



**AN ASSESSMENT OF THE INFLUENCE OF MATHEMATICS TEACHERS' TRAINING ON USE OF QUESTIONING TECHNIQUE AND STUDENTS' ACHIEVEMENT IN MATHEMATICS IN PUBLIC SECONDARY SCHOOLS IN MWALASUB-COUNTY, MACHAKOS COUNTY, KENYA**

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**Abstract**

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*Mathematics' teachers play an important role in teaching of concepts in mathematics and ensuring that students register good grades in tests. However, in Mwala Sub-county, the scenario is different with many students registering low achievement in mathematics. Thus, the purpose of this study was to assess the influence of mathematics' teachers training on use of questioning technique on students' achievement in mathematics in public secondary schools in Mwala Sub-county, Machakos County, Kenya. The study was guided by the learning theory. This study adopted mixed methodology and thus applied concurrent triangulation research design. Questionnaires were used to gather quantitative data from mathematics' teachers whereas interview guides were used to collect qualitative data from principals. Qualitative data were analyzed thematically based on study objectives and presented in narrative form. Quantitative data were analyzed using descriptive statistics and inferentially using linear regression analysis in Statistical Package for Social Sciences (SPSS Version 23) and presented using tables. The study established that many mathematics' teachers have basic training on how to use questioning technique in teaching mathematics. However, this has not improved students' achievement in mathematics. Thus, the study recommends that mathematics' teachers should undergo many in-service trainings on how improve the questioning technique skills. Mathematics' teachers interact more with experienced colleagues by attending seminars and workshops designed to improve their experience and levels of exposure to different approaches of questioning. The Ministry of Education should create room for more in-service trainings for the newly recruited mathematics' teachers.*

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**Keywords:** *Mathematics, Students' Achievement in Mathematics, Teachers' Training*



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## **1.0 Introduction**

Teacher training is a very important step in teacher preparation since it involves equipping teachers with pre-requisite skills for effective classroom pedagogy. According to Henderson (2014), training equips teachers with teaching methods and assessment skills to be adopted while teaching. Moore (2014) asserts that a major setback in effective use of questioning

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technique is the problem of unqualified teachers. In other words, questioning technique and its elements are designed in a manner that requires well-trained manpower to translate the elements into reality in a mathematics' class. Cognizant of this fact, Harris and Tim (2013) conducted a study in the United States which established that there remains an acute shortage of trained teachers for Introductory Technology, Creative and Cultural Arts, Local Crafts, which are manifested in the poor use of questioning technique.

In a study carried out in Nigeria, Amugo (2013) established that availability of expert teachers impacts on adoption of questioning technique in secondary schools. Amugo (2013) further established that there exists a significant relationship between the availability of trained subject teachers and use of questioning technique in teaching skills in mathematics to students in Nigeria. Similar argument was posited by Ajibola (2014) who also pointed out that most of the teachers are not qualified to embrace the use of questioning technique in daily instruction. These findings are indicative of the fact that the most important person in the use of questioning technique is the trained mathematics' teacher. In other words, with their knowledge, experience and competencies, teachers are central to the use of questioning technique in teaching mathematics to students.

In the same token, Akinoglu (2014) also underscores the fact that teachers who are most knowledgeable about the practice of using questioning technique in teaching mathematics are responsible for adopting every element of questioning technique in class in order to improve students' achievement in skills in mathematics. Thus, the key to getting teachers committed to an innovation is to enhance their knowledge of the programme. This means teachers need to be trained and workshops have to be organized for professional development. Unfortunately, in any use of questioning technique process not all teachers will have the benefit of such exposure. In a study carried out in KwaZulu Natal Province in South Africa, Cobb (2014) suggests that the most common approach is to have one-day workshops given by experts with the questioning technique being the dominant pedagogical strategy in mathematics class. In Kenya, teachers are viewed as technicians, however they are rarely trained on use of questioning technique in their teacher education programmes. Certainly, an adequate teacher education programme should include elements of questioning technique both in theory and practice; if teaching of skills in mathematics in secondary schools is to be a profession and if educational opportunities for students are really to be improved. In a study conducted in Narok Sub-county, Shinali and Ng'ethe (2018) established that it is important for teachers to

understand both the philosophies behind every teaching method such as questioning technique and the effectiveness of such methods in teaching mathematics. Shinali and Ng'ethe (2018) noted that teacher training curriculum should introduce content in questioning approaches and make teachers understand the goals and elements of questioning technique well in order to use it effectively in teaching mathematics to students. However, Shinali and Ng'ethe (2018) noted that the greatest difficulty is likely to be encountered when teachers are required to change their educational approaches to teach skills in mathematics to students using questioning technique.

