CHALLENGES FACING TEACHERS IN SETTING SCHOOL BASED
MATHMATICS TESTS USING BLOOM'S TAXONOMY IN
SECONDARY SCHOOLS OF NJORO DISTRICT, KENYA

BY

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Challenges facing teachers in setting

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DECLARATION

This research Thesis is my original work and has not been presented for a degree in any other University.

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I dedicate my work to my family who has supported me throughout the process. I also dedicate this thesis to my course mates who have always been encouraging me.
ACKNOWLEDGEMENT

This work would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study.

First and foremost, my utmost gratitude to Dr. S.M. Rukangu, my supervisor for his professional guidance, sincerity and concern throughout my study period. Special thanks to Dr. H. Babusa, my supervisor for his direction and encouragement during the study. I will not forget the late Professor P.K Mutunga for his invaluable support during proposal stage of the thesis writing.

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ABBREVIATIONS AND ACRONYMS

BT  Bloom’s Taxonomy
CATs  Continuous Assessment Test
DEO  District Education Officer
HOCS  High Order Cognitive Skills.
HOD  Head of Mathematics department
K.C.S.E  Kenya Certificate of Secondary Education.
KNEC  Kenya National Examination Council
LOCS  Low Order Cognitive Skills.
MOEST  Ministry of Education Science and Technology
MOCS  Middle Order cognitive Skills
MSQ  Mathematics Students Questionnaire
MTQ  Mathematics Teachers Questionnaire.
PISA  Program for International Student Assessment
SPSS  Statistical Program for Social Science
TIMSS  Trends in International Mathematics and Science Study
ABSTRACT

The purpose of this study was to identify challenges faced by teachers when using Bloom’s Taxonomy in setting school based Mathematics tests in secondary schools of Njoro district, Kenya. The objective of the study was to find out whether teachers apply BT in setting school based Mathematics tests and to identify challenges faced by teachers when using the BT in setting the school based Mathematics tests. The assumption of the study was that unless the tests are appropriately set, the assessment and students performance would come into question. The research adopted a descriptive research design. Data was collected using teachers’ Mathematics questionnaire, Mathematics BT checklist for tests analysis and an interview schedule for Heads of Mathematics departments. Stratified, purposive and simple random sampling techniques were used to identify schools, teachers and heads of Mathematics departments respectively for the study. The target population was teachers of Mathematics in 44 secondary schools in Njoro district. Sample size comprised of 12 (28%) schools, 36(25%) Mathematics teachers and 12(28%) Heads of Mathematics departments in the district. Secondary data involved the analysis of 2011 end year tests for Form One to Three and pre mock for Form Four classes. Data collected was coded and subjected to SPSS for analysis, representation and interpretation. From the correlation analysis of school based Mathematics tests, it was found out that majority of test questions in secondary schools of Njoro were skewed toward Application (28%) and Analysis (22%) skills of cognitive domain of BT. The study noted that majority of Mathematics teachers in Njoro district secondary schools have not been applying Bloom’s Taxonomy concept in setting Mathematics tests. The study revealed Mathematicsteachers’ ignorance on use of BT concept, weak policies on setting tests and overloaded curriculum as some of the challenges faced by teachers in setting School Based Mathematics Tests using Bloom’s Taxonomy. The study is useful to schools administration, Mathematics department and Ministry of Education in understanding the importance of BT and improving students’ performance in Mathematics through setting standardized school based Mathematics tests. The researcher recommends among others the establishment and introduction of examination policies.
guiding preparation and administration of school based tests. The study forms basis for future research in other regions in the country for improved students’ performance in Mathematics.
CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Mathematics plays a great role in physical sciences, engineering, biological sciences, medicine, military aerodynamic advancements and household chores. This has made the subject to be one of the compulsory subjects in the school curriculum in Kenya (Mutunga and Breakel, 1992). It is considered as a key subject in students’ career choices. Students are expected to apply the knowledge in both familiar and unfamiliar situations. For this reason, the government continues to accord immense support to teaching and learning of Mathematics in schools. The support is seen in the areas of allocation of teaching and learning resources, procurement of text books, and introduction of calculators in learning of Mathematics among others. This is done in order to improve performance in the subject (KNEC, 2005). Despite all these initiatives, poor performance in the subject continues to persist (KNEC report, 2008). A case in point is of Njoro district, Kenya.

The performance in Mathematics in KCSE in Njoro district (study area) has been below average for a considerable period for the year 2010 and 2011 as shown in Table 1.1
Table 1.1 KCSE Performances in Mathematics 2010 and 2011, Njoro District

<table>
<thead>
<tr>
<th>Year</th>
<th>Entry</th>
<th>A</th>
<th>A-</th>
<th>B+</th>
<th>B</th>
<th>B-</th>
<th>C+</th>
<th>C</th>
<th>C-</th>
<th>D+</th>
<th>D</th>
<th>D-</th>
<th>E</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1420</td>
<td>47</td>
<td>45</td>
<td>51</td>
<td>38</td>
<td>20</td>
<td>42</td>
<td>36</td>
<td>71</td>
<td>67</td>
<td>245</td>
<td>371</td>
<td>420</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2.1</td>
</tr>
<tr>
<td>2011</td>
<td>1427</td>
<td>58</td>
<td>35</td>
<td>40</td>
<td>52</td>
<td>41</td>
<td>59</td>
<td>58</td>
<td>89</td>
<td>82</td>
<td>185</td>
<td>305</td>
<td>382</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Source: DEO, Njoro district. (2011)

Table 1.1 indicates that Mathematics had a mean grade of D plain in year 2010 and 2011. Majority of the students therefore did not qualify for the competitive science based courses in institutions of higher learning. Table 1.1 shows the subject performance for the years 2009, 2010 and 2011 in KCSE in Njoro district.

Table 1.2  KCSE Subject Mean score for year 2009, 2010 and 2011 in Njoro District.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Mean score 2009</th>
<th>Mean score 2010</th>
<th>Mean score 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math</td>
<td>2.89</td>
<td>3.13</td>
<td>3.59</td>
</tr>
<tr>
<td>Physics</td>
<td>4.8</td>
<td>4.93</td>
<td>4.00</td>
</tr>
<tr>
<td>Chemistry</td>
<td>3.47</td>
<td>4.73</td>
<td>4.72</td>
</tr>
<tr>
<td>Biology</td>
<td>4.21</td>
<td>4.37</td>
<td>5.30</td>
</tr>
<tr>
<td>English</td>
<td>5.04</td>
<td>4.73</td>
<td>5.33</td>
</tr>
<tr>
<td>Kiswahili</td>
<td>5.04</td>
<td>4.73</td>
<td>5.66</td>
</tr>
<tr>
<td>History</td>
<td>7.67</td>
<td>5.63</td>
<td>5.43</td>
</tr>
<tr>
<td>Geography</td>
<td>4.39</td>
<td>4.21</td>
<td>4.41</td>
</tr>
<tr>
<td>H/science</td>
<td>6.13</td>
<td>8.19</td>
<td></td>
</tr>
<tr>
<td>CRE</td>
<td>5.95</td>
<td>6.43</td>
<td>6.79</td>
</tr>
<tr>
<td>B/studies</td>
<td>5.64</td>
<td>5.81</td>
<td>5.84</td>
</tr>
<tr>
<td>Computer</td>
<td>8.21</td>
<td>8.16</td>
<td>7.16</td>
</tr>
</tbody>
</table>

Source: DEO, Njoro district. (2011)
According to the table, Mathematics subject for a span of three years had the lowest mean score in comparison to the mean score of other subjects. The mean score for the subject has consistently been below average. Appropriate measures should be put in place at the school based level to reverse the trend considering the fact that the subject is compulsory in Kenya’s education curriculum.

The worrying performance in the subject has been attributed to many factors including students’ attitude and characteristics (Eshiwani, 1993), teachers’ abilities and perceptions (Anderson et al, 1989), availability and use of text books (Eshiwani, 1993), teaching methods and classroom climate (Hatano and Inagaka, 1991). Literature indicates that a considerable number of students have inadequate understanding of Mathematics and Mathematical concepts and skills (MOEST, 2001). Poor performance in Mathematics examinations has motivated calls for innovative instructional practices. Interventions depend on reformed assessment programs (Frykholm, 1999). This calls for standardized school based testing.

According to Joan (1991), Standardized testing has assumed a prominent role in recent efforts to improve the quality of education. Policymakers view testing as a significant tool in educational improvement. Tests can therefore be used as feedback to shape classroom instruction. Testing makes schools and teachers more accountable for student learning. Students’ performance in school tests is a reflection of their performance in National examination as mentioned by Herman and Baker (2005). Weaknesses in the school based tests may affect the performance of students in the national examination. School based tests should ensure all skills of learning are tested.
While testing is thought by many to benefit education in a variety of ways, the validity and value of school based tests are subjects of increasing debate. Studies point out that school based tests' narrowness of content, their lack of match with curriculum and instruction, their neglect of higher order thinking skills, and the limited relevance and meaningfulness of their multiple choice formats (Baker, 1989; Herman, 1989; Shepard, 1987) affect students' performance.

Rather than exerting a positive influence on student learning, testing may trivialize the learning and instructional process, distort curriculum, and usurp valuable instructional time (Romberg, Zarinnia,Williams, 1989). Schools serving disadvantaged students are thought to be particularly at risk for such adverse effects (Dorr-Bremme & Herman, 1986). Tests should be set with high degree of professionalism and standardization. To guide test preparation, Benjamin Bloom came up with a classification of different education objectives that educators set for their students (Bloom 1956). He came up with a criteria used in analyzing instructional objectives and questions. The classification was given his name, Bloom's Taxonomy (BT). It divides educational objectives into three domains namely; cognitive, affective and psychomotor. Bloom's Taxonomy categorized cognitive domains into six levels: knowledge, comprehension, application, analysis, synthesis and evaluation. In this categorization, Learning at the higher levels is dependent on having attained prerequisite knowledge and skills at lower levels (Bloom 1956).

Tests should assess the amount of learning along the cognitive domain of learning objectives. Construction of well-balanced tests can be challenging if teachers are
not conversant with the requirement of BT. Challenges can be a major impediment towards expected performance in Mathematics. If the challenges can be established then the problem of poor performance in Mathematics can be given an appropriate redress. The researcher has interest in finding challenges facing teachers in setting school based Mathematics test using BT.

1.2 Statement of the Problem

Poor performance in Mathematics has aroused great interest for a long time. This has been occasioned by performance which has been below educational policy expectations according to the Ministry of Education reports (KNEC 1996, KNEC 2002, KNEC 2007). Most of the work has revolved mainly on poor teaching methods, lack of teaching resources and students’ negative attitudes towards the subject among others. Little attention has however been given to the nature and quality of school based tests.

Professional preparation and development of school based tests are central to the teaching and learning process. Students who excel in national examinations are subjected to standardized school based tests. Students’ performance in school based tests is important when they are seeking for transfers, promotion and also gauging their preparedness in National examinations. Preparation of these tests is not an easy task because they have to undergo crucial stages before they are approved for administration to students. With this in mind, teachers are therefore faced with challenges of tests preparation. It is in the view of the foregoing that
the researcher felt the need to identify the challenges teachers face when using Bloom's Taxonomy in setting school based tests along the cognitive domain. To guide the study, the researcher had to establish the extent use of BT in setting school tests by analyzing cognitive level of tests questions.

1.3 Purpose of the Study

The purpose of the study was to identify the challenges faced by teachers in setting school based Mathematics tests using Bloom's Taxonomy along cognitive domain. It also established the extent of use of Bloom's Taxonomy in setting school based Mathematics tests in secondary schools of Njoro district.

1.4 Objectives

The study intended to achieve the following objectives;

i. To find out the extent to which teachers apply BT in setting school based Mathematics tests in secondary school in Njoro district.

ii. To identify challenges faced by teachers when using the BT in setting the school based Mathematics tests in secondary school in Njoro district.

