

Influence of Teacher-Related Factors on Students' Performance in Mathematics in Secondary School

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Abstract: *This study investigated the influence of teacher related factors on students' performance in Mathematics in Secondary school. The insight into the study arose from the recurrent poor performance of mathematics in Kenyan secondary schools. Specifically, the investigation was on the teaching methods used by teachers, teachers' attitudes and assessment techniques. Participants were mathematics teachers randomly chosen from 20 schools in Mombasa County. Data collected was analyzed using descriptive statistics where percentages and weighted means for the schools were used. The findings indicated that teachers assessed all cognitive domains of learning except creativity, imagination and data interpretation domains. The students' difficulties were mostly sprung from their disabilities in representation and understanding of word problems, making a plan and defining the related vocabularies. Therefore, to enhance mathematics learning, teachers need to be in-serviced on use of various teaching and assessment techniques. Teachers need to help students in interpreting mathematical questions by teaching them to look for a pattern, draw a picture and rewording the problems.*

Keywords: Teaching methods, Assessment technique, Descriptive statistics, Cognitive domain.

1. Introduction

Mathematics is a way of thinking that enables us in organizing our experiences of the world. Mathematics is a diverse discipline that deals with data, measurements and observations from science, with inference, deduction, proof, and with mathematical models of natural phenomena of human behavior and social systems. It is a culture, which enriches our understanding and enables us to communicate and make sense of our experiences. By doing mathematics, we can solve a range of practical tasks and real life problems. Mathematics is a language. It is important to know that in mathematics we use dual languages, the ordinary language and special language of mathematics. Mathematics is therefore a way of communication. As a base for critical thinking, we can work on problems that use mathematics to describe, explain and predict what might happen. Even nature also embraces mathematics completely. We see so much of symmetry around us and have a deep sense of awareness and appreciation of patterns. In plants there are innumerable examples of symmetry, shapes, patterns, etc. Such examples exist in animals, objects, pictures and other things. The sun rises and sets at specific moments, the stars appear at a fixed time etc. Importance of Mathematics can be understood by the definition given by Galileo. He defined mathematics as "a language in which God has written the world".

Learning skills and remembering facts in mathematics are important but they are only a means to an end. Facts and skills are not important in themselves. They are important when we need them to solve a problem. Students will remember facts and skills easily when they use them to solve real problems.

General objectives of learning mathematics in Kenya is to assist in the process of producing a person who is numerate, orderly, logical, accurate and precise. The person should also be competent in appraising and utilizing mathematical skills in playing a positive role in the developing society.

Therefore at the end of the four year course, the learner should be able to:

- Make precise and logical use of mathematical language
- Perform mathematical operations with confidence, speed and accuracy
- Symbolize and concretize problems from everyday situation
- Comprehend, analyze, synthesize and evaluate a set of numerical data
- Apply mathematical knowledge and skills to familiar and unfamiliar situations
- Interpret the result of analysis, draw conclusions and make predictions
- Appreciate the aesthetic and utilitarian values of mathematics

2. Literature Survey

In an attempt to improve the performance in mathematics, many studies have been done and various recommendations made. Explanations for poor performance in mathematics in Kenya and other countries have indicated that the following factors are significant: students' attitude and characteristics (Eshiwani, (1983); Fuller, (1987); teacher quality and perception (Anderson *et al* (1989); Durkin, 1989); availability and use of textbooks (Fuller, (1985); Stodolsky, (1988); Eshiwani (1993); student entry behaviour (Bloom, (1976); Hanusheck, (1989); time allocation (Hussen, (1967); Fisher *et al* (1978); Fuller, (1987); Anderson, (1984); MoEST-KNEC report (2000). Other factors cited are: sex of student (Maccoby and Jacklin, (1975); Gould, (1981); Stobart *et al*, (1992); Kutnick *et al*, (1996); teaching methods and classroom climate (Resnich (1985); Hatano and Inagake, (1991); class size (Eshiwani, (1983); Lockheed (1993) and homework ((Pascal *et al* (1984); Leone and Richards, (1989); Postlewaite and Wiley, (1992). While analysis the foregoing studies, Miheso (2002) points out that a common assumption in all these studies is that enhanced mathematics achievement is related to the variations in

exposure to instruction and provision of educationally stimulating environments within and outside the school.