In Mwala Sub-county, students' performance in mathematics is low. For example, a report by Ministry of Education (2018) shows that secondary schools in Mwala Sub-county registered 19.7% in mathematics in 2017 KCSE examinations against a national aggregate which stood at 57.9%. Ministry of Education (2018) blames this dismal performance on instructional strategies and techniques adopted by teachers. Cognizant of these assertions, Rudhumbu (2014) posits that the problem related to teachers' questioning technique in mathematics is lack of experience and proper training to match the questions they ask with students' ability. A report by KNEC (2017) to monitor learner's achievement in literacy and numeracy had revealed that 52% of secondary school students were incompetent in solving mathematics problems. In the same token, a survey conducted by Uwezo (2010) had revealed that seven out of ten students in form III could not perform a form one mathematical tasks.

Uwezo (2010) further revealed that 60% of the students in public secondary schools do not have the basic mathematical skills, while 34% of the students could not perform simple tasks that demonstrate basic mathematics' skills. Uwezo (2010) recommends that teachers should adopt teaching methods which are learner-centered. In keeping with these assertions, many mathematics teachers have adopted questioning technique as a mitigant to low grades in mathematics. According to Rudhumbu (2014), this is because, the questions teachers ask are often not well prepared and not effective in strengthening students' understanding of concepts in mathematics. Rudhumbu (2014) further indicates that, to make teaching of mathematics effective amongst secondary school students, teachers have adopted questioning technique. According to Rudhumbu (2014), questioning has changed classrooms from being teacher-centered where the focus is on the teacher imparting knowledge to the students to secondary school learner-centered where the secondary school students are expected to take a more active part in their own learning. This indicates that asking questions in mathematics' lessons

requires knowledge of the types of questions, strategies and the art of questioning. In the same token, Wachira (2010) also posits that teachers argue that such decisions are likely to have profound effects on the success of the use of questioning technique in teaching mathematics in secondary schools.

According to Gachiri (2014), in Mwala Sub-county, teachers fail to adopt questioning technique since, according to them, it is likely to waste time, money and effort because the desired outcomes will not be achieved. This implies that successful use of questioning technique in teaching mathematics needs more than just a teacher who has sufficient pedagogical and content knowledge since most aspects of the questioning technique deal with the teaching of values and teachers whose conduct is perceived by students as inappropriate are unable to be successful facilitators of questioning technique. In other words, use of questioning technique has not been smooth with teachers' competency, professional adequacy, professional interest, motivation and professional competence being brought into focus. However, Gachiri (2014) as did other empirical studies have not interrogated the extent to which teacher training influence use of questioning technique in teaching mathematics on students' performance in mathematics in secondary schools; hence the need for this study.

### **1.1 Statement of the Problem**

Training of mathematics' teachers plays an important role in teaching of concepts in mathematics and ensuring that students register good grades in tests. However, in Mwala Sub-county, the scenario is different with many students registering low achievement in mathematics. As stated in the background, KNEC (2017) reports 52.0% of students are incompetent in basic mathematics' skills. In addition, a report by Uwezo (2010) also indicates that 60.0% of students in Mwala Sub-county are not able to perform basic operations in concepts in mathematics test scores which has led to low performance in mathematics in national examinations. Efforts including induction of teachers on use of a multiplicity of teaching methods to mitigate these challenges have not yielded much and have failed to register remarkable progress. Despite these statistics, few empirical studies have interrogated the extent to which training of mathematics' on use of questioning techniques influences students' performance in mathematics in public secondary schools; thus, the study.