1.5 Research Questions

The following research questions guided the study:

i. How frequently do teachers use BT in setting school based Mathematics tests?
ii. What teacher related problems do teachers face when using BT in setting school based Mathematics tests in secondary schools in Njoro District, Kenya?

1.6 Significance of the Study

The study provides useful information to school administrators on reform to be instituted in Mathematics and examination departments for quality testing of students. The study recommendation is useful to teachers in improving the nature and quality of their assessment practices in schools. Policy makers in the Ministry of Education are better guided and informed on the need to increase Mathematics teacher-pupil ratio in secondary schools in Njoro district in order to enhance good performance in Mathematics. The research forms important literature to other scholars who may want to explore the problem further.

1.7 Scope and Limitations of the Study

The study explored challenges faced by teachers when using Bloom’s Taxonomy in setting school based Mathematics tests in secondary schools of Njoro district, Kenya. It did not extend to other regions. However, the data forms a representative sample from which generalizations can be made covering the entire republic.

The participants of the study were volunteers. This was in line with the ethical requirements of the research. Volunteers were at liberty to give the information they felt like giving and they would leave the study any time they wanted. The
rights of people to privacy were respected with regard to the information they
gave. The quantitative delimitation of the study was that it only recruited
Mathematics teachers and heads of Mathematics department. School
administrators were not recruited.

1.9 Assumptions of the study

The following were the assumptions of the study:

i. Mathematics teachers were aware of the use of cognitive levels of
Bloom’s Taxonomy and its application in setting school based tests.

ii. Bloom’s Taxonomy Cognitive dimension had not been extensively
used in setting school based Mathematics tests.

iii. Teachers faced impediments in applying Bloom’s Taxonomy in setting
the school based Mathematics tests.

1.10 Theoretical Framework

This study was based on Bloom’s Taxonomy theory. This theory was created in
1956 under the leadership of Benjamin Bloom in order to promote high order
thinking in education. The theory has three domains; cognitive, affective and
psychomotor. For the purpose of this study, cognitive domain was used. Cognitive
domain involves knowledge and development of intellectual abilities and skills
(Bloom, 1956). Under this domain there are six skills to be achieved for learning
to be said to take place. These are; knowledge, comprehension, application,
analysis, synthesis and evaluation. It is along this line that the research
ascertained the challenges teachers face in setting school based Mathematics tests using BT. The theory is closely related to Piaget's theory of cognitive development (Piaget, 1977). According to Piaget, questioning strategies are designed to enhance students' cognitive development. It is this dimension that the researcher used extensively in analyzing the extent of use of BT to enhance student's cognitive development through testing. Teachers contribute to cognitive discrepancies in students by not recognizing and addressing individual learning patterns of students; a situation that was observed when analyzing the cognitive level of school Mathematics tests in Njoro district.

1.11 Conceptual Framework

The conceptual framework of this study was based on Bloom's Taxonomy and how it can be used as a checklist in setting Mathematics tests. The relationship between various variables of the study is as provided in figure 1.1
Figure 1.1 Conceptual framework of the study.

Figure 1.1 shows how the theoretical framework was operationalised. It clearly indicates that poor performance in Mathematics could be caused by inappropriate assessment of students at school level. This may be as a result of various teachers and school related challenges of using BT in setting school based Mathematics tests. If these challenges are managed then improved performance in the subject could be realized.
1.12 Operational Definition of Terms

Assessment- A process of gathering and providing information on the learner about his or her performance on learning tasks.

Bloom’s Taxonomy- A classification of three educational domains namely; cognitive, affective and psychomotor as developed by Benjamin Bloom and a group of educators. The study focused on cognitive domain.

Cognitive domain- Educational objectives arranged in hierarchy from less to more complex, that is, knowledge, comprehension, application, analysis, synthesis and evaluation (postulated by Benjamin Bloom)

Examination- Test given to assess the acquired knowledge after learning and teaching processes.


Performance- Students ability to think, reason and solve problems.

School Based Tests- Tests prepared by teachers at the school level to assess students’ mastery of content. They are often referred to as Continuous Assessment Tests.

Test- An instrument for measuring sample behaviour.
1.13 Chapter summary

The introductory chapter has detailed the topic of study at great length. The background of the study and statement of the problem shows that there is a need to carry out a research on the challenges and extent of use of Blooms Taxonomy in Mathematics test in schools. The justification section has provided the rationale of the study. The theoretical and conceptual framework established the perspective through which the challenges and extent of use of BT in setting school based Mathematics tests was tackled. Relevant studies that have been undertaken and the contribution of the study to the world of knowledge are covered in the next chapter.
CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

Literature was reviewed in areas of role of school based tests, essence of cognitive skills in learning, Bloom’s Taxonomy in setting Mathematics tests, related Bloom’s Taxonomy studies and Bloom’s Taxonomy criticism. This was done in order to buttress the study objectives and lay the ground work for research methodology and data interpretation.

2.1 Role of School Based Tests in Promotion of Learning.

Assessment, as defined by National Council of Teachers of Mathematics (NCTM) (1995), is “the process of gathering evidence about students’ knowledge of, ability to use, and disposition towards Mathematics and making inferences from the evidence for a variety of purposes.” To promote effective classroom assessment, teachers are expected to evaluate learners in all areas of knowledge. Teachers use assessment to help students to achieve the aims of Mathematics curriculum by giving an account of their learning over a period of time. Assessment of students’ learning serves as a mean to attain educational goals (Webb, 1993). Once the assessment is done, it will function as “an important tool for understanding the knowledge that students are constructing, the meaning that they are assigning to Mathematical ideas, and the progress that they are making toward achieving Mathematical power” (Webb, 1993). However, most of the teachers fail to make use of such evidence to plan and make sound instructional
decisions because of "unacceptable low levels of assessment among practicing 
teachers and administrators in our schools" (Stiggins, 2001). Assessment remains 
crucial in education, both in content and instructional approach (Neill et al, 1995).

The government of Malaysia (Ministry of Education Malaysia, 2007) suggested 
that school assessment be reformed by introducing a school-based grading system 
that emphasizes on task-based assessment. The aim of school-based assessment is 
to improve the quality of teaching, learning and assessment. Under this 
assessment format, teachers will be given greater responsibility in developing 
assessment and linking it to effective learning. Students' achievements will be 
judged and graded based on the criteria and standards specified in subject 
syllabuses, and are moderated by review panels consisting of subject experts 
(Queensland Studies Authority, 2007).

However, implementing school-based assessment is not an easy task. Adi 
Badiozaman Tuah (2006) pointed out that there are three contributing factors: (a) 
the schools fail to interpret and comprehend assessment into wider operational 
terms that bring improvement to the learning and instruction in schools; (b) the 
schools will forego the short-term instructional responsibilities, such as school- 
based assessment, in order to fulfill the interest of the public in getting good 
results in the public examinations; and (c) there is the human factor where 
teachers are not preparing or equipping themselves with the knowledge or skills 
that make school-based assessment an integral part of the school curriculum 
development process.
Based on the remark made by Adi Badiozaman Tuah (2006), it is clear that the teachers are far from ready to implement the school-based assessment into our education system. They do not fully understand the concept of school-based assessment and lack the know-how in developing the assessment tasks. The deficiency has led to another issue, the validity of the school-based assessment.

In Kenya, the government is yet to establish the assessment frameworks for our teachers to be used as a guide in executing school-based assessment. Hence, there is an urgent need to develop an assessment framework that is valid and reliable, which may contribute to the success of assessment reform and performance of Mathematics at the national level.

2.2 Essence of High and Low level Cognitive Skills

Education is said to change learners' behaviour desirably, and the quantity and quality of such changes determined by assessment (Adedoyin et al, 2005). The most important aspects of these changes are the level of the cognitive, affective and psychomotor skills that are developed among learners. It is in the evaluation part of cognitive skills that objectives of education can be measured. The study examined the cognitive aspect of education with a bias to assessment tests set by teachers.

For cognitive behaviour, the concept of higher order thinking is based on the Taxonomy of Educational Objectives popularly known as Bloom's Taxonomy (Bloom's et al. 1956). This system involves a six-level hierarchical progression
for the categorization of human cognitive behaviour from a most basic to a higher order level of cognitive processing. The six levels are:

- Knowledge
- Comprehension
- Application,
- Analysis
- Synthesis
- Evaluation.

The first two levels of Bloom's Taxonomy involve accumulation and understanding of information only. While the other four levels which are often classified as higher order thinking involves application of such information for finding solution to real life problems. These four levels of cognitive thinking are the more desirable ones for development and educators have been challenged to develop these among the learners in order to enhance their ability to contribute to the development of the society.

High level cognitive questions are questions that require learners to use higher order thinking or reasoning skills. By using these skills, learners not only remember factual knowledge but also use such knowledge to solve problems. But a number of research studies have indicated that students possess limited abilities to think at higher levels of cognition (Gardiner, 1998; Tsui, 1998). This can be used as a justification by teachers for majorly assessing students on low order cognitive skills. Their view cannot be generalized to all students. The researcher
concentrated on the level of Mathematics questions that teachers set in schools considering the view of Gardener and Tsui.

A growing body of educational literature has challenged teacher educators to provide pre-service teachers with the knowledge and skills necessary to develop thinking skills and problem solving abilities in their respective students (Buriak et al., 1996). Teacher educators were found through the researcher's study to be reneging this important duty that they have been entrusted. In the study, it was found that assessment styles of majority of Mathematics teachers were not in line with professional requirements. According to Wilen (1991), teachers spend most of their time asking low-level cognitive questions in assessing their pupils. These questions concentrate on factual information that can be memorized. These types of questions are widely believed to limit pupils by not helping them to acquire a deep, elaborate understanding of the subject matter. This will in turn affect the performance of students in the National Examination. Their assertion cannot be used in all cases due to the fact that a number of students perform well above average in KCSE.

Ellis (1993) claimed that many classroom teachers rely on low level cognitive questions in order to avoid a slow paced lesson, keep the attention of the students and maintain control of the classroom. If the claim is true, then educators will be left wondering what is good for learning to take place. Arends (1994) also argues that many of the findings concerning the effects of using lower-level cognitive versus higher level-cognitive questions have been inconclusive. This may arise due to lack of clear cut distinction between the levels of knowledge.
While some studies and popular beliefs favour asking high-level cognitive questions, other studies reveal the positive effects of asking low level cognitive questions. For example, Gall (1984), cited that, “emphasis on fact questions is more effective for promoting young disadvantaged children’s achievement, which primarily involves mastery of basic skills; and emphasis on higher cognitive questions is more effective for students of average and high ability....” Nevertheless, other studies do not reveal any difference in achievement between students whose teachers use mostly high level questions and those whose teachers ask mainly low level questions (Arends, 1994; Wilen, 1991). Therefore, although teachers should ask a combination of low-level-cognitive and high-level-cognitive questions, they must determine the needs of their pupils in order to get the appropriate balance between the six levels in the cognitive domain.

2.3 Bloom’s Taxonomy in Setting Mathematics Tests

The creation of the Bloom’s Taxonomy was the result of many years of seeking a tool to measure achievement among students (Kilpatrick, 1993), as well as classify intended activities and outcomes of students and offer a structure in which one could group test questions. According to Kilpatrick (1993), the taxonomy attempts to reflect the differences of the students’ actions (made by the teachers). He further stated that it is logically and internally reliable and reflects the psychology of learning by discussing how to teach and learn. He concludes that it is suitable in all school subjects. It can be used as a tool for measurement of education learning.
Three domains of educational activities are identified in the taxonomy: cognitive, affective and psychomotor, as described by Bloom (Bloom, 1956) in the following way. The 'cognitive' is demonstrated by knowledge recall and intellectual skills like comprehending ideas and applying knowledge. The affective domain is demonstrated by behaviour in a learning situation for example awareness, interest and ability to listen, whereas the 'psychomotor' is verified by physical skills such as coordination, strength and speed. Psychomotor and affective domains possess limited application in designing of teachers' assessment. The study is limited to cognitive aspect of teachers' assessment.