Grouwns and Koehler (1988) identified teacher and student-related factors that affect learning. Teacher-related factors such as his or her knowledge of mathematics content how students learn and teaching techniques of particular content and class. Other significant factors include teachers' attitudes and beliefs about mathematics and teaching. For instance, some teachers believe that students learn by explicit examples and repetition and other believe that they learn by discovery or investigation, hence making their teaching approach to teaching of mathematics different. Opportunity to learn mathematics effectively is dependent upon a wide range of factors, but among the most important are those which are related to activities and practices within the classroom. The above studies focused strongly on the classroom and what happens there. They suggested that within the classroom, it is possible to discern a number of key elements. These include: teaching practices; the nature of student learning activities; the amount and nature of engaged learning time experienced by students; the learning environment and the scope and nature of the feedback given to students.

Effective teaching practices involve:

- 1) A focus on the meaning and understanding of mathematics and on the learning task;
- 2) Encouragement of student autonomy, independence, self-direction and persistence in learning; and
- 3) Teaching of higher-level cognitive processes and strategies.

This indicates that teaching practices are central to understanding what makes effective teaching. Successful teaching strategies require an organized approach to teaching where, material is taught until it is mastered. In the classroom instruction, three modes exist: giving information, soliciting information and providing feedback. This implies that both the teacher and students should participate in the teaching and learning process. Teachers have to engage students in rich, meaningful tasks when teaching. This means students' thinking whether shared orally or in writing, must be used by teachers to guide the classroom in exploration of important mathematical ideas.

However, there are other factors such as the decisions that teachers make, the methods they use, and the attitudes displayed, that are relevant to performance on mathematical tasks that influence the direction and outcome of student performance. It is often declared that the attitude of a teacher could influence their actions in the classroom, which becomes critical to student learning. In other words, a teacher's attitude regarding mathematics and students is relative to attitudes towards the teaching of mathematics, which in turn, has a powerful impact on mathematics learning. Thus, students' understanding of mathematics, their ability to use it to solve problems, and their confidence in, and disposition towards mathematics are shaped by the teaching they encounter in school (National Council of Teachers of Mathematics (NCTM), 2000).

The education commissions reports of Gachathi (1976) and Mackay (1981), suggested that teaching should be learner-centred so that learning becomes more relevant to the learner. Such opportunities could be realized if teachers used teaching methods that encourage students' participation in class. This implies that students' learning largely depends on teaching process which points at the teaching methods used by teachers. This study intended to establish the extent to which teachers dominate the lesson since this could be a possible challenge to mathematics learning in secondary school. Miheso (2002) points out that teaching mathematics well involves creating, enriching, maintaining and adapting instruction to move towards mathematical goals while capturing and sustaining as well as engaging students in building mathematical understanding. She further notes that teachers have a wide range of instructional strategies at their discretion, which, often differ in terms of the amount of teacher direction, the number and type of students being taught at any given time. This implies that the choice of any of these strategies depends on their purpose in teaching, their understanding of teaching-learning processes and considerations of cost effectiveness. Mathematics teachers therefore need to be more cautious when choosing teaching strategies to ensure a clear and harmonious link between syllabus contents. Cohen (1976) recommended the use of small groups as a method of teaching. He emphasizes that collaborative efforts by learners allow problem solving to continue when an individual member encounters a difficult situation. In this case, the teacher provides external monitoring for individuals in a group and a less restrictive social environment in which students are enabled to pursue various mathematical techniques and ideas.

