SELECTED TEACHING STRATEGIES AND PERFORMANCE OF STUDENTS IN MATHEMATICS IN PUBLIC SECONDARY SCHOOLS OF BAHATI SUB-COUNTY, NAKURU COUNTY, KENYA

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THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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DECLARATION AND RECOMMENDATION

This thesis in its form and nature, organization, and content, is the product of my effort and original research work. To the best of my knowledge, it has never been submitted or presented to any university or college for academic credit. All the information obtained from other sources herein has been duly acknowledged.

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DEDICATION

I dedicate this work to all mathematics teachers in secondary schools who work tirelessly to equip learners with mathematics competences.

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I owe my sincere thanks to Almighty God for his provision of good health, knowledge, opportunities, and fulfilment of his good plans in my academic journey. I wish to extend my sincere gratitude to all who assisted me to make this journey a reality. In particular, I appreciate the professional guidance, patience, and understanding of my supervisors; Dr. Jared Anyona Ntabo and Dr. Joel Muriithi. I am grateful too to Sr. Professor Mercella Momanyi the Head of the Department of Postgraduate Studies in Education for encouraging me to take the challenge of writing with determination and dedication. My sincere thanks goes to Conrad Hilton Foundation through the Association of Sisterhood Education in Kenya (ASEK), for funding my master's education. In a big way, I thank Sr. Cecilia Njeri and all the Little Sisters of St. Francis for the financial and moral support they have accorded me.

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ABSTRACT

The purpose of this study was to find out mathematics teaching-strategies used and the performance of mathematics in secondary school. The study focused on teaching strategies in mathematics and students' performance in secondary schools of Bahati Sub-County. This research was significant for it looked at how varied teaching strategies were used to improve mathematics performance of students. The research was guided by the following research questions: What are the teaching strategies used by mathematics teachers in teaching mathematics? How do teaching strategies affect students' mathematics performance? What affects the choice of teaching strategy by a mathematics teacher? What are the challenges facing the mathematics teachers in choosing a teaching strategy in secondary school? And what intervention can be put in place to improve teaching strategies in secondary school. The research was anchored by the cognitive workload theory of cognitive construction. This research employed convergent parallel mixed-method research design. Probability and non-probability sampling procedures was used to select 17 Schools, 17 Principal, 17 HODs of mathematics, 1 Sub-County Education Officer, 44 mathematics teachers and 312 students who participated in the study. The data was collected using semi-structured questionnaires, interview guide, and document analysis guide. The researcher ensured both face and criterion validity of the research instruments. The researcher found the Cronbach $\alpha = 0.83$ to ascertain the reliability for quantitative data. A pilot test was done in two secondary schools where 2 principals, 6 mathematics teachers, and 10 students participated to test the reliability and credibility of the research instruments. The researcher sought permission from the relevant authorities and the research participants before collecting any data. The quantitative data was analyzed using SPSS Version 21.0 software and presented as graph, tables, frequency and percentages. While qualitative data was analyzed thematically. The ethical considerations were observed at all. The research finding revealed that teacher explanation, group work, and random assessment test were the most preferred strategies in teaching and learning of mathematics. The number of lessons, attendance of seminars, lesson planning, number of students in a class, student entry behaviour, nature of the topic, school management, availability of resources, examination system, students interest, prescribed curriculum and ease of use of a strategy where the main factors that affect teacher's choice of a teaching strategy. Too much workload, lack of support from administration, allocation of mathematics lesson, student entry behaviour, large class size, inadequate staffing, and adequate resources were the major challenges that affected the choice of a teaching strategy. The measures that can be put in place include, employing more mathematics teachers, creation of more time for mathematics practise, guidance and counselling to overcome poor attitude. The use of RAT and CAT, Group work, increase of mathematics teachers, more resources, ICT integration, more time allocation, individualised learning, peer teaching and peer consultation, interclass joint examinations, building good teacher relationship, and reducing class sizes would be some of the intervention are that were needed to improve teaching strategies in mathematics. The study concluded that the teaching strategies used were not adequate because of the poor performance of students recorded. The study thus recommended use of student-centered methods as opposed to teacher-centered methods, school to support mathematics program, ministry of education to employ to ease teachers work load, and reduce class size.