Bloom (1956) described cognitive domain as central to the work of test developers and stresses on definitions of objectives. It is due to this fact that it has been viewed as more useful and has received more attention during recent years (Kilpatrick, 1993). However, the application aspect of the taxonomy is in question and sometimes challenging. The challenges associated with its use by teachers in Secondary schools of Njoro district has been discussed in detail in the fourth chapter of this study.

The competency of classroom teachers is an important factor in the success of students as noted by National Commission on Teaching and America's Future (1996). The competency can be revealed by the standard of tests set by teachers, mastery of content and use of instructional methods among others. The level of
competency of teachers on formulation of standardized school based tests has now been assessed in selected secondary schools in Njoro district.

The Taxonomy can inspire teachers to help students gain skills in all cognitive levels and establish the appropriate foundation for higher levels by assuring mastery of lower levels such as knowledge level. The taxonomy also provides a basis for finding a plan to assess students’ performance at all levels of learning (Bloom, 1956). Teachers with the understanding of cognitive demand and good questioning strategies can improve student achievement in Mathematics, maintain student interest, and allow multiple entry points into the lesson. The performance in Mathematics at higher levels can be realized if good questioning strategies are employed in setting school based tests for students along all levels of cognitive domain.

In the knowledge level of Bloom's Taxonomy, questions are asked solely to test whether a student has gained specific information from the lesson. Students must be able to know common terms, basic concepts, and principles of any lesson. Question cue words are list, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when and where (Joyce, 2008). Questions include "State the definition", "State the theorem", or "Use the specified method." For instance a question may be, find the square root of 441 by factorization method.
The Comprehension level measures a student’s ability to grasp the meaning of the lesson. In Mathematics class, the teacher might ask students to rewrite a question in their own words (Bloom, 1956). Question cue words are summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, convert, discuss and extend (Joyce, 2008). Example question is; in your own words, describe similarities and the differences between a square and a rhombus. Question includes asking the student to use definitions or methods to calculate something. For instance, find the slope of the tangent line to the following function $y = x^2 + 4x$ at a point $(3,-7)$.

The application level determines whether students can apply understanding in new contexts. This may include the application of rules, formulas, or theories (Bloom, 1956). Question cue words are apply, demonstrate, calculate, construct, complete, illustrate, solve, modify, relate, change, classify, experiment and discover (Joyce, 2008). For example, a question can be; which one of the following values; 3.24, 31.49, 314.159, approximates best the volume of a sphere with a radius of 5 centimetres? There are also questions which require the use of more than one definition, theorem, and/or algorithm. For instance one may ask a student to find the derivative of the following implicitly defined function: $y^3 = 2x^2 - 3x^3 - 7$. 
The analysis level refers to the ability to break down a concept into its module parts so that its clerical arrangement may be understood (Bloom, 1956). Question cue words are analyze, separate, order, explain, connect, classify, arrange, illustrate, divide, compare, select and infer. (Joyce, 2008). Example of a question can be; a cylinder has a radius of 4 centimeters and surface area of $72\pi$ square centimeters, calculate its height. The questions require the student to identify the appropriate theorem and use it to arrive at the given conclusion. Alternatively, questions can provide a scenario and ask the student to generate a certain type of conclusion. For instance, if $f(x)$ is a fourth-degree polynomial. How many roots can $f(x)$ have? Determine the strategies that would be necessary to calculate the height of this cylinder.

The synthesis level focuses on the ability to combine contents in order to form a new whole. This level involves unique communication, a plan of operation, or a set of symbolic relations (Bloom, 1956). Questions cue words are formulate, generalize, rewrite, combine, integrate, rearrange, substitute, invent, what if and compose" (Joyce, 2008). Example of a questions can be; a cylinder has a radius 4 centimeters and surface area of $72\pi$ square centimeters. Apply and integrate several different strategies to find the height of the cylinder. Questions are similar to Analysis questions, but the conclusion to be reached by the student is an algorithm for solving the given question. This also includes questions which ask the student to develop their own classification system. For instance, the
optimization word problems where student generates the function to be differentiated.

The evaluation level is concerned with a student's ability to critique the information given to them. These might be organized according to the purpose and the student may verify the criteria or be given them. Students should also be able to make hypotheses based on Mathematical facts or theories (Bloom, 1956). Question cue words are assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, and summarize (Joyce, 2008). Example of a question can be; a cylinder has a radius 4 centimeters and surface area of $72\pi$ square centimeters. What is the height of the cylinder? When you have finished solving the problem, determine the degree to which that problem was solved. Questions are similar to Synthesis questions, except the student is required to make judgments about which information should be used. For instance, related rate word problem where student decides which formulae are to be used and which of the given numbers are constants or instantaneous values.

2.4 Studies Based on Bloom's Taxonomy Studies.

Yeya (2002) asserted that facilities alone cannot count in improvement of Mathematics performance. Other factors should be taken into consideration. One of the factors that should be explored is assessment and evaluation in Mathematics. These two factors are crucial in school setting considering the fact
that Mathematics is a key school subject. Assessment in Mathematics is riddled with some challenges. These challenges have a bearing on the quality of Mathematics tests set and eventually affecting student’s performance in National Mathematics examinations.

Educational success is judged in terms of students’ results. Assessment and evaluation that only require students to reproduce facts and definitions will inevitably train students for rote learning and memorization of fact (World Bank, 2008). Such kind of evaluation and assessment may hamper the achievement of goals of education. To avoid that kind of situation, critical reassessment of the role and challenges of BT in setting of school based tests and National examination is important.

KNEC have been setting the examination for the Kenya Certificate of Primary Education and Kenya certificate of Secondary Education since time immemorial. Facts, reasoning and problem solving are now given substantial emphasis by this body (KNEC 2007). Cognitive domain of Bloom’s Taxonomy is an important tool for this body in setting National Examination (KNEC 2007). Care is also taken to keep teachers informed of the changes. A newsletter, which analyses questions and solutions, is provided for use by teachers and students. Such analysis is of great help to teachers and students in keeping in touch with the gist of every Mathematics question set by a professional body. The situation in Njoro Secondary schools is rather different. Mathematics department in secondary
schools in Njoro were found to be deficient of policies guiding setting and tests administration.

Teachers have been sensitized on the need to test students on all levels of learning objectives in accordance with cognitive requirement of BT (Brophy and Everton, 1976; Redfield; Berliner, 1984). Students overall achievement scores rise when teachers ask questions which require students to apply, analyze, synthesize and evaluate. This may not be an easy task for teachers when setting school based tests. They need adequate time and skills to carry out this important task.

Educationists and Policy makers in Education will find the information useful since the success of any education program cannot be measured by the students' performance as observed by way of academic achievement in examination but also structure of the measuring instruments. Archbald and Newman (1988) rightly suggested that dominant approaches to assessment fail to tap authentic form of academic achievement. Improvement of measuring instrument should be given top priority.

Assisting students to improve their thinking skills is recognized as a primary goal of education (Privateer 1991). Jones and Idol (1990) affirms that “we must improve students’ capacity to acquire, apply, analyze, complex information and to solve problems quickly and efficiently.” One way of doing this is by ensuring that teachers set standardized Mathematics test focusing on all cognitive level of
knowledge. If this is not done then performance of students in Mathematics can be affected in one way or another.

There is a lot of hue and outcry about the 8-4-4 system of Education on its ability to produce graduates who can be job creators as opposed to job seekers. This has been attributed to overloaded curriculum. The study found out that teachers are burdened by heavy work load to the extent that standard testing of students is compromised.

Teachers may find it necessary to examine students on LOCS as suggested by Miller (1990) who remarked that examiners have a tendency to measure element of content that are easy to measure. The reason behind doing this is to demystify the myth that Mathematics is a difficult subject. This assertion cannot be generalized to all teachers and all subjects a viewpoint shared by Njoka (2001).

Azar (2005) analyzed the use of Bloom’s Taxonomy in setting questions in Turkey. The study noted that Physics teachers use questions at application and comprehension level to determine students’ achievements. Results showed that teachers rarely use higher level questions such as analysis, synthesis and evaluation which help students to progress their scientific thinking. The study concluded that questions being prepared and asked without considering the levels of cognitive may affect students’ achievement on University Entrance Examination. For this reason, teachers should take courses on measuring and
assessing students’ achievement by considering the cognitive domain of Bloom’s Taxonomy.

Majority of students in Sub-Saharan Africa have been found to mainly pass examinations in the lowest category according to World Bank (2008). This has raised concern in the countries, because the examinations document low achievements in limited items measured mainly through multiple choices, and structured papers. The concern is even greater when considering learning achievements of higher cognitive skills. This is not the case in Mathematics in secondary school of Njoro district as was revealed through analysis of end of year 2011 school based Mathematics test administered. Most of the questions tested application skills of Bloom’s Taxonomy.

The World Bank report (2008) notes that in Tanzania and Ghana, continuous assessment is practised as the continuous evaluation of subject content covered. Its main purpose is to promote students through periodic tests to the next educational level or class. Although curricula formally move to the inclusion of practical skills and higher learning, assessment practices still ignore the specified areas of knowledge and skills, and test the memorization of facts only. In Tanzania, the examination of practical skills in Physics and Chemistry appear to have for many years revolved around the same problem area and rather consist of the repetitive conduct of experiments (Coppard, 2002). This may affect students’ performance if exposed to tests in other problems.
The research borrowed and relates with study by Luliana Marchis etal (2009) in their research project which alluded that problems given at international tests (PISA, TIMSS) are related with everyday life. Most of these problems have a long description of the situation, and pupils have to discover the data needed for solving the problem. These problems cover all the levels of Bloom’s cognitive levels. The study is also related to the one that was done while investigating National Mathematics tests in Romania. In Romania, it was discovered that tests only covered knowledge, understanding and application of cognitive levels (Luliana Marchis etal, 2009). To solve them, it was required to apply formulas or algorithms. These problems have Mathematical formulations; they do not have any connection with real life. Reasoning, which is present at TIMSS test is not covered, the study concluded.

Douglas (2004) asserted that, even if the state test is dominated by lower-level thinking skills and questions are posed in a multiple-choice format, the best preparation for such tests is not mindless testing drills, but extensive student writing, accompanied by thinking, analysis, and reasoning. In this regard, the researcher is of the opinion that teachers need a broad range of curriculum material and activities that address standards as provided by Bloom’s Taxonomy. If this is employed in teaching, learning and assessment of Mathematics then the problem of poor performance could be managed.
According to Herman and Baker (2005) there is strong predictive relationship between performance on state assessments and benchmark tests. They cautioned, however, that aligning benchmark tests too closely with state tests may accelerate curriculum narrowing. They further remarked that tests should, “focus on the big ideas of a content area” and be designed to "allow students to apply their knowledge and skills in a variety of contexts and formats." If the wordings of Joan and Eva are followed to the letter then the performance of Mathematics can be improved.

2.5 Bloom’s Taxonomy Criticism

It is difficult to apply Bloom’s Taxonomy in assessment consistently as mentioned by Simon and Margaret Hamilton (2008). There are no clear boundaries separating the levels of knowledge. Bloom himself acknowledged the fact that categories defined in his work could not work clearly and were open to some interpretation (Bloom et al. 1956). In the years following publication of the taxonomy, critics and researchers generated philosophical and empirical evidence against the claim that the taxonomy is hierarchical (Anderson, 1994). Additional criticism focused on distinction made among categories.

Despite criticism, research designed to refute the existence of categories has been inconclusive. This means that BT has stood the test of time. In response to critics Bloom’s wrote, “It is obvious to me at least, that many of the criticism directed to me toward the taxonomy have resulted from very narrow interpretation of both
the taxonomy and its proper application.” The taxonomy had an impact on instruction and assessment in many parts of the world (Airasian 1994). So despite criticism, the taxonomy has been and can still be a useful tool to teachers as they develop and evaluate assessment. This is why the researcher is fully confident that the BT as postulated by Bloom comes in handy in addressing the persistently poor performance in Mathematics in secondary schools in Njoro district, Kenya.