Assessment and evaluation are essential components in mathematics education. They help in monitoring students' readiness for new learning, gives teachers feedback on the success for their strategies and approaches and help to plan new learning. Evaluation encompasses diagnostic assessment practices that enable teachers to discover difficulties in individual learners. Assessment is expected to focus on what students are able to do and how they think about mathematics. Skills assessed should incorporate ability to communicate findings, to present an argument and exploit an intuitive approach to a problem (Ministry of Education, (2000)). This further emphasizes that the need for assessment to be an integral part to the teaching and learning process. Davies (2004) points out that assessment should illustrate the partnership that exists between teaching and learning process rather than collecting data on performance. This keeps the student informed about the learning objectives they are working towards. The purpose of diagnostic assessment is not just to assess, but rather to use test results to improve learning (Black & William, (1998)). Progress toward meeting the students' goals is measured by comparing expected and actual rates of learning. Based on these measurements, teaching is adjusted as needed. Thus, the students' progression of achievement is monitored and instructional techniques are adjusted to meet the individual students learning needs.

3. Research Questions

The following research questions are answered in this study:

- 1) What teaching methods are used in teaching mathematics in secondary school?
- 2) What assessment techniques are used in secondary schools to enable students to learn mathematics?
- 3) What attitudes do mathematics teachers have towards their students'?

Methodology

This study was guided by three research questions. A cross-sectional descriptive survey design was adopted and carried out in ten secondary schools in Mombasa County. A Mathematics Teachers' Questionnaire (MTQ) was used to collect data. The validity and reliability of the questionnaires were enhanced by a pilot study. The MTQ was administered to mathematics teachers from 20 schools sampled for the study. Data collected was analyzed using descriptive

statistics where percentages and weighted means from the schools were used.

4. Results

4.1 Teaching methods in use in teaching mathematics

The main objective of teaching is learning. Teaching, therefore, should produce at least observable changes in the student in form of performance at the end of each concept. This study sought to establish teaching methods used by teachers in secondary schools. The researcher suggested eight (8) methods that are applicable when teaching mathematics in secondary.