TABLE OF CONTENTS

DECLARATION AND RECOMMENDATION ii
DEDICATION ii
ACKNOWLEDGMENTS iv
ABSTRACT v
TABLE OF CONTENTS vi
LIST OF FIGURES x
LIST OF TABLES xi
ACRONYMS AND ABBREVIATIONS xiii

CHAPTER ONE 1
1.0 INTRODUCTION 1
1.1 Background to the Problem 1
1.2 Statement of the Problem 8
1.3 Research Questions 9
1.4 Research Hypothesis 9
1.5 Significance of the Study 9
1.6 Scope and Delimitation of the Study 11
1.7 Theoretical Framework 12
1.7.1 Strength of Cognitive Workload Theory 14
1.7.2 Weakness of Cognitive Workload Theory 15
1.7.3 Justification and Application of the Cognitive Workload Theory 16
1.8 Conceptual Frame Work 17
1.9 Operational Definition of Key Terms 19

CHAPTER TWO 21
2.0 REVIEW OF RELATED LITERATURE 21
2.1 Introduction 21
2.2 Review of The Related Theories 21
2.2.1 Piaget's Theory of Cognitive Development 21
2.2.2 Vygotsky's Theory of Learning 22
2.3 Review of Empirical Studies 23
2.3.1 Learner Centered Strategies and their Effect on Performance in Mathematics . 23
2.3.2 Teacher Centered Strategies and their Effect on Performance in Mathematics . 26

2.3.4 Teaching Strategy and Students' Mathematics Performance 30
2.3.5 Factors Affecting the Choice of Mathematics Teaching Strategies 39
2.3.6 Challenges Facing Mathematics Teachers in Choosing Teaching Strategies 45
2.3.7 Measures for Improving Mathematics Teaching Strategies 49
2.4 Summary of Reviewed Literature and the Knowledge Gap 55

CHAPTER THREE 58
3.0 RESEARCH DESIGN AND METHODOLOGY 58
3.1 Introduction 58
3.2 Research Design 58
3.3 Locale of the Study 59
3.4 Target Population 60
3.5 Sampling Procedures and Sample Size 60
3.5.1 Sampling of Schools 61
3.5.2 Sampling of Mathematics Teachers 62
3.5.3 Sampling of the Heads of Department Mathematics 64
3.5.4 Sampling of the School Principals 65
3.5.5 Sampling of Sub-County Education Officer 66
3.5.6 Sampling of Form Four Students 66
3.6 Description of Research Instruments 67
3.6.1 Questionnaires 67
3.6.2 Semi-Structured Interview Guide 68
3.6.3 Document Analysis Guide 69
3.7 Validity, Pilot Testing, and Reliability of the Instruments 69
3.7.1 Validity 69
3.7.2 Pilot Testing 70
3.7.3 Reliability of the Instruments 71
3.8 Data Collection Procedures 72
3.9 Description of Data Analysis Procedures 73
3.10 Ethical Consideration 74

CHAPTER FOUR 76
4.0 PRESENTATION, INTERPRETATION AND DISCUSSION OF FINDING 76
4.1 Introduction 76
4.1.1 Participation and Research Instruments Return Rate 76

4.1.2 Responses by School Category and School Type 77
4.1.3 Responses by School Category and School Type 79
4.2 Demographic Characteristics of the Respondents.....80
4.2.1 Gender of the Respondents.....80
4.2.2 Respondents' Age.....82
4.2.3 Experience as Mathematics Teachers.....83
4.3 Teaching Strategies.....83
4.3.1 Strategies Used in Teaching Mathematics (Students' Responses).....84
4.3.2 Strategies Used in Teaching Mathematics (Teachers' Responses) 85
4.3.3 Students and Teachers Response on Preferred Teaching Strategy.....86
4.3.4 Student Reason for Preferring a Teaching Strategy 87
4.3.5 Teachers' Reason for Preferring a Teaching Strategy.....94
4.4 Teaching Strategies and Students' Mathematics Performance 97
4.5 What Affects Teachers Choice of a Teaching Strategy for a Mathematics Teacher 100
4.5.1 Effect of Number of Lessons taught on choice of Teaching Strategies 100
4.5.2 How Attending Seminars affect the Choice of Mathematics Teaching Strategies 102
4.4.3 How Lesson Planning affects the Choice of a Teaching Strategy.....104
4.5.4 Teachers' Responses on Factors Influencing the Choice of a Teaching Strategy 105
4.6 Challenges facing the Mathematics Teachers in choosing Teaching Strategies.....110
4.6.1 Students' Response on Challenges Facing Teachers in Choosing Teaching Strategies 110
4.6.2 Challenges Facing Teachers in Choosing Teaching Strategies (Teachers' Response).....115
4.7 Interventions for Improving Teaching Strategies in Mathematics.....117
4.7.1 Students' Response on Interventions of Improving Teaching Strategies.....117
4.7.2 Teacher's Response on Intervention to Improve Teaching Strategies 120
4.8 Hypothesis Testing.....123
4.8.1 Teaching Strategies and Mathematics Performance of Students during the years 2015-2019.....123