2.6 Chapter Summary

An assessment framework is based on an underlying theory of learning that can be used to plan instructional activities and classroom assessment. The framework was developed by Benjamin Bloom and a small team of university examiners who provided guidelines for the framework. The result of Bloom's now classic work is compiled in Taxonomy of Educational Objectives: Cognitive Domain (Bloom et al. 1956). In their statement of purpose, Bloom and his colleagues wrote, "Some teachers believe their students should 'really understand,' others desire their students to 'internalize knowledge,' still others want their students to 'grasp the core or essence' or 'comprehend.' Do they all mean the same thing?"(1956, p. 1). Bloom answered this question by defining and categorizing processes that students might use to demonstrate their content knowledge. The research has identified teachers' abilities and challenges in preparing tests using Bloom's Taxonomy along cognitive dimension.
CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

The purpose of the study was to identify the challenges faced by teachers in setting school based Mathematics tests using Bloom’s Taxonomy in secondary school of Njoro district. This chapter discusses the procedures and strategies that were used in the study. The chapter is organized under the following subsections: the research design, target population, sample size, sampling procedures, research instruments, data collection procedures, data analysis procedures and logistical and ethical consideration.

3.1 Research Design

The research adopted a descriptive research design. Descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals (Orodho, 2002). It can be used when collecting information about people’s attitudes, opinions, habits or other social issues. This type of survey was used to obtain information from a representative selection of the population and from that sample the researcher was able to present findings as being representative of the population as expressed by Bell (1993). Both quantitative and qualitative approaches were used. The questionnaires were used to access qualitative data. In this way, verification and deeper explanation of findings of the survey was done.
3.2 Location of the Study

The study was conducted in Njoro district, Nakuru County in Kenya. It is situated in the larger Rift Valley region, Nakuru County. It borders Nakuru North district to the East, Molo district to the West, Rongai district to the North and Narok district to the South. The district headquarters is situated in Njoro town. Njoro district borders Eastern edge of the Mau Forest Complex, the largest single forest block in Kenya. The area lies between the forest and Lake Nakuru National Park, a world famous flamingo habitat. The district covers an area of 798.01 km² and is located between Longitude 35°45'1" and 35°46'1" East and Latitude 0°16'1" and 1°10'1" South. Njoro stands at an altitude of 1,800 m (6,000 ft) above sea level. It has 5 divisions and a total of 36 secondary schools. The study location has been chosen due to the fact that the performance of Mathematics in the secondary schools in the district has consistently been below average at KCSE level. Suffice is to say that the district is accessible and the researcher is familiar with the schools. Singleton (1993) observed that the ideal setting for any study is the one that is directly related to the researchers own interest.

3.3 Target population

The research population comprised of Mathematics teachers of the 44 public and private secondary schools. The heads of Mathematics department of these schools were part of study population. According to Republic of Kenya (2010), the district has 5 administrative divisions. Njoro, Kihingo, Mauche, Lare, and Mau Narok.
Table: 3.1 Types of schools in Njoro district

<table>
<thead>
<tr>
<th>Types of school</th>
<th>Mixed</th>
<th>Boys</th>
<th>Girls</th>
<th>Mixed Boarding</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public school</td>
<td>34</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>36</td>
</tr>
<tr>
<td>Private School</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>44</td>
</tr>
</tbody>
</table>

Source: DEO, Njoro district.

3.4 Sampling Techniques and Sample Size

3.4.1 Sampling Techniques

Both public and private secondary schools in the district were purposively selected. They were selected since they follow the same KIE curriculum. Under public schools category, the researcher further subdivided them into county and district schools. This enhanced appropriate representation of students and teachers.

Stratified sampling techniques were used to identify school type to be used in the study. [That is whether boys, girls or mixed schools (Table 3.1)]. This is due to the fact that it had a high statistical precision compared to simple random sampling as pointed out by Castillo Joan (2009). In the identified schools, random sampling technique was used to select Mathematics teachers to be used in the
research. In schools with three or less Mathematics teachers, all of them were recruited. However, in schools with more than three Mathematics teachers' folded papers with yes and no answers were used to select three of them.

3.4.2 Sample size

According to Nkpa (1997) a sampling fraction of between 10% and 30% of total population in research is appropriate for descriptive studies. This percentage was used in estimating the sample size of schools and teachers to be used in the study. Sample size of 12(28%) schools, 36(25%) teachers and 12(28%) heads of Mathematics department in the sampled schools was arrived at.

Table 3.2 Type and categories of schools Sampled in Njoro district

<table>
<thead>
<tr>
<th>Type of School</th>
<th>Target population</th>
<th>Sample</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public School</td>
<td>36</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>Private School</td>
<td>8</td>
<td>5</td>
<td>62%</td>
</tr>
</tbody>
</table>

Source: DEO, Njoro district.

Table 3.1 shows categories and sample distribution of the schools involved in the study. Mixed day secondary schools formed the highest proportion. Due to the few number of boarding schools, all of them were involved in the study. The number of respondents involved in the study in the sampled schools was tabulated in Table 3.2.
Table 3.3 Number of Mathematics teachers involved in the study

<table>
<thead>
<tr>
<th>Type of school</th>
<th>Mixed day secondary</th>
<th>Boys boarding</th>
<th>Girls Boarding</th>
<th>Mixed boarding</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public school</td>
<td>15</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>21</td>
</tr>
<tr>
<td>Private school</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>36</td>
</tr>
</tbody>
</table>

Source: DEO Njoro district

Table 3.2 shows that 36 teachers were involved in the study. It is worthwhile to mention that heads of Mathematics department of each sampled school were subjected to interview exercise.

3.5 Research Instruments

Since the study was quantitative and qualitative in nature, various approaches were adopted in order to obtain a holistic view of the issue under question (Mwiria and Wamahiu, 1995). The study therefore employed the use of questionnaire; BT checklist and interview schedule. The researcher used these instruments in order to complement each other.

3.5.1 Mathematics Teachers Questionnaire (MTQ)

Questionnaire was the main research instrument for the study. According to Kothari (1990), questionnaires are cost effective and give freedom to the respondents from interviewer’s bias. A questionnaire is appropriate for giving
similar or standardized questions as observed by Berliner (1973). This made it possible for comparisons of the responses. The questionnaire had both simple closed ended questions and open ended questions. It was used to source data from teachers on the problems they face in using Bloom’s Taxonomy. Information pertaining to whether they could recall Bloom’s Taxonomy concept and how they used it in assessing students was sought. Their opinion toward the BT concept was vital to the study.

3.5.2 Mathematics tests for Cognitive Analysis

Mathematics tests for BT cognitive analysis were designed. The test had 6 questions (Appendix C). Twelve teachers were required to specify the cognitive level of each question. Teachers’ scores in the tests were noted and recorded. Performance of each teacher in the analysis was recorded. The information on test response was useful in ascertaining teacher’s level of understanding of BT and its application in assessment of Mathematics. Challenges encountered in the process of analyzing were noted.

3.5.3 Bloom’s Taxonomy Checklist

Cognitive analysis of the end of year 2011 school based tests was carried out. This was done in order to ascertain the extent of use of BT in setting schools Mathematics tests. The study revolved around the use of BT and therefore the checklists was the best tool to use. BT checklist was used to confirm the cognitive skill level of the questions that were set in the end of year 2011 examinations in
Form One up to Form Three and Form four pre-mock examination of year 2011. Heads of Mathematics departments of the sampled schools were requested to provide the school based Mathematics tests. Each question set was scrutinized against the BT checklist to give the cognitive skill tested. The researcher analyzed a total of 48 Mathematics tests comprising of 824 Mathematics questions.

3.5.4 Interview Schedule for Mathematics HODs

The researcher engaged the heads of Mathematics department from the sampled schools through semi structured interviews. Semi structured interview was preferred due to the fact that respondents are free and open to respond according to the way they felt was relevant (Ortiz, 2003). To do this, an interview guide consisting of a set of 11 items was used to guide the interview. It was useful in the sense that it would gather more information which may not have been captured in the questionnaire or the open ended questions. The researcher probed the respondent to elicit the relevant data required. Respondents were able to speak freely and express their opinion with a lot of ease. Through this, information from the interview schedules was collected and analyzed.

3.6 Pilot study

Pilot study was carried out to test the validity and reliability of the instruments. This enabled the researcher to determine the difficulty of the items in the questionnaire. This exercise was done in 2 schools that did not form part of the study sample. Teachers and HODs of these piloted schools were not involved in
the actual study. Necessary adjustment was done to improve the instruments. The piloting ensured that the research instruments did not have potential misunderstanding and instilled confidence on the researcher for the actual study.

3.6.1 Validity

Orodho (2002) defines validity as the accuracy and meaningfulness of inferences which are based on the research results. In other words, validity is the degree to which results obtained from the analysis of the data actually represents the phenomena under study. Content validity method was used to validate the content employed in the questionnaires. Experts in the area who included researcher’s supervisors among other experts in the Mathematics department were sought on relevance and correctness of the research instruments.

3.6.2 Reliability

Orodho (2002) defines reliability as a measure of the degree to which a research instrument yields consistent results or data after repeated trials. The stability of questions was assessed in terms of test-retest reliability. The questionnaires were administered twice to the same group of respondents. The second administering was done after two weeks to check whether the same results could be obtained. Spearman rank correlation was used to compute the correlation coefficient which was used to determine the extent to which the contents of the questionnaire are consistent in producing the same response every time the instrument is
administered. A correlation coefficient (r) of 0.75 was found. This was considered as having high reliability.

### 3.7 Data Collection Techniques

After obtaining research permit from the MOHEST (Appendix F), letter of introduction was obtained from DEO's office to conduct the research (Appendix G). The researcher then visited the sampled schools, identified himself and sought permission to be allowed to conduct research in the schools. The researcher agreed with the school principals on appropriate dates and time for data collection. The researcher was given an opportunity to interact freely and develop rapport with Mathematics teachers. The purpose of the visit was to explain to the respondents the purpose and value of the research. Specific details of the study were not divulged. All this was done in order to control Hawthorne effect (Borg and Gall, 1971).

### 3.8 Data Analysis and Presentation

Data collected from questionnaires, interviews and checklist was organized in patterns to reveal the essence of data. Data collected was analyzed quantitatively and qualitatively. Descriptive statistics methods; means, percentages and frequency distribution were used for data analysis. Open ended questions and interview schedule record were analyzed thematically.

Qualitative data was coded according to the particular question item. Graphical presentation of data through the use pie charts and bar graphs was done. The
Statistical Program for Social Sciences (SPSS) software aided the analysis of the data collected.

3.9 Logistical and Ethical Considerations

The study sought approval from the Kenyatta University Graduate School (Appendix E). A permit was also sought from MOHEST before the study was conducted. Consent was sought from institutions and individual respondents that were to be included in the study. Confidentiality, anonymity, and respondents' consent were put in place as requirement conditions for the whole research process. Data was presented in such a way that it could not be linked to individuals who gave it.
4.0 Introduction

This chapter presents the results obtained from the study according to researcher’s specific objectives namely;

i. Find out the extent of use of BT in setting school based Mathematics tests in secondary school of Njoro district.

ii. Identify challenges faced by teachers when using the BT in setting the school based Mathematics tests in secondary school of Njoro district.

The study was guided by three main research questions:

i. How frequently do teachers use BT in setting school based Mathematics tests?

ii. What challenges do teachers face when using BT in setting school based Mathematics tests in secondary schools in Njoro District, Kenya?

Data analysis reporting is divided in three sections. The first section is analysis of background information of respondents. Section two is the discussion of questions of the study and in section three, the summary of the chapter.
4.1 Background Data of the Respondents

The respondents comprised of 22 males teachers and 14 female teachers. Twelve heads of Mathematics department were also interviewed.

From the teachers responses, it was evident that majority of teachers were adequately qualified to teach Mathematics. Out of 36 teachers, 30 were degree holders, 4 were diploma holders and only two were untrained. The competence of teachers was good and they were expected to discharge their teaching duties with professionalism. This is in agreement with Gitonga (1990) who observed that the potential of any education system is related to the teachers' ability. It was a clear indication that they were exposed to Knowledge of BT in teaching, learning and students assessment.