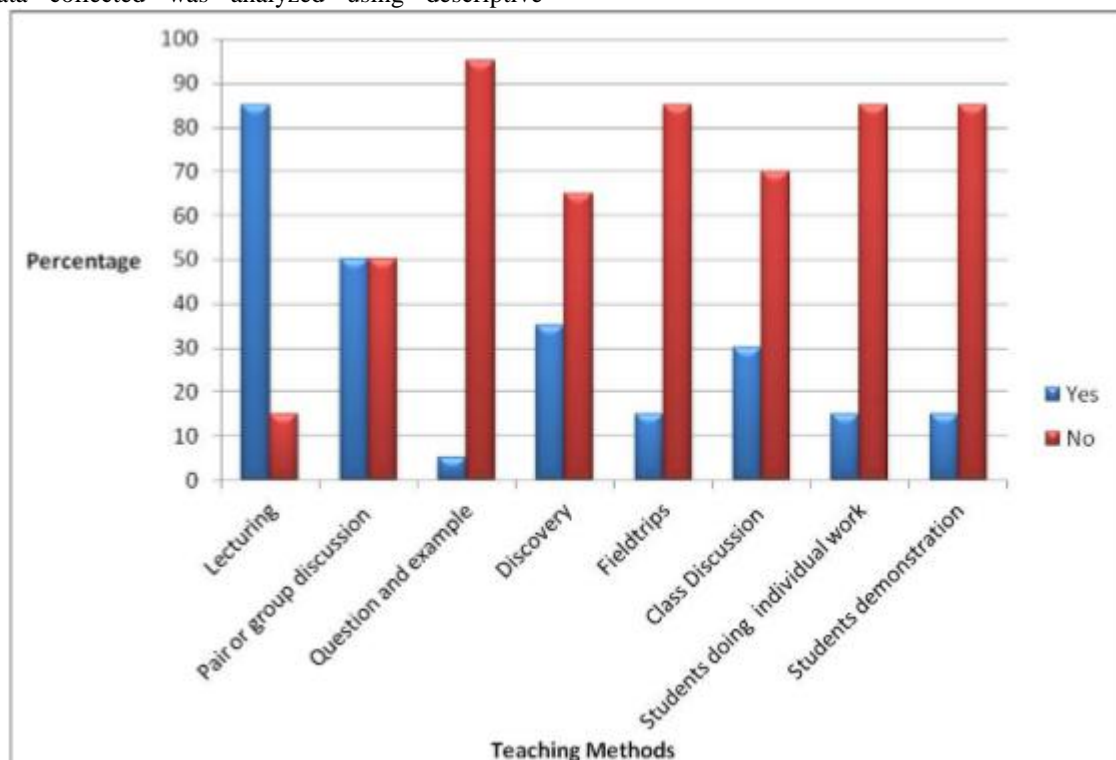


Figure 4.1: Teaching methods in use by Teachers

The results in Figure 4.1 show that 85% of the teachers surveyed used lecture method with only 50% using pair and group discussions. A further 30% used class discussions with another 35% using the discovery method. However, most teachers of mathematics did not use the other methods as indicated. In particular, 85% of the teachers did not use field trips, 95% did not use question and example. These methods are also very important in enhancing students' performance in mathematics. Similarly, 85% did not encourage students demonstrating to each other and a further 85% did not employ teacher assisting individual student method.

These sentiments also echoed by Wasiche (2004) who noted that the initial step in encouraging students to like mathematics is to keep them motivated by knowing their external motivators and external motivators such as peer influence and encouragement from the teacher. This implies that approximately, 85% of teachers need to arouse the

students' interest by using a combination of teaching methods that encourage students' participation.

It is important to note that effective teaching requires knowing and understanding mathematics students and pedagogical strategies since students learn mathematics through experiencing what teachers provide. Consequently, the learning techniques developed by students depend on the teaching methods employed by teachers. As noted by Centre for Curriculum Studies in Africa (1987), no particular teaching-learning strategy gives optimum learning conditions to all students. This implies that teachers need to combine more than one teaching method to enhance learners' understanding. In connection to this, the researcher sought to establish from the teachers whether there are times they use more than one method in the same lesson. All the teachers surveyed indicated that there are times they use more than one method. Table 4.1 is presents the information on how the sampled teachers combined the methods.

Table 4.1: Teaching methods in use by Teachers

Teaching Method	Percent (n=20)
Lecturing, give example then questions	85
Teaching the whole class then give an exercise to be done in groups	30
Giving questions ,students do individual work then do a class discussion	40
Lecturing and then students demonstrate to the class	35

Sidhu (1991) argued that it would be impossible to adapt to extreme form expository or heuristic methods. This is because extremes are either teacher-centered or learner centered thus the need to strike a balance between the two strategies. In relation to this, the teachers were asked to indicate with reasons the teaching methods that were thought to enhance mathematics teaching and learning in secondary schools. This information is presented in Figure 4.2