## **1.2 Theoretical Framework**

This study was guided by the learning theory which was postulated by Voigt (1992). This theory was premised on the assumption that mathematical learning and teaching are linked through classroom interaction which requires negotiation of meaning. Voigt (1992) defines the phrase “negotiation of meaning” as the specific means of classroom interactions by which teachers and students form opinions, criticize, explain, test, refine ideas and procedures in mathematics lessons. One of his central concerns was to clarify the process by which the teacher and students developed a basis for mathematical communication through questioning. In the context of this study, this theory is relevant in that it underscores the fact that teachers have intentions to use various types of questions in order to negotiate meaning with students, which results in student learning.

During the negotiation of meaning, questions serve several key functions: they allow teachers to diagnose students’ prior knowledge or misconceptions, probe for understanding, guide student thinking, especially when there is a difficulty or misunderstanding and informally assesses student goals in mathematics. Student learning can be classified into achievement of skills, concepts or solving problems and applying them to solve problems in real life situations. The types and purposes of questions have a direct relationship to student performance. It should be noted that unless questions are directly related to the mathematical learning goal, they are unlikely to lead to student learning that goal.

## **2.0 Research Methodology**

The study applied mixed methodology which adopted both quantitative and qualitative methods. Thus, the study applied concurrent triangulation design since it was single-phase design in which researcher implemented the quantitative and qualitative methods during the same timeframe and with equal weight. This design was suitable for this study since it enabled the researcher to collect both quantitative and qualitative data. It could involve collections of quantitative information that can be tabulated along a continuum in numerical form. This design enabled gathering of data that described events and then organized, tabulated, depicted and described the data collection. Target population comprised 67 principals and 201 mathematics’ teachers all totaling to 268 respondents from which a sample of 160 respondents was determined using Yamane’s Formula. Stratified sampling was used to create eight different strata based on the number of zones in Mwala Sub-county. From each zone, one principal and 19 mathematics’ teachers were selected using purposively and

randomly sampled. This sampling procedure enabled the researcher to realize a sample of eight principals and 152 mathematics’ teachers. Qualitative data were analyzed thematically based on study objectives and presented in narrative form. Quantitative data were analyzed using descriptive statistics and inferentially using linear regression analysis in Statistical Package for Social Sciences (SPSS Version 23) and presented using tables.

### **3.0 Results and Discussions**

In this section, the data analysis, presentation and interpretation are reported. The following main objective guided the study:

To assess the influence of mathematics’ teachers training on use of questioning technique on students’ achievement in mathematics in public secondary schools in Mwala Sub-county, Machakos County, Kenya.

#### **Response Rate**

In this study, 144 questionnaires for Mathematics’ Teachers were administered. In return, 120-Mathematics’ Teachers’ questionnaires were filled and returned and 14 Principals were interviewed. This yielded response rates shown in Table 1;

**Table 1: Response Rate**

Respondents	Sampled Respondents	Those Who Participated	Achieved Rate (%)	Return
Principals	8	8	100.0	
Mathematics’ Teachers	152	140	92.1	
<b>Total</b>	<b>160</b>	<b>148</b>	<b>92.5</b>	

**Source: Field Data (2019)**

Table 1 shows that Principals and Mathematics’ Teachers registered a response rate of 92.5%. This is within the acceptable or recommended response rates of 75.0% (Creswell, 2014) and was adequate to allow for generalization of the outcomes to the target population.

#### **Influence of Mathematics’ Teachers Training on Use of Questioning technique on Students’ Achievement in Mathematics in Public Secondary Schools**

The study sought to find out how mathematics’ training on questioning techniques influence students’ achievement in mathematics’ in public secondary schools. Descriptive data were collected from Mathematics’ Teachers, organized into specific thoughts and results are shown in Table 2;

**Table 2: Views of Mathematics’ Teachers on the Influence of Training on Questioning Techniques on Students’ Achievement in Mathematics in Secondary Schools**