The researcher sought to gather data on teaching experience of teachers. The data is presented in the Table 4.1

Table 4.1: Length of Service for Teachers.

<table>
<thead>
<tr>
<th>Length of service in years</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than one year</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>6-10 years</td>
<td>16</td>
<td>44</td>
</tr>
<tr>
<td>11-15 years</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td>More than 15 years</td>
<td>10</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 4.1 shows that 95% of teachers possessed over 6 years’ experience in teaching and learning of Mathematics in schools. This means they had a long time experience in teaching and learning of Mathematics. Their opinion on the topic of study was therefore valuable and credible.

4.2 Extent of Use of Bloom’s Taxonomy in Setting Mathematics Tests

To assess the level of usage of BT in setting Mathematics tests in school, the researcher sought to know whether Mathematics teachers were responsible of setting school based tests. The results were shown in table 4.2

Table 4.2: Personnel in Charge of Setting School Based Mathematics Tests.

<table>
<thead>
<tr>
<th>Personnel in Charge</th>
<th>Frequency</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject teacher only</td>
<td>28</td>
<td>79%</td>
</tr>
<tr>
<td>HOD only</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>School administration through outsourcing</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Subject head only</td>
<td>4</td>
<td>10%</td>
</tr>
<tr>
<td>HOD, Subject head &amp; subject teacher</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>100%</td>
</tr>
</tbody>
</table>

From the Table 4.2, 79% of teachers responded in affirmative that they were fully in charge of setting school based tests. From the result, it was observed that it was the duty of teachers of Mathematics to set school Mathematics tests. This was a justification that the researcher recruited the reliable respondent for the
study. The success or failure of students in Mathematics is partially attributable to the Mathematics teachers. Having known that Mathematics teachers were responsible for whatever happens in Mathematics classes, it was of prominent importance to find out whether teachers practically participated in setting school Mathematics tests. Ninety percent of respondent answered yes, 5% answered no and the rest, 5% answered that they sometimes did. This information is shown in Figure 4.1.

Figure 4.1: Teacher’s Participation in Setting School Tests.

As illustrated in figure 4.1, ninety percent of teachers disclosed that they participated in setting school based tests in their schools. The other 5% were occasionally setting the school based Mathematics test. Since majority of Mathematics teachers in secondary schools of Njoro participated in setting tests, it follows that they were fully responsible of the quality of tests set.

In an attempt to find out how the school based Mathematics tests were prepared, the researcher established that 84% of Mathematics teachers in Njoro district designed their own Mathematics test questions using textbook and past questions as the major source. This is illustrated in Table 4.3.
Table 4.3: Sources of school based Mathematics tests questions

<table>
<thead>
<tr>
<th>Major source</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook only</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Past papers only</td>
<td>2</td>
<td>5%</td>
</tr>
<tr>
<td>Both Textbook &amp; past papers</td>
<td>28</td>
<td>84%</td>
</tr>
<tr>
<td>Joint inter school tests</td>
<td>4</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

From Table 4.3, teachers of Mathematics in Njoro district refer to both Mathematics textbook and past Mathematics test questions in setting school based Mathematics tests. Relying on Mathematics textbooks and past papers may affect the quality of school based tests considering the fact that some of the question in past papers of textbooks may be substandard.

Findings on how frequent the teachers use BT in setting school based Mathematics test is summarized in Table 4.4. The results show that 65% of teachers in Njoro district rarely or do not use BT concept in setting Mathematics tests questions. It's only 35% that concede to be using BT in setting Mathematics tests. The high percentage of teachers who are not using BT concept in setting tests raises questions on the standard of Mathematics tests in secondary schools in the district.
Table 4.4: Teachers Apply BT in Setting Mathematics Test.

<table>
<thead>
<tr>
<th>Whether they apply BT</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I fully apply BT in setting tests</td>
<td>13</td>
<td>35%</td>
</tr>
<tr>
<td>I rarely apply BT in setting test</td>
<td>14</td>
<td>37%</td>
</tr>
<tr>
<td>I never use BT in setting tests</td>
<td>4</td>
<td>13%</td>
</tr>
<tr>
<td>I pick questions arbitrarily</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>100%</td>
</tr>
</tbody>
</table>

The information in table 4.4 shows that 65% teachers in Njoro do not frequently apply BT concept in setting school based Mathematics tests. Inability to use BT in setting school based Mathematics tests is a testament that majority of students were not being subjected to the right type of questions at school level. Ignorance of BT is a major problem to implementation of BT in setting school based Mathematics tests.

The researcher sought to know whether Mathematics teachers in Njoro district can recall basic concepts of BT as taught in teacher training colleges. The respondents’ viewpoints toward the question are summarized in Figure 4.2
Figure 4.2: Mathematics Teachers can recall BT Concept

Figure 4.2 reveals that 28% of Mathematics teachers could recall basic principles of BT. Thirty two percent could only remember faintly or had forgotten the BT concept. The usage of the concept in setting school tests was not possible due to the fact that only a few could fully remember the concept. Failure to fully recall the basics of BT formed a major challenge in its use in setting school based Mathematics tests. To support the response on recall level, a cognitive analysis test was administered to teachers and the findings and discussion is provided in figure 4.8.

The researcher sought to know the level of skills they endeavoured to examine in Mathematics assessment. The results are tabulated in Table 4.5.
Table 4.5: Cognitive Level of Questions in School Based Mathematics Tests

<table>
<thead>
<tr>
<th>Cognitive level</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower cognitive skills</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Middle cognitive skills</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>Higher cognitive skills</td>
<td>4</td>
<td>10%</td>
</tr>
<tr>
<td>Combination of three above</td>
<td>16</td>
<td>43%</td>
</tr>
<tr>
<td>High and Middle cognitive skills</td>
<td>7</td>
<td>24%</td>
</tr>
<tr>
<td>Low and middle cognitive skills</td>
<td>6</td>
<td>21%</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>100%</td>
</tr>
</tbody>
</table>

The results show that 43% of Mathematics teachers endeavour to assess students on HOCS, MOCS and LOCS. In the same tune, 21% assess on MOCS and LOCs in the school based Mathematics tests. This was interpreted to mean, that 57% of the teachers were not using BT in setting school based test as expected. It follows therefore that there exist serious challenges faced by Mathematics' teachers in setting School based Mathematics tests using BT. This formed the topic of the research study.

Respondent were required to give their opinion on whether they moderate the school based test before they are administered to students. Their views are summarized in Figure 4.3
Figure 4.3 shows that 58% of teachers agree to the fact that they moderate Mathematics test before they are administered to students. This means that, 43% of Mathematics teachers rarely or never attempted to eliminate areas of difficulties and ambiguities in school based Mathematics tests through moderation. Failure to moderate Mathematics test raises serious issues on the usage of BT concept and level of professionalism employed in setting Mathematics tests.

4.2.2 Mathematics Tests for Cognitive Analysis.

The researcher had a task of further scrutinizing the extent of use of BT in school based Mathematics tests. The researcher analysed Mathematics tests of the twelve sampled schools. In each school, Form One, Two and Three Mathematics tests administered at the end of year 2011 and pre-mock Mathematics paper for form four in the year 2012 were picked for analysis. A
total of 48 scripts were analyzed, question by question. All questions from sampled schools were rated according to cognitive skill tested using BT check list. The result of the findings is as provided in figure 4.4, 4.5, 4.6 and 4.7.

![Bar chart showing percentage distribution of cognitive skills tested in Form One Mathematics tests in Njoro district.](image)

**Figure 4.4: Analysis of Form One Mathematics Test Questions in Njoro district**

From the Figure 4.4, it is shown that 58% of questions asked in Form One Mathematics tests were testing LOCS. Forty two percent of tests questions examined MOCS and HOCS. It is evident that BT concept was partially applied. Emphasis was on understanding and comprehension level of Mathematics in Form One class. The students at this level need to master the concepts at initial stages before proceeding to higher levels of application and analysis. The use of BT concept was biased toward examining lower order cognitive skills. The finding in this study contradicts the research study of Billy (1974) which showed that 60% of Science teachers’ questions required students to merely recall facts.
The analysis of Form Two Mathematics tests is provided in **Figure 4.5**. The analysis of Form Two Mathematics tests shows a slight difference from the observation done in Form One Mathematics tests.

**Figure 4.5 Analysis of Form Two Mathematics Test Questions in Njoro District**

**Figure 4.5** indicates that majority of Mathematics tests questions in Form Two examined comprehension and application skills in Mathematics. As can be observed, the number of questions testing the simplest cognitive level of knowledge was 8%. Test questions examining students understanding on HOCS was rather compromised. The use of BT concept in Form Two Mathematics tests was not well balanced. A clear distinction can be drawn from Form Three test questions as illustrated in **Figure 4.6**
Figure 4.6: Analysis of Test Question of Form Three in Njoro District

From figure 4.6, we find that Mathematics tests of the end year for Form Three had a bulk (60%) of questions testing the application and analysis skill of BT. This contrasted the opinion of Wilen (1991) who said that teachers spend most of their time asking low level questions. However the questions testing knowledge, evaluation and synthesis skill of learners were somehow inadequate in term of total numbers. Failure to incorporate questions on the knowledge level can disadvantage slow learners. Also, setting fewer questions on evaluation and synthesis was not appropriate considering the fact that form three is a potential candidate class in National examinations. Subjecting the potential candidate class to more questions at HOCs is advisable. Findings of analysis of Form Four tests questions are shown in Figure 4.7
Figure 4.7 Analysis of Test Question of Form Four Pre-mock of Year 2011

Njoro district

As observed in figure 4.7, a case similar to Form Three is replicated in Form Four. There were a few questions testing knowledge level (8%), synthesis (13%) and evaluation (10%) skills of BT. Most of the questions tested examined students on application and analysis. It was discovered that HOCS and LOCS of BT were ignored and this compromised the validity of Form Four pre mock tests.

A correlation analysis of the Mathematics tests in Form One, Two, Three and Form Four was conducted and the results are shown in Figure 4.8
Figure 4.8 Correlation analysis of Form one, Two, Three and Four Mathematics Tests.

From the graph, majority of the tests questions set were examining students on application (28%) and analysis (22%). Few of the test questions were examining on evaluation (9%) and Knowledge (10%). It can therefore be said that the Mathematics tests in Njoro are biased toward testing middle order cognitive Skills (Analysis and Application) in comparison to HOCS and LOCS.

From the cognitive analysis of test questions it can be deduced that BT concept was not well applied in the district. A near balancing of test questions was noted; however, strict use of BT concept should be emphasized in a way that teachers should not ignore questions appearing at lower level of cognitive domain at the expense of HOCS questions. Teachers may be influenced by the thinking of Belly J(1974) who remarked that the level of teachers’ questions have a direct relationship to the cognitive level that students have to employ and arrive at
satisfactory responses to the questions. HOCS questions should be introduced after students grasp concepts at lower level of BT. Tests should be set not only with the skills to learn in mind but also with student’s ability in mind. Ampia .(2003) contends that a teacher needs to know what children are able to do if he/she is to plan effectively. It is incumbent upon every teacher to examine higher levels after lower level cognitive skills are well grasped

4.3 Challenges Facing Teachers in Setting School Based Mathematics Tests

4.3.1 Performance of Cognitive Analysis of Mathematics Test administered to Mathematics Teachers.

The researcher administered Mathematics tests which contained six questions (Appendix C). Respondents were required to state the cognitive level each question was testing. Out of 12 teachers involved, 4 teachers honestly admitted that they were unable to state the cognitive level each question was testing. Three teachers had difficulties in analyzing cognitive level of Mathematics tests questions. Three of the teachers scored less than 50 % and the other two scored over 50 % in cognitive analysis of test questions. The result is represented in the Figure 4.8
Figure 4.9 Performance of Cognitive Analysis Mathematics Test

Administered to Teachers

From the finding, over 50% of the respondents were not sure of what BT was all about as far as teaching and learning of Mathematics is concerned. Only 17% of teachers in Njoro District were well conversant with practical application of BT in Mathematics tests. Eighty three percent of teachers encountered challenges in its use in assessment. Appropriate measures need to be instituted to reverse the trend.