CHAPTER FIVE **126**
5.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS **126**
5.1 Introduction 126
5.2 Summary of the Findings 126
5.2.1 Teaching Strategies used by Mathematics Teachers in Teaching Mathematics 126
5.2.2 Teaching Strategies and Students Mathematics performance 126
5.2.3 What Affects the Choice of a Teaching Strategy 126
5.2.4 Challenges Facing Mathematics Teachers in Choosing a Teaching Strategy 127
5.2.5 Intervention for Improving Teaching Strategies in Mathematics 128
5.3 Conclusions 128
5.4 Recommendations 130
REFERENCES **131**
APPENDIXES **139**
Appendix I: Students' Questionnaire 139
Appendix II: Questionnaire for Mathematics Teachers 142
Appendix III: Interview Schedule for HODs 145
Appendix IV: Interview Schedule For the Principal 146
Appendix V: Interview Guide for Sub-County Education Officers 147
Appendix VI: Document Analysis Guide 148
Appendix VII: Research Budget 149
Appendix VII1: Introductory Letter 150
Appendix IX: NACOSTI Research License 151
Appendix X: Permission Letter from County 152
Appendix XI: Map of Kenya 153
Appendix XII: Map of Nakuru County 154

LIST OF FIGURES

Figure 1: Conceptual framework for teaching strategies in mathematics 17
Figure 2: Gender of the Respondents 81
Figure 3: Mathematics Teachers' Teaching Experience 83

LIST OF TABLES

Table 1: Country National Mathematics Performance since 2013-2019 in KCSE.....6
Table 2: Nakuru County K.C.S.E. Mathematics Performance Since 2015-2019 in KCSE..6
Table 3: Bahati Sub-County KCSE Mathematics Performance Since 2015-2019 in KCSE 7
Table 4: Sampling of Schools 62
Table 5: Sampling Matric of Mathematics Teachers 63
Table 6: A Sampling Matrix of Mathematics HODs 64
Table 7: Sampling Matrix of Principals.....65
Table 8: Sampling Matrix of Sub-County Education Officer.....66
Table 9: Sampling Matrix of Form Four Students 67
Table 10: Cronbach's Alpha Analysis 71
Table 11: Instruments Return Rate of Research Instruments.....77
Table 12: Responses by School Category.....78
Table 13: Responses by School Category and School Type.....79
Table 14: Students' Age.....82
Table 15: Strategies Used in Teaching Mathematics (Students' Responses) 84
Table 16: Strategies Used in Teaching Mathematics (Teachers' Responses).....85
Table 17: Preferred Teaching Strategies According to the Students and Teachers 86
Table 18: Students Reasons for Preferring a Teaching Strategy.....88
Table 19: Teachers' Reason for Preferring a Teaching Strategy 94
Table 20: Teaching Methodology 98
Table 21: Effect of Number of Lessons taught on Choice of Teaching Strategies.....101
Table 22: How Attending Seminars Helps Improve the Teaching Strategies in Mathematics.....102
Table 23: How Lesson Planning affects the Choice of a Teaching strategy.....104
Table 24: Teachers' Responses on Factors Influencing the Choice of a Teaching Strategy 105
Table 25: Students' Response on Challenges Facing Teachers in Choosing Teaching Strategies 111
Table 26: Challenges Facing Teachers in Teaching Mathematics - Teachers' Responses 115
Table 27: Students - Measures to Improve Mathematics Performance 118
Table 28: Teachers Response on Intervention to Improve Teaching Strategies.....120

Table 29: Pearson Product Moment Correlation between Teaching Strategies and Students Mathematics Performance of Students during 2015-2019 123