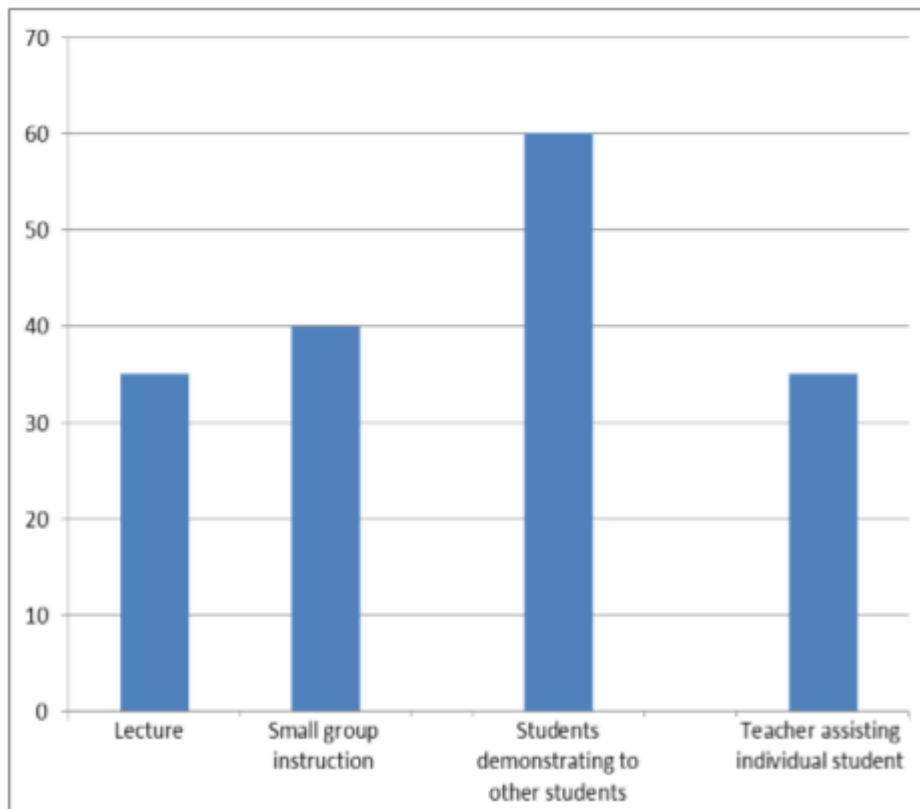


Figure 4.2: Teaching methods that enhanced students' mathematics learning

Figure 4.2 shows 60% of mathematics teachers felt that students demonstrating to each other if used during teaching are likely to enhance students' mathematics learning techniques. Few (35%) teachers indicated lecture method, 40% cited small group discussion and 35% indicated that teacher assisting individual student could enhance learning. As noted earlier, most teachers (85%) used lecture method when teaching yet very few of them thought the technique enhances students' adaptation to mathematics learning techniques. This, partly, could be possible challenge students may be facing in learning mathematics and consequently poor performance in mathematics examinations in KCSE.

Teachers who suggested lecturing method stated that a lot of content is covered within a short time while those who cited small group instruction said students feel free to discuss in groups and enables the teacher to focus on the learner. Teachers also noted that students learn to express themselves while asking or answering questions thus gaining confidence when they demonstrate to each other in class. Teachers who suggested teacher assisting individual student noted that weak students are identified and assisted when this method is employed. In addition, it was noted that in this method, the teacher is able to identify and correct misconceptions as

well as learners building confidence and trust in their teachers.

4.2 Assessment techniques in use in secondary schools

The researcher also sought to establish the teachers' reasons for assessing their students. Teachers of mathematics in the sample gave reasons for assessing their students. Table 4.3 presents a summary of this information.

Table 4.3: Teacher's reasons for assessing their students

Reasons for assessing	Percent (n=20)	
	Yes	No
Determining who needs individual attention	30	70
Integral part of teaching and learning	70	30
Judging teaching effectively	25	75
Finding out pupils, mastery of content and skill	55	45
Preparing students for external exams	70	30
Ranking students	65	35
Encouraging students to learn	40	60
Determining learners early behaviour	20	80
Predicting the courses that students will take		

Table 4.3 shows that majority (70%) of the teachers surveyed indicated that they assess for continuous

assessment as part of teaching and learning. On determining learners' readiness for a topic, 70% of the teachers indicated that it was not a reason for assessing. This implies that majority (70%) of teachers surveyed mainly take assessment as a teaching routine. Only 25% of the teachers indicated that they assess students in order to judge teaching effectively. These results contradict the view by Davies (2004) who points out that assessment should illustrate the partnership that exists between teaching and learning processes rather than collecting data on performance. Such emphasis on assessment keeps the students informed about the learning objectives they are working towards. This depicts the stress put on assessment and shows that teachers do not give assessment the adequate emphasis it deserves. A further 55% however indicated that they assess their learners to find out students' mastery of the content while 70% of the teachers indicated that they assess students to prepare them for external examinations and 65% stating that they assess students to rank them. 60% of the teachers did not consider encouraging students to learn as a reason for assessment. Similarly, besides assessing their students for various reasons, 30% of the teachers also assessed to predict the courses their students will take in future whereas a majority (70%) does not. These shows the concern teachers have for their students even after formal schooling that translates to the need to shape up their students' abilities. This could be done by properly inducting them in mathematics learning techniques at each class level to improve performance. Thus, there is need for teachers of mathematics to have concern for their students if the students are to overcome challenges they face in adapting to mathematics learning techniques in secondary school. Teachers' realization of the fundamental reasons of assessment may achieve this. The research also sought to establish the methods employed by teachers when assessing their students during the teaching process. Table 4.4 summarizes this information.