Going by the findings from teaching experience of Mathematics teachers (See Table 4.1), 47% of the respondents had taught secondary schools for over a period of more than 11 years and they may have forgotten. Possibility of memory lapse was therefore high. The fact that the concept was not fresh in their mind posed a challenge to teachers in its use in setting school tests.
The research established that 84% of Mathematics teachers in Njoro district designed their own Mathematics test questions using textbook and past questions as the major source. This is illustrated in Table 4.3

Table 4.3 shows that teachers of Mathematics in Njoro district refer to Mathematics textbook and past Mathematics test questions in setting school based Mathematics tests. The availability of textbook and past paper questions restrains Mathematics teachers from designing their own questions. Credibility of tests questions from textbooks and past papers is in question.

Fifty five percent of teachers’ respondents agreed that they experience problems in using BT in setting Mathematics as displayed by Figure 4.9.

Figure 4.10: Teachers Experience Problems in Setting Tests Using BT

Fifty of five percent of respondents were in agreement that they experienced problems in using BT when setting Mathematics tests. It is evident that there exists challenges teachers face while using BT. The challenges should be probed further so that solutions can be sought.
Teachers indicated their attributes on what they perceived would be their response on issues pertaining to extent of use of BT concept and the challenges faced. The key of their response was indicated on 5.0 point Likert scale. The result of their opinion is tabulated in Table 4.7.

Table: 4.7 Perceived Challenges of Setting School Based Mathematics Tests.

<table>
<thead>
<tr>
<th>Issues on BT a concept</th>
<th>SA</th>
<th>A</th>
<th>SD</th>
<th>D</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bloom's Taxonomy concept is rather difficulty to use</td>
<td>34%</td>
<td>32%</td>
<td>24%</td>
<td>7%</td>
<td>3%</td>
</tr>
<tr>
<td>I understand BT concept</td>
<td>7%</td>
<td>34%</td>
<td>36%</td>
<td>5%</td>
<td>8%</td>
</tr>
<tr>
<td>BT concept is highly involving concept to use in Mathematics</td>
<td>25%</td>
<td>35%</td>
<td>17%</td>
<td>18%</td>
<td>10%</td>
</tr>
<tr>
<td>BT concept is theoretical and is not applicable in Mathematical practice</td>
<td>24%</td>
<td>23%</td>
<td>17%</td>
<td>20%</td>
<td>6%</td>
</tr>
<tr>
<td>Existence of commercial examination inhibit my setting of school tests using BT</td>
<td>35%</td>
<td>33%</td>
<td>17%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>BT concept is a boring concept</td>
<td>7%</td>
<td>12%</td>
<td>60%</td>
<td>16%</td>
<td>5%</td>
</tr>
<tr>
<td>Overloaded curriculum and demanding math's syllabi hampers use of BT in assessment</td>
<td>27%</td>
<td>37%</td>
<td>10%</td>
<td>25%</td>
<td>2%</td>
</tr>
<tr>
<td>Desire to change students attitude towards Math's makes me set questions testing only lower level skills</td>
<td>4%</td>
<td>6%</td>
<td>25%</td>
<td>62%</td>
<td>3%</td>
</tr>
<tr>
<td>I feel that all Mathematics questions revolve around application level of BT and little use in other BT cognitive levels.</td>
<td>29%</td>
<td>57%</td>
<td>7%</td>
<td>8%</td>
<td>0</td>
</tr>
<tr>
<td>There is a clear cut distinction between levels of BT</td>
<td>46%</td>
<td>30%</td>
<td>13%</td>
<td>7%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Sixty six percent of the respondents found difficulties in applying BT in assessment. Similar views are shared by Simon and Margaret (2008) that majority of teachers experience complications in the use of BT. The challenge therefore was on usability. Twelve percent said that they do not understand the concept. Those who disagreed plus those who were undecided with the statement that BT concept is highly involving were 45%. This means that a good number of
Mathematics teachers felt that the challenge was on how to use BT. Forty seven percent thought that the concept is not applicable in Mathematics testing. To them, it was theoretical and cumbersome to use. While asked whether the concept is boring, few of the respondents agreed. Eighty one percent asserted that BT concept was hard. The BT concept was appreciated and recognized in the district. The table further shows that other challenges facing teachers in setting Mathematics tests using BT is attributed to the demanding Mathematics curriculum where 64% of respondents either strongly agreed or supported. The number of Mathematics topics to be taught were numerous and assessing them was tedious and challenging. The findings relate to the study published in Current Issues in Education, where teachers reported that a heavy workload of designing assignments, planning lessons, grading students, as one of the biggest challenge they faced in the classroom.

Seventy percent of the respondents regarded the presence of commercial Mathematics tests as a challenge on use of BT by teachers in setting Mathematics tests. Mathematics tests found in the market lessened the task of teachers in designing their own Mathematics test. These commercial tests denied teachers opportunity to use BT in setting Mathematics tests. The tests are available upon payment of some fee.

Desire for teachers to change students' attitude by ignoring BT and setting LOCS questions was not viewed as a challenge on use of BT concept. Those who either agreed or strongly agreed were 10% in total and 87 % of the respondents highly
objected. They felt that students' attitude was not a factor to be considered in setting Mathematics tests.

The researcher found out that 86% of teachers had a feeling that most Mathematics test questions revolved around application level of BT. The other 15% objected to the statement. It was the lack of clear cut distinction between cognitive levels of BT that posed challenges to the use of BT in setting Mathematics tests. It was also established that 76% of teachers were of the opinion that clear cut distinction between cognitive levels of BT is non-existent. The finding will fuel the debate raised by Arends (1994) that the issues between low level cognitive questions versus high level cognitive have been inconclusive. The view contributed also to the support of Simon and Margaret H. (2008) claims that there are no clear boundaries separating the levels of knowledge.

Figure 4.11 Performance in Mathematics can improve if BT is used in Setting Tests

Ninety five percent of teachers believe that if BT is applied in setting school based Mathematics tests then performance in Mathematics can improve as
summarized in Figure 4.10. Incorporation of BT concepts in setting of Mathematics tests can improve performance in Mathematics in one way or the other. This is an issue that curriculum implementers should consider while seeking solutions towards below average performance in Mathematics at National level. It follows that, Mathematics teachers in Njoro district were in agreement that BT is important in setting school based tests. There was hardly any respondent who objected to that assertion.

Opinion on the need for refresher training on use of BT in setting school based Mathematics was also sought. The results of these are summarized in Figure 4.11.

![Circle diagram showing strongly agree and agree percentages](image)

**Figure 4.12 Teacher Refresher Training on use of BT in Teaching of Mathematics**

Forty seven percent of teachers strongly agreed and 53% agreed there was need to organize training on the use of BT in setting school assessment tests. There was no respondent who disagreed. There exist teacher and school related challenges
on use of BT in setting Mathematics tests which should be dealt with through training on use of BT in setting Mathematics tests.

Teachers’ response towards refresher training on the use of BT is in line with the study carried in 23 countries in Europe which reported that 50% of secondary school teachers viewed professional development as having a great impact on their performance, 36% of the secondary school teachers felt that the impact was sufficient and the rest said it had little impact.

4.4 Other Challenges Facing Teachers in Setting School Based Mathematics Test

In order to solicit additional information, the researcher included open ended questions in the questionnaires. A good number of the respondents discussed at length how time was a major challenge. Respondents felt that for better use of BT in setting Mathematics tests, teachers needed enough time to analyze all test questions to be examined. They observed that they handle large numbers of students up to the last minute before the tests are administered. The only way to meet the deadline is by lifting previous Mathematics tests word for word.

Others were of the opinion that the teachers’ workload was high. A respondent declared candidly that he was the only Mathematics teacher in the school. He was required to set school based tests in all classes within a tight schedule. This affected the quality of testing.
In some schools, examination officers gave short notice of setting and submission of school based tests. This compelled Mathematics teachers to employ unprofessional means to beat the deadline set. BT concept was therefore ignored in such situations.

The presence of commercial examinations and district panel for setting Mathematics tests also limited teachers in using BT in setting tests. Revision books which contained Mathematics questions where teachers lifted questions restrained teachers on designing their own. This made the tasks setting the Mathematics tests simple and fast.

There were those respondents, who honestly admitted being ignorant of BT and how it could be used in setting Mathematics tests. Certain respondents were skeptical of the use of BT in setting Mathematics tests. The respondent wrote “Mathematics performance of my students is above average despite my ignorance on BT.” Teachers who taught fast learners found it difficult to examine students on understanding all BT skills. The reason given was LOCS questions were too simple for them. Their students needed to be subjected to HOCs questions.
Analysis of interviews schedule for HODs

The researcher conducted interviews with the heads of Mathematics department in schools. He engaged the HODs on interactive sessions. The interview guide schedule came in handy during the exercise.

From the interview, it was found out that majority of HODs taught Mathematics in Form Three and Form Four classes. HODs were considered as the most experienced Mathematics teachers in schools. Few HODS were satisfied with the performance of Mathematics in their respective schools. Most heads of Mathematics department decried the poor performance of their students in both school based tests and National examinations. It was reported that majority of students in schools had developed a negative attitude toward Mathematics as a subject. This had major bearing in students' performance in the district Mathematics performance at KCSE level.

The study further established that majority of schools had three sets of school based tests in the course of the school term. Continuous assessment test at the beginning of the term, another one at the midway along the term and at the end of term examinations. Other schools administered monthly CATs and another major test at the end of the term. In several schools, it was the duty of Mathematics teachers to set and administer school based Mathematics tests. Mathematics teachers were also required to ensure that students' scores for school based tests were availed to the HOD at the end of the term for analysis.
Teachers employed the following methods in setting school based Mathematics tests:

i. Some teachers designed their own test by lifting questions from past papers, textbooks or downloading from website which offered Mathematics questions papers like \textit{www.Shule fiti.com}. Some teachers edited the tests questions others did not.

ii. Some schools procured end of term tests and CATs from examination bureaus in the market.

iii. Form Four class did a common district test at the end of term two commonly referred to as Mock examination. The mock examination was prepared by a panel of Mathematics teachers in the district.

It was evident that moderation of school based tests exercise was superficial according to HODs. It was basically a proof reading exercise with minimal scrutiny on the quality and nature of tests questions set. BT parameter of setting tests was hardly used as moderation tool in the exercise. Teachers were requested to ensure that the total number of marks awarded in the test was the required one. The CATs marks were out of 30 in majority of schools. This meant that the CATs contributed 30\% of the total score by the end of the term. Majority of schools did not have examination policies guiding the nature and quality of school based tests. The HODs were of the opinion that Mathematics teachers in their capacities were considered professional and authorities in areas of their jurisdiction. Proper scrutiny of the quality and nature of school based Mathematics tests was done when tests were designed by trainees or untrained teacher.
When asked about whether they would remember the cognitive level of Bloom’s Taxonomy, majority of the HODs would not respond to the question with expected confidence. Others searched the meaning in the internet mobile connections of their phones during the interview sessions. Such behaviour was noted during questionnaire-filling sessions.

Other challenges faced by teachers as raised by the interviewee included overloaded curriculum where there were as many as 23 Mathematics topics in Form One and Form Two classes to be covered. Teachers were compelled by circumstances to teach up to the last moments of the session and on the eve of dates set aside for doing school based tests. The deadlines of test submission were also short and this impeded the way the tests were set. Blame also went to examination officers of some schools who were accused of giving short notices for submission of school based tests.

The researcher learnt that understaffing in their departments was also an issue of major concern. This brought a situation where Mathematics teachers were also members of other departments. This compromised quality of setting Mathematics tests.
CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter presents a summary of the major findings and conclusion of the study. The chapter also presents recommendations and suggestions for further research.