Test Items	SA %	A %	U %	D %	SD %
Mathematics’ teachers have acquired training on questioning technique as a way of improving students’ achievement in mathematics	80.5	8.5	1.5	5.5	4.0
Mathematics’ teachers have not been trained to ask questions which cater for all students’ needs as a way of improving their achievement in mathematics	78.5	14.5	2.5	3.0	1.5
Mathematics’ teachers have been trained how to design questions which has improved students’ achievement in mathematics	69.5	12.0	2.0	10.0	6.5
Training of mathematics’ teachers on use of questioning technique has helped improve students’ achievement in mathematics	74.5	17.0	2.5	3.5	2.5

**Source: Field Data (2019)**

Table 2 reveals that majority (80.5%) of the Mathematics’ Teachers strongly agreed with the view that mathematics’ teachers have acquired training on questioning techniques as way of improving students’ achievement in mathematics as did 8.5% who agreed. However, only a paltry 1.5% were undecided, 5.5% disagreed whereas 4.0% strongly disagreed. Similar views were expressed by Principals who also noted that teachers are often trained on mathematics’ teaching methods including questioning technique. Principal, P1, indicated:

*In training colleges and universities, teachers undertake a unit on mathematics’ teaching methods where they are expected to acquire basic training skills on how to use questioning as a teaching pedagogy*

These findings lend credence to the assertions of Henderson (2014) that training equips teachers with teaching methods and assessment skills to be adopted while teaching. This implies that questioning technique and its elements are designed in a manner that requires well-trained manpower to translate the elements into reality in a mathematics’ class. The study also found out that majority (78.5%) of the Mathematics’ Teachers strongly agreed with the view that mathematics’ teachers have not been trained to ask questions which cater for all students’ needs as a way of improving their achievement in mathematics. At the same time, 14.5% agreed. However, 2.5% were undecided, 3.0% disagreed whereas 1.5% strongly disagreed. On the contrary, principals refuted claims that mathematics’ teachers are not trained to ask questions which cater for the needs of all the students. Principal, P2, noted:

*In any teacher training institution, the curriculum is often designed to be learner-centered. As trained professionals, teachers should adopt teaching strategies including questioning techniques which cater for the needs of all students*

These findings lend credence to the assertions of Wachira (2010) who posits that successful use of questioning technique in teaching mathematics needs more than just a teacher who has sufficient pedagogical and content knowledge since most aspects of the questioning technique deal with the teaching of values and teachers whose conduct is perceived by students as inappropriate are unable to be successful facilitators of questioning technique. In other words, use of questioning technique has not been smooth with teachers' competency, professional adequacy, professional interest, motivation and professional competence being brought into focus. Despite these contradictions, these findings point to how training of mathematics' teachers on how to adopt questioning techniques in a way that accommodates the interests, needs and preferences of all students. This indicates that the most important person in the use of questioning technique is the trained mathematics' teacher. In other words, with their knowledge, experience and competencies, teachers are central to use of questioning technique in teaching mathematics to students.

The study also revealed that majority (69.5%) of the Mathematics' Teachers strongly agreed with the view that mathematics' teachers have been trained how to design questions which has improved students' achievement in mathematics. On the same breath, 12.0% agreed. However, 2.0% were undecided, 10.0% disagreed whereas 6.5% strongly disagreed. Majority (74.5%) of the Mathematics' Teachers strongly agreed with the view that training of mathematics' teachers on use of questioning technique has helped improve students' achievement in mathematics. 17.0% agreed. At the same time, 2.5% were undecided, 3.5% disagreed whereas 2.5% strongly disagreed. During the interviews, principals also indicated that mathematics' teachers have a basic training on how to set and design types of mathematics' questions. Principal, P3, observed:

*In many training colleges and universities, teachers are trained on how to set all the six levels of questions based on Bloom's Taxonomy. To me, what hinders such applications of questioning techniques is teachers' attitude and workload*



