-qualified teachers' in Misau local is retained.

The fourth and fifth findings above contradict that of Adodo, 2015, who affirm that qualification does not reflect on valid test development. Similarly, Obade, 2015 in his research he concluded that there is no significance difference between qualification, experience, and competency in test development.

CONCLUSION

From the findings of the study, it can be concluded that, Teachers-Made-Test developed by Senior Secondary Schools Mathematics Teachers in Misau Local Government Bauchi state,

Differences existed between teachers working experience on the frequency of cognitive level of item use regarding Blooms' taxonomy, majority of experience teachers measure higher cognition whereas in-experience measure lower cognition

In addition, on the placement of specific verbs and its role in-relation to qualification, the finding shows slide difference between qualified and un-qualified teachers which indicated that placement of specific verbs in testing cognitive functioning of students play a key role in determining teacher's qualification.

On the frequency of cognitive level of test items constructed in relation to working experience and qualification, at first instance the Exact Sig of .882 is greater than α level 0.05 while the Exact Sig of .882 is greater than α level 0.05, this shows that the 3rd hypotheses is retained but 4th hypotheses is rejected

Conclusively, this research work affirms that on the placement of epecific verbs in relation to working expereince and qualification, the null hypotheses which says that the placement of specific verbs in testing cognitive functioning of students do not differ significantly by teachers' working experience as well as qualification is retained, Since the Exact Sig of .134 is greater than α level of 0.05 and also the Exact Sig of .509 is greater than α level 0.05 respectively.

RECOMMENDATION

Based on the result this study, the following recommendations were made:

1. Utilization of Bloom's taxonomy should be extended to various level such as analyzing problems up to the level of practical life situation this will reduce the level of total memorization of exercises book. This can only be possibly through providing workshops and seminars on related issues
2. Items dealing with the same content may be grouped together; doing this will help the examinee to concentrate on a single domain at a time rather than having to shift back and forth among areas of content. Furthermore, the examiner will have an easier job of analyzing the results, as it was easier to see at a glance whether the errors are more frequent in one content area than the other. Items may be so arranged that difficulty progress from easy to hard. Items should be arranged in the test booklet so that answers should follow number set pattern.
3. Teachers should work hard to differentiate the two level (higher –lower), because their concern should be on the development of instructional methods that efficiently uses people's limited cognitive processing capacity to stimulate their ability to apply acquired knowledge and skills to new situations, hence teachers should not lay their hand after

- graduation, they must keep on updating their knowledge and skill in accordance with technological advancement regarding their profession.
4. Since exam questions were answered based on language content and instructions, there is a need for proper utilization of verbs. In construct, some action words (verbs) can be classified at different depth-of-knowledge levels, depending on the context of the item and the complexity of the action, hence teachers should update their status on this by a thorough investigation of standardized question papers and contacting an expert on that related field.

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