5.1 Summary of the study

The purpose of this study was to examine the challenges faced by teachers in setting school based Mathematics test using BT in secondary schools in Njoro district, Kenya. The study also sought to find out the extent to which teachers of Mathematics used Bloom’s Taxonomy when setting school based Mathematics tests. Analysis of school based test in Njoro district was done in order to assess the extent of use of BT in setting school based Mathematics tests. Mathematics teachers’ questionnaires, interview schedule and Mathematics cognitive tests were used for the study.

5.2 Summary of the findings

Eighty three percent of Mathematics teachers involved in the study possessed a minimum qualification of a degree in education. Those who had a diploma in education were only 10% of the representative sample. Mathematics teachers who had an experience of more than 6 years were 95% of the representative
sample, only five percent of teachers had less than 6 years' experience in teaching and learning of Mathematics.

Seventy nine percent of respondents conceded that it was their duty to set school based test and the percentage of Mathematics teachers who participated fully in setting school based test was 90%. Mathematics textbooks and past papers were the major source of school based Mathematics test. The statistics that supported this fact was 84% of teachers. Bloom's Taxonomy was rarely applied or not used totally by 65% of the Mathematics teachers involved in the study. Forty seven percent of teachers involved in the study did not set school based Mathematics tests along the three important levels of cognitive domain of BT.

Mathematics test moderation was done by 57% of Mathematics teachers involved in the study the rest 43% failed to moderate or rarely moderated school based tests to minimize difficulties. Proportion of teachers who could recall partially or fully about BT as taught in training colleges in the study were 68%. Thirty two percent of teachers in the study would not remember the BT concept. Over fifty percent of teachers were not able to specify the cognitive level of Mathematics test questions administered.

Almost all teachers were in agreement that BT is an important concept in setting school based tests and if properly applied, performance in Mathematics could be realized. Sixty eight percent of teachers faced challenges in setting school based Mathematics test using BT concept. Whereas 65% of teachers strongly agreed or just agreed that the concept was difficult to use, 12% said that they did not
understand the concept at all. Forty percent of respondents thought that the BT concept is rarely applicable in Mathematics and thus it is theoretical and not practical all. Those who felt that the concept was boring were 19%.

Sixty four percent of respondents agreed that the demanding Mathematics curriculum was a major challenge to implementation of BT concept in setting Mathematics tests. Seventy percent of respondent found out that presence of commercial tests in market denies them an opportunity of designing their own school based tests. Desire to change students attitude by setting LOCS questions was not viewed as a major challenge toward the use of BT in setting school based tests as was alluded by 87% of the respondents.

Out of 100, 85 teachers believed that most of Mathematics questions focused only on application skills of BT and 76% of teachers were of the opinion that clear cut distinction between levels of BT was nonexistent. It is worthwhile to mention that 48% of teachers strongly agreed and 52% simply agreed that refresher training on use of BT in setting school based tests should be conducted due to the perceived crucial role it plays.

From the open ended questions the following summary can be made;

i. Lack of time to organize BT table of specification and questions in each level was found out to be a challenge in use of BT in setting school based tests.

ii. Teachers found it difficult to set test questions with all level of cognitive domain of BT in a class with several above average students.
iii. Heavy work overload on part of teachers compromised quality of setting school based test.

iv. School examination officers were blamed for giving short notices for Mathematics tests submission.

From the interview session with HODs it can be said that

i. Majority of Heads of Mathematics department were not impressed with general performance of students in Mathematics tests.

ii. There were three kinds of school based tests; One at the beginning of the term, another half way the term and the end of term tests.

iii. Superficial moderation of school based Mathematics tests was evident in majority of schools

iv. Majority of schools lacked examination policies guiding quality and nature of school based tests.

v. Examination officers gave short deadlines for submission of raw school based tests for typing and printing. Teachers had short time for test preparation.

vi. HODs considered subject teachers, beside those who were untrained or on teaching practice, to be professionals and authorities in setting of school based tests. Dared not to correct or attempted to offer professional guidance and directions.

vii. Majority of HODs could not remember clearly the meaning of BT.
viii. The Mathematics curriculum was viewed to be demanding during tests preparation. Teachers taught up to the last moment before the time set for school based test administration.

ix. Understaffing was an issue of concern where some Mathematics teachers were members of other departments. They did not offer the best foot forward in school based test preparation.

A total of 48 school based tests were analyzed to ascertain the level of cognitive skills they were testing. From the analysis it can be said that;

i. Majority of tests questions in Form One and Form Two were testing knowledge, comprehension and application. This is the lower order cognitive skills.

ii. It was noted that majority of test questions in Form Three and Form Four classes tested on application, analysis and synthesis skills of cognitive level of BT.

iii. Generally, the Mathematics tests in Njoro district showed that majority of questions tested application skills. This is in harmony with the study conducted in Turkey by Azar (2005) for Physics (science subject like Mathematics) test questions analysis.

iv. Teachers strived to have well balanced tests covering all areas of BT.

5.3 Conclusion of the Study

From research findings from the data, the researcher presents the following conclusion according to the following study objectives;
a) Extent of use of Bloom’s Taxonomy in setting school based Mathematics tests.

b) Finding out the challenges facing teachers when setting school based Mathematics tests using Bloom’s Taxonomy.

5.3.1 Extent of use of Bloom’s Taxonomy in Setting School Based Mathematics Tests

Going by results on questionnaire for teachers, BT was rarely applied by teachers in setting Mathematics tests in secondary school in Njoro district. Only 65% of respondents admitted applying the Taxonomy in rare occasions. As much as majority of respondents accepted the fact that BT is useful for enhancement of performance in Mathematics, still 32% of respondent did not remember the concept. Fifty five percent were ignorant of efficacy of BT assessment of Mathematics. Forty seven percent of the respondent did not endeavour to set well balanced Mathematics tests combining simple, moderate and technical Mathematical tasks.

Seventy percent of teachers who participated in the study conceded that they set Mathematics tests by lifting (picking) questions from past papers, textbooks and downloading questions from the internet. On the same note, 43% of respondents said that they did not moderate test questions and therefore BT was not applicable to them. Even the 57% of teachers who agreed that they had been moderating test questions did not carry out the exercise in line with BT requirement.
On the other hand, analysis of school based tests in Form One, Two, Three and Four classes depicted that most of the questions were skewed toward the middle level and lower order cognitive skills as bulleted;

Knowledge- 10%
Comprehension-18%
Application- 28%
Analysis-22%
Synthesis-13%
Evaluation-9%

The fact that sampled Mathematics tests in all classes tend in some way to examine all the skills of BT cognitive domain, could not be ignored. In spite of this, the problem of poor performance in Mathematics still persists in secondary schools of Njoro district. This therefore holds true the study done by Wilen (1991) and Arend,(1994) which revealed that there is no study which shows any difference in achievement between students whose teachers use mostly high level questions and those who ask mainly low level questions.

The researcher can reasonably conclude that Mathematics teachers in Njoro district secondary schools have not been applying Bloom’s Taxonomy concept in setting Mathematics tests professionally and in line with cognitive requirement. The partial application of BT could be by default. Failure to use BT in setting school based Mathematics tests may be attributed to teacher related or school related challenges. These challenges are as discussed;
5.3.2 Teacher challenges in Setting School Based Mathematics Tests

Ignorance of Bloom’s Taxonomy concept was mentioned as major challenge facing teachers when using BT in setting school based Mathematics tests. Only seventeen percent of respondents scored 60% of Mathematics cognitive analysis tests. It was discovered that over 95% of respondents possess over 6 years’ experience in teaching. Holding all other factors constant, it means that they left teacher training colleges in the past 6 years. This is not a short period for the memory of BT to be fresh in their mind. This was the reason why a sizable proportion of teachers would only remember the concept partially or had forgotten it totally.

Insufficient time for preparation of test was also a setback to the use of BT. Due to the demanding Mathematics curriculum, the teachers taught the students up to the last moment before the test administration. Teachers therefore hurriedly set Mathematics tests by lifting questions from text books, past papers or downloading them from the internet. The view was expressed by 64% of the respondents. The lifted test questions were not professionally moderated in line with BT cognitive requirements.

The researcher considers the teachers’ attitude toward BT concept hindrance towards the use of BT in setting Mathematics tests. Teachers lacked interest of having to prepare tests using BT cognitive domain. In this case, 20% of respondents found the exercise to be boring.
Philosophical argument arose whether BT is really applicable in teaching and learning of Mathematics or not. On the same note, 85% percent of teachers who participated in the study were of the opinion that majority of Mathematics questions revolved around application skills of BT. Their opinion was also revealed where majority of test questions across the board tested application concept of BT. Further, 76% of respondents held the view that clear cut distinction between the different levels of cognitive domain of BT was nonexistent.

Issues of practicability of BT arose where 47% of teachers said the concept was theoretical in nature and 65% found the concept difficult to use. The researcher therefore considers these arguments and lack of clarity as teacher related problem toward the use of BT in setting Mathematics tests.

Solution to the mentioned teacher related problems should be sought in order to improve assessment of Mathematics in schools.

5.3.3 Other Challenges of Using of BT in Setting School Based Tests.

Lack of examination policies guiding setting and moderation of Mathematics tests was found to be a major challenge as mentioned during the interview session with heads of Mathematics department. Mathematics and examination departments of sampled schools were lacking tests moderation committees. This was further complicated by the notion that professionally qualified teachers were viewed to be authorities in their discipline and whatever test they set was considered as being
above board. This gave Mathematics teachers a leeway of designing tests which may not be in line with BT requirement of Cognitive domain.

Short term deadlines given by examination officers for submission of Mathematics test was viewed as school related problem facing teachers when using BT in setting Mathematics tests. Examination officers set strict short notice for submission of school based tests for typing and printing. By so doing, Mathematics teachers speedily lifted questions from past papers and textbooks for the mere purpose of meeting the deadline to avoid reprisals.

A situation where schools were understaffed and the few Mathematics teachers were deployed to other departments curtailed the use of BT. Mathematics teachers were too occupied in teaching other subjects at the expense of Mathematics. This compromised the quality and nature of Mathematics tests. Shortage of Mathematics teachers was an impediment toward setting of standard tests in line with BT requirement.

Outsourcing of external examination was a problem faced by teachers when using BT in setting Mathematics tests. Some school administration procured examination from businessmen without difficulties. It denied teachers opportunities of designing their own to Mathematics test. This view was shared by 70% of teachers who were recruited in to the study.

Tests and examination occupies an important position in our lives today. In a situation where rules and regulations for setting the tests are violated by teachers, the validity and reliability of the tests are put into question. Setting of school
based Mathematics tests is the essence of this study. The challenges of setting school based tests in line with BT are numerous as found out in the study. They include having responsible teachers, ignorance of BT, lack of policies for setting examinations, demanding Mathematics curriculum, heavy workload for teachers, presence of commercial tests among others. The study articulates that it is inappropriate setting of school based Mathematics tests that has brought dismal performance in Mathematics at national level.

5.4 Recommendations

From the findings, the researcher is left with no option but to recommend the following:

Ministry of Education should conduct a refresher training/seminar on the use of BT in setting Mathematics test in the district. In the seminar, clarification on the use and applicability of BT in teaching and learning of Mathematics should be done. Workshops should be organized for all Mathematics teachers to emphasize on the use BT in setting and moderation of School based tests. Training on quality student’s assessment for improved performance in Mathematics should be carried out.

Secondary school heads should formulate examination policies guiding setting and moderation of school based tests. Examination departments in school should be strengthened and empowered so that they can undertake their responsibilities with due diligence and high level of professionalism. Quality assurance and
examination moderation committee for enforcement of quality standards in test setting, production and administration should be constituted in schools.

Teacher Service Commission should recruit more teachers to lessen the workload of Mathematics teachers in schools that have a shortage of Mathematics teachers. Mathematics being one of the compulsory subjects should be taught by teachers who are not overloaded or overcommitted. By simplifying teacher’s workload, there is no doubt that teachers will dedicate adequate period of time for designing standard Mathematics tests.

Heads of Mathematics department in secondary schools should institute strict measures on Mathematics tests moderation. They should strive toward excellence and success. Having been bestowed with authority and power to oversee Mathematics departments, they are required to be above board and execute their duty without fear or favour. They should scrutinize all tests to ensure that they meet the minimum standard required before they are administered to students.