Table 4.4: Assessment methods employed by teachers

How teachers assess during teaching	Percent (n=20)	
	Yes	No
All students do supervised exercise during the lesson	80	20
All students are given the same assignment	50	50
Giving challenging questions to brighter students	35	65
Giving extra lessons to weaker students	10	90
Marking all assignments done by my students	10	90

Table 4.4 shows that 80% of teachers indicated that all students do supervised exercise during the lesson, a further 50% of them stating that all their students are given the same assignment. This implies that only 50% of the teachers surveyed take into consideration the mixed ability of the students. Similarly, only 35% of the teachers sampled give extra lessons to weaker students. All the teachers indicated that they do not give extra lessons to weaker students. This could be a possible challenge to weak students because they need to develop learning techniques that would enhance their understanding. In addition, 90% of teachers indicated that they do not mark all assignments done by their student. This implies that students do not get adequate feedback on their learning. Assessment gives evidence of student learning and can be used to help improve the quality of instruction and monitor progress in achieving learning outcomes. Notably, homework also falls into this category of

formative assessment because it typically supports learning. Thus, teachers need to develop assessment methods that would provide constant feedback as well as cater for mixed abilities of their students.

In addition, the research also sought to establish the frequency of assessment in mathematics during teaching process. Five techniques commonly used in assessment of mathematics were listed and teachers indicated the frequency of use for each technique in assessing their students. Table 4.5 presents this information.

Table 4.5: Assessment techniques in use

Assessment Technique	Percent (n=20)			
	Daily	Weekly	Monthly	Overall
Written tests	15	15	70	100
Manipulation of objects	0	0	15	15
Making Models	0	0	0	0
Oral Communication	0	0	30	30
Homework	85	15	0	100

Table 4.5 shows that written tests and homework are the techniques used most (by all the teachers surveyed). The most frequently used technique is homework with 85% of the sampled teachers using it daily and the rest weekly. Though most teachers used written tests in assessing their students, most of them used it monthly (70%) while only 30% (by adding weekly and daily percentages) used it more frequently. Assessment using written tests done monthly may not be sufficient to diagnose students' weakness. Again, these commonly used techniques of written tests and homework mainly assess the acquisition of knowledge and facts, which though useful are not sufficient for good learning of mathematics.

The least frequently used techniques are manipulation of objects and oral communication done monthly by 15% and 30% of the teachers respectively. This implies that teachers were aware of the need to use a variety of techniques of assessment. Davies (2004) also noted that assessment involves multiple techniques including written, oral and demonstration formats as well as group and class activities. Despite the fact that teachers use most of the assessment techniques suggested, the frequencies are not sufficient. The frequencies of these techniques could significantly influence the learners' adaptation to mathematics learning. However, this generalization may be true for all cases if most teachers assess their students as frequently as possible.

4.3 Teachers' attitude towards learners of mathematics in secondary schools

The research sought to establish the teachers' attitude towards learners of mathematics on a 5-point Likert scale. The respondents were expected to indicate their opinion using a Likert scale of Strongly Agree or Strongly Disagree. The mean score for every statement was calculated. A score below three (3) was viewed as an indication of agreement with the stated statement while a score above three (3) was viewed as disagreement with the stated statement. A score of three (3) was viewed as neither agreeing nor disagreeing with the given technique. Table 4.6 presents the frequencies and mean scores for the teachers' feelings.