These findings corroborate the suggestions of Shinali and Ng’ethe (2018) who noted that teacher training curriculum should introduce content in questioning approaches and make teachers understand the goals and elements of questioning technique well in order to use it effectively in teaching mathematics to students. However, Shinali and Ng’ethe (2018) noted that the greatest difficulty is likely to be encountered when teachers are required to change their educational approaches to teach skills in mathematics to students using questioning technique. This implies that the ability to set and design mathematics’ questions which adheres to basic standards such as Bloom’s Taxonomy are able to adopt every element of questioning technique in class in order to improve students’ achievement in skills in mathematics. To further ascertain the influence of teachers’ training on students’ achievement in mathematics in public secondary schools, data were collected on number of in-service trainings which mathematics’ teachers have undertaken and students’ achievement in mathematics in KCSE. The results are shown in Table 3:

**Table 3: Results of Number of In-Service Trainings Mathematics’ Teachers Have Undertaken and Students’ Performance in Mathematics in 2018 KCSE**

Number of In-Service Trainings Mathematics Have Undertaken	Achievement in Mathematics in 2018 KCSE
0	1.165
0	1.921
2	2.013
2	3.045
3	3.743
4	5.129
5	7.123
6	8.743

**Source: Field Data (2019)**

Table 3 indicates that the number of in-service training a mathematics’ teacher undertakes determines the performance of their students in KCSE. This implies that mathematics’ teachers who undertake many in-service trainings have more skills to enhance students’ achievement in mathematics in KCSE.

**Inferential Findings on the Influence of Teachers’ Training on Questioning Techniques on Students’ Achievement in Mathematics in Secondary Schools**

The results in Table 4 were subjected to linear regression and results are shown in Table 4:

**Table 4: Linear Regression Analysis Showing Relationship Between Number of In-Service Trainings Mathematics’ Teachers Have Undertaken and Students’ Achievement in Mathematics in 2018 KCSE**

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.867	.491		1.767	.128
	Number of In-Service Trainings Teachers Have Undertaken	1.179	.143	.959	8.240	.000

a. Dependent Variable: Students’ Achievement in Mathematics in KCSE

Source: SPSS Generated (2019)

Table 4 shows linear regression analysis which generated a linear model of the form; **Students’ Achievement in Mathematics in KCSE = 0.867 + 1.179Number of In-Service Trainings Teachers Have Undertaken**. These results from the linear regression equation indicates that the coefficient for students’ achievement in mathematics in KCSE attributed to the number of in-service trainings mathematics’ teachers have undertaken is 1.179. This implies that for every increase in the number of in-service trainings mathematics’ teachers undertake, students’ achievement in mathematics in KCSE is expected to increase by a factor of 1.179 (positive coefficient). The value 0.867 (positive) indicates that students’ achievement in mathematics in KCSE does not only depend on in-service training, but also on the basic training which mathematics’ teachers acquired in universities or teacher training colleges. In other words, in-service training only improves on the kind of training which mathematics’ teachers already have from training institutions; all of which influence students’ achievement in mathematics in KCSE.

Similarly, from the results in Table 4, the p-value, 0.000 is less than 0.05, that is, a low p-value (0.000 < 0.05) indicates that the null hypothesis, is rejected. Thus, there is significant influence of mathematics’ teachers’ training on students’ achievement in mathematics in public secondary schools. Hence, teacher training, whether basic or in-service, is a very important step in teacher preparation since it involves equipping teachers with pre-requisite skills for effective classroom pedagogy. Besides, training equips teachers with teaching methods and assessment skills to be adopted while teaching.

#### 4.0 SUMMARY AND CONCLUSIONS OF RESEARCH FINDINGS

From the study findings, it is evident that training plays an important role in imparting skills on how to use questioning techniques in teaching mathematics in secondary schools. However, besides the basic training from colleges and universities, very few mathematics' teachers have undertaken in-service training to acquire new strategies of applying questioning techniques during mathematics' teaching and improve students' achievement.

#### 5.0 RECOMMENDATIONS

The study recommends that mathematics' teachers should strive to undergo many in-service trainings on how improve the questioning technique skills. The Ministry of Education should create room for more in-service trainings for the newly recruited mathematics' teachers. This will go a long way in enhancing their levels of exposure to new approaches of teaching and learning mathematics using questioning techniques. The Ministry of Education should revise teacher training curriculum to ensure that questioning techniques adopted by mathematics' teachers are learner-centered.

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