Schools examination officers should formulate a calendar of events at the beginning of the each academic year clearly stating deadlines tests submission by teachers. Wider consultation with all teachers should be done so that teachers are aware of deadlines of school based tests submission. Teachers should own up the time frame set for tests submission. This will enable Mathematics teachers set the test in line with cognitive requirement of BT.

Mathematics teachers should endeavour to set a well-balanced test incorporating LOCS and HOCS. They should show great interest in teaching, learning and
assessment practices using BT cognitive requirements. They are challenged to scrutinize every test question to ascertain the cognitive skill being examined. Strictness and caution should be exercised when procuring commercial Mathematics tests, downloaded Mathematics questions as well as other Mathematics tests which are outsourced. They should be subjected to strict scrutiny and thorough moderation should be undertaken to ensure that they are above board and are reflection of National assessment tests.

5.5 Suggestion for Further Research Study

The research was conducted in secondary schools of Njoro district only. Out 36 schools only 12 sample schools were involved, therefore the researcher suggest the following:

i. Since the research study was conducted in Mathematics, similar research study in other school subjects such as science, languages, humanities and other technical subjects should be undertaken in the region.

ii. Similar research studies can be replicated in other regions in the country.

iii. Research study on the challenges faced by teachers when using BT in teaching and learning of Mathematics can be undertaken.
REFERENCES


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education/doc/talis/report_en.pdf


Jones, E. and Idol, S. (1990). State must create Teaching standard Boards:


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Appendix A: Mathematics Teachers 'Questionnaires (MTQ)

Instructions: The information given in this questionnaire will be treated as very confidential, please give your opinion as honestly and accurately as possible. Give the appropriate response by either ticking in the bracket [ √ ] or by giving further information in the spaces provided. No answer will be considered wrong because that will be your honest opinion. The information given will be kept secret and will only be used for improving teaching and learning of Mathematics.

Section A: Personal Background information

1. Gender: Male [ ] Female [ ]

2. What is your professional qualification
   a) Degree in education [ ]
   b) Diploma in Education [ ]
   c) Untrained [ ]

Any other specify ...............................................................

Teaching information

1) How long have you been teaching Mathematics?
   a) Less than one year [ ] b) 1-5 years [ ] c) 6-10 years [ ] d) 11-15 years [ ] e) more than 15 years [ ]
2) Do you participate in setting school based Mathematics tests?
   a) Yes [ ]
   b) No [ ]
   c) Sometimes [ ]
   d) Any other .................................................................

3) Who is charged with the responsibility of setting school based Mathematics test in your school?
   a) Subject teacher [ ]
   b) Subject head [ ]
   c) Departmental head [ ]
   d) School administration [ ]
   e) Subject head, teacher and HOD [ ]

4) What is the major source of Mathematics test questions in your class?
   a) From Text book only [ ]
   b) From past papers only [ ]
   c) Buying from business men/women (outsource the service) [ ]
   d) Text book and past papers [ ]
   e) Joint inter school External tests only [ ]

5) Can you recall the basic principles of Bloom’s Taxonomy and their applicability in setting Mathematics examinations?
   a) I remember fully [ ]
   b) I fairly remember [ ]
   c) I faintly remember [ ]
d) I cannot remember

e) I don’t know about it

6) Can you apply BT concept in setting school based tests?

a) I fully apply Bloom’s Taxonomy concept in setting

b) I rarely use Bloom’s Taxonomy examinations

c) I never use Bloom’s taxonomy in setting examination

d) I pick the questions arbitrarily

7) Tick the appropriate statement according to you.

SA- strongly Agree, A- agree, SD- strongly disagree, D- disagree, U- undecided

<table>
<thead>
<tr>
<th>Perceived challenge</th>
<th>SA</th>
<th>A</th>
<th>SD</th>
<th>D</th>
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</thead>
<tbody>
<tr>
<td>Bloom’s Taxonomy concept is rather difficulty to use</td>
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<tr>
<td>I do not understand BT concept</td>
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<tr>
<td>BT concept is highly involving concept to use in Mathematics</td>
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<tr>
<td>BT concept is a theoretical and is not applicable in Mathematicsal practice</td>
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<td>Existence of commercial examination inhibit by setting of school tests using BT</td>
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<tr>
<td>BT concept is a boring concept</td>
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<tr>
<td>Overloaded curriculum and demanding mathsyllabi hampers use of BT in assessment</td>
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<tr>
<td>Desire to change students attitude towards Maths makes me set questions testing only lower level skills</td>
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<td>I feel that all Mathematics questions lies in application level of BT and little use in other BT cognitive levels.</td>
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<tr>
<td>There is a clear cut distinction between levels of BT.</td>
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<tr>
<td>Performance in Mathematics can improve greatly if Bloom’s Taxonomy cognitive requirement is adhered to in setting tests questions.</td>
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<td>I do not consider Bloom’s Taxonomy relevant in assessment of student learning.</td>
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<tr>
<td>Mathematics teachers should have refresher training on the role of Bloom’s Taxonomy in setting and moderating Mathematics Examination.</td>
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</table>
8) Which questions do you prefer setting or being set in school based test for your class?

   a) Lower cognitive levels
   b) Middle cognitive levels
   c) Higher cognitive level
   d) Combination of all
   e) Both high and middle cognitive level
   f) Low and middle cognitive levels

9) Is school based Mathematics test moderated before administration to students?

   a) It is fully moderated
   b) Rarely moderated
   c) Never moderated
   d) Any other

10) Do you experience any problems when using Bloom’s Taxonomy in setting your tests?

    a) Yes
    b) No
11) Mention some of the problems that you may be encountering in using Bloom’s Taxonomy in setting Mathematics tests.

a) .................................................................

b) .................................................................

c) .................................................................

d) .................................................................

e) .................................................................

12) How would you rate the performance of your students in the school based Mathematics examinations?

Excellent [ ]

Good [ ]

Average [ ]

Fair [ ]

Poor [ ]

Thank you for spending time to participate in my study.
Appendix B: Interview schedule for Heads of Mathematics department

1) Which class do you teach Mathematics?

2) How do your students perform in school based test and national examination generally?

3) How do you go about setting school based Mathematics school?

4) How test moderation exercise of school based test done in your school?

5) Shed more light on examination policy guiding setting of school based tests in your school?

6) If teacher sets a school based test with over 90% questions testing understanding on comprehension concepts can he/she be compelled to reset?

7) What about if a Mathematics teaches set a school based with over 90% testing high level concepts, can he/she be compelled to revise the test?

8) In your words, what is Bloom’s Taxonomy concept all about?

9) What are some of the challenges that you experience when setting school based test using BT?
   - Curriculum based?
   - School based?
   - Teacher based?
   - Any other?

Thank you for spending time in the interview session
Appendix C: Mathematics Test Question for Analysis by Mathematics teachers

Analyse the following questions according to cognitive level they are testing

1. Without using tables or calculator, evaluate the following. (2 marks)
   
   \[8 + (13) \times 3 - (5)\]
   \[1 + (6) + 2 \times 2\]

2. A translator T maps P (8, -2) onto \(P'\) (-2, -3). Find the image of Q (6, -2) under the same translation. (4 marks)

3. The equation of a circle is given as
   \[2x^2 + 2y^2 - 8x + 5y + 10 = 0\]. Find the radius of the circle and the coordinates of its centre. (4 marks)

4. (a) Draw the graph of \(y = x^2 + 4x + 1\) for \(-4 \leq x \leq 2\). (Show the table of values) (4 marks)
   (b) On the same axis, draw line \(y = 3x + 2\). (2 marks)
   (c) Use the graph to solve the equations
      
      (i) \(x^2 + 4x + 1 = 0\) (2 marks)
      (ii) \(x^2 + x - 1 = 0\) (2 marks)

5. Four towns P, Q, R and S are such that town Q is 120km due east of town P. Town R is 160km due North of town Q. Town S is on a bearing of 330° from P.
and on a bearing 300° from R. use a ruler and a pair of compasses only for all your constructions.

a. Using a scale of 1cm to represent 50km, construct a scale drawing showing the positions P, Q, R and S. (6 marks)

b. Use the scale to determine

i. The distance from town S to town P. (2 marks)

ii. The distance from town S to town R. (2 marks)

6. Mr. Mark Mutunga wishes to take students from wonderful mixed secondary school for a tour. The total number of pupils to be taken should not exceed 60. Each girl must contribute sh. 10,000 and each boy sh. 15,000 and money to be contributed must not exceed sh. 120,000. If this trip is to be successful the number of boys must conditionally be greater than girls.

   a) Write down five inequalities to represent this information taking the number of boys and girls to be x and y respectively. (4 marks)

   b) Represent the above information on the graph paper provided. (4 marks)

   c) What is the optimum number of boys and girls to be taken in order to minimize cost. (2 marks)

Thank you for spending time to answer the questions.
Appendix D: Bloom’s Taxonomy Checklists for Analyzing School Based Test

Secondary data was collected by analyzing the cognitive level of schools based tests in the sampled schools

<table>
<thead>
<tr>
<th>Question</th>
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<th>%</th>
<th>Frequency</th>
<th>%</th>
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<tbody>
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<td>Knowledge</td>
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<td>Comprehension</td>
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<td>Application</td>
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<td>Analysis</td>
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<td>Synthesis</td>
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<td>Evaluation</td>
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Guiding key words

1. **Knowledge** - Remembering previously learned material

   Example: State the formula for the area of a circle.
2. **Comprehension** - Grasping the meaning of material

Example: Given the Mathematical formula for the area of a circle, paraphrase it using your own words.

3. **Application** - Using information in concrete situations

   Examples: Compute the area of actual circles.

4. **Analysis** - Breaking down material into parts

Example: Given a math word problem, determine the strategies that would be necessary to solve it.

5. **Synthesis** - Putting parts together into a whole

Example: Apply and integrate several different strategies to solve a Mathematical problem.

6. **Evaluation** - Judging the value of a product for a given purpose, using definite criteria

Example: After solving a problem determine the degree to which that problem was solved as efficiently as possible.
Internal Memo

FROM: Dean, Graduate School


TO: Mr. Nguthiru Charles Wachiuri
    C/o Educational Communication & Technology Department

REF: E55/CE/15632/08

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that the Graduate School Board at its meeting of 9th July 2012 approved your M.Ed Thesis Research Proposal entitled, “Challenges Facing Teachers in Setting School Based Mathematics Tests Using Bloom’s Taxonomy in Secondary Schools of Njoro Districts, Kenya.”

You may now proceed with your Data Collection.

Thank you.

JOSEPHINE K. NJAGI
FOR: DEAN, GRADUATE SCHOOL

c.c. Chairman, Educ. Communication & Technology Dept.

Supervisors:

1. Dr. Simon M. Rukangu
   C/o Educ. Communication & Technology Dept. – KU

2. Dr. Hamisi Babusa
   C/o Educ. Communication & Technology Dept. – KU

JKN/fwk
RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "Challenges facing Teachers in setting School based mathematics tests using bloom's taxonomy in secondary schools of Njoro District, Kenya" I am pleased to inform you that you have been authorized to undertake research in Njoro District for a period ending 30th November, 2012.

You are advised to report to the District Commissioner and the District Education Officer, Njoro District before embarking on the research project.

On completion of the research, you are expected to submit two hard copies and one soft copy in pdf of the research report/thesis to our office.

DR M.K. RUGUTT, PhD, HSC.
DEPUTY COUNCIL SECRETARY

Copy to:
The District Commissioner
The District Education Officer
Njoro District.
RE: RESEARCH AUTHORIZATION

Following your request for authority to carry out research on "Challenges facing teachers in setting school based mathematics tests using bloom's taxonomy in secondary schools of Njoro District Kenya", I am pleased to inform you that you have been granted authority to carry out the research in secondary schools in Njoro District, for the period ending 30th November 2012.

This office would like to wish you success in your research undertaking.

PATRICK OCHIENG
FOR DISTRICT EDUCATION OFFICER
NJORO DISTRICT