Table 4.6: Teachers' feelings about their students

Teachers' feelings	Percent (n=20)			
	Agreeing	UD	D	Mean Score
Most students have problems in expressing themselves while asking or answering questions	80	0	20	2.100
If I were to judge my students, they appear dull and fear mathematics	70	0	30	2.650
Most of my students are shy to display their solutions on blackboard	65	20	15	2.450
My students only memorize the formulae without understanding	90	0	10	2.050

Table 4.6 shows that the highest mean score ($M=3.60$) corresponds to teachers' view that the students' readiness to learn is an indicator of learners' interest in mathematics. These results indicate that students are not usually prepared or ready to learn. Students 'readiness to learn is an indicator of learners' interest in mathematics. However, these results point out that teachers feel that their students are not usually prepared or ready to learn. Thus one of the possible challenges facing learners in learning mathematics techniques in secondary schools is the students' readiness to learn.

The analysis also reveals that majority (70%) of the teachers feel that their students usually appear dull and fear mathematics. 65% felt that most of their students are shy to display their solutions on the blackboard while 80% felt that most students have problems in expressing themselves while asking or answering questions. Lack of confidence is one of the main indicators of poor performance in mathematics. This is because low confidence hinders students' effective participation in the teaching and learning process. This could probably be a possible challenge facing students in learning mathematics in secondary schools.

The results in Table 4.6 further show that that only 15% of the teachers agree that their students are always active during mathematics lessons with another 90% agreeing that their students only memorize the formulae without understanding them. These results show that the students' interest in mathematics according to teachers, need to be cultivated.

5. Discussions

Teaching methods in use in teaching mathematics

Majority (85%) of the teachers surveyed used lecture method with only 50% using pair and group discussions. 30% used class discussions with another 35% using the discovery method. Another 40% of the mathematics teachers felt that students demonstrating to each other if used during teaching are likely to enhance learning mathematics learning in secondary schools with only 15% of the teachers citing lecture method. This implies that approximately, 85% of teachers need to arouse the students' interest by using a combination of teaching methods that encourage students' participation.

Assessment Techniques in use in teaching mathematics

Written tests and homework are the techniques used by all the teachers surveyed. Though teachers used written tests in

assessing their students, most of them used it monthly (70%) while only 30% using it weekly and daily. The least frequently used techniques were manipulation of the objects and oral communication which is done monthly by 15% and 30% of the teachers respectively.

Teachers' Attitude towards Learners of Mathematics

Most (70%) of the teachers felt that their students usually appear dull and fear mathematics and a further 65% felt that most of their students are shy to display their solutions on the blackboard. Majority (80%) of the teachers felt that most students have problems in expressing themselves while asking or answering questions. Only 15% of the teachers agreed that their students are always active during mathematics lessons with 90% agreeing that their students only memorize the formulae without understanding. Most of the teachers' sentiments point at the attitudes that the students may have developed towards mathematics learning. Students may develop negative attitude due to frustrations from teaching techniques used by teachers, the curriculum or even parents. Therefore, all the people concerned especially teachers need to help students to develop positive attitude if their performance in mathematics is to be enhanced.

6. Conclusion

Teachers surveyed agreed that small group instruction, individualized attention and students demonstrating to each other are methods that are likely to enhance mathematics learning in secondary schools. Ironically, teachers felt that lecture method did not enhance students' in learning mathematics yet most of them use it frequently during the lessons. This shows that the teaching methods used by most teachers did not enhance proper adaptation to mathematics learning and this could be a possible challenge facing students.

The findings of this study indicate that teachers gave assignments but did not mark them frequently leading to lack of timely and immediate feedback to the students.

Teachers practiced both positive and negative teaching habits in class. Positive teaching habits enhanced mathematics learning while negative habits de-motivated students leading to poor performance.

Teachers felt students were not usually prepared or ready to learn mathematics yet students' readiness to learn is an indicator of learners' interest in the subject. In addition, 'lack of confidence hindered students' effective participation in the teaching and learning process.

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