ACRONYMS AND ABBREVIATIONS

3DG	Three Dimension Geometry
BOM	Board of Management
CAT	Continuous Assessment test
CEMASTEA	Centre for Mathematics Science and Technology in Africa
CWT	Cognitive Workload Theory
HODs	Head of Department
ICT	Information Communication and Technology
IN-SET	In-Service Training
KSCE	Kenya Certificate of Secondary Education
KLB	Kenya Literature Bureau
KNEC	Kenya National Examination Council
KICD	Kenya Institute of Curriculum Development
LCD	Liquid Crystal Display
LTM	Long Term Memory
NACOSTI	National Council for Science Technology and Innovation
RAT	Random Assessment Test
SCEO	Sub-County Education Officer
SMASSE	Strengthening Mathematics and Science in Secondary Education
SPSS	Statistical Package of Social Science
TSC	Teacher Service Commission
WM	Working Memory
ZPD	Zone of Proximal Development

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Problem

Mathematics is one of the branches of science that plays a critical part in the advancement of science and technology because it gives the basic requirement of quantifying and accurate evaluation of changes and advancement in the field of research (Clements & Sarama, 2017). According to Fatima (2019), mathematics knowledge informs other science subjects because it deals with the measurement of quantities, data, magnitude, inference, deductions, and proofs and hence discloses hidden patterns that aid us to appreciate the world around us.

There are varied teaching strategies that have been used in the world. These include: teacher-led explanation, group work, practical instruction method, class discussion, teacher-led discussion, teacher-centered instruction, individual work, learner-centered, team teaching, assessment, real-life examples, investigation, project, and self-discovery these have been used for both the teacher trainees and the students, (Munyaradzi, 2013). These teaching strategies are meant to foster mathematical skills, encourage critical thinking and exploration for learners.

Effective mathematics teaching in Europe involves use of variety of teaching methods although there is a general agreement on the use of certain methods as problem-based learning, investigation, and contextualising (Androulla, 2011). These methods of teaching have been found effective for raising achievement and improving student's attitude towards mathematics. In Pakistan there are many teaching strategies used by mathematics teachers such as lecture method, problem solving, heuristic or discovery, inductive, deductive, analytic synthetic and project methods depending on merit and demerit of each

teaching method along with the relevance of each method to the branches of mathematics in classroom context (Faward, 2015).

In most African countries the use of teacher-led instruction methods had been commonly employed by various countries. Umugizaneza and Bansil (2017), opine that most of the teachers in South Africa use a single instructional method that is majorly teacher-led instruction and formal assessment as opposed to student-led strategies. They further suggested that the choice of teaching strategies is basically determined by several factors that include demographic aspects such as age gender, teaching experience, and partaking in professional development courses. Similarly, Rudhumbu (2014) mentioned that most of the teachers in Zimbabwe are obsessed with teacher-centered strategies like drilling practices which prevent students from being creative in demonstrate problem-solving skills. This has killed creativity at the manner at which learners are handling mathematics and creation of teacher independency when it comes to problem-solving of new concepts.

In Rwanda, the use of learner-centered strategies includes oral-questioning, group-discussion, experimentation, or doing exercises (Nsengimana, Habimana & Mutarutinga, 2017). Teachers' skills and knowledge, which are regarded as the learners-centered pedagogical paradigm, are limited. This poses a big challenge to the implementation of teaching mathematics especially with the employment of a competence-based curriculum in Rwanda. Learners are denied precious opportunity of learning problem solving skills and creation of teacher dependency on simple sums. On the other hand it raises concerns whether teaching methodologies used are up to the task in passing these mathematics competences to the students.

The teaching strategies used by teachers basically determine students' performance in mathematics (Mwema, Mulwa & Mailu, 2018). Kamau, Thinguri, Koech and Ngaruiya (2015) opine that the inconsistent instruction method applied by mathematics teachers in

Kenyan schools denies children a valuable start to their future mathematics performance. Mettow and Makewa (2014) observe that Kenya is among the countries that continue to use the traditional method of teaching mathematics in secondary school. Although the majority of schools in Kenya employ traditional methods in teaching mathematics, some outstanding secondary schools are using modern strategies such as the use of ICTs in learning and teaching of mathematics (Mwema, Mulwa & Mailu, 2018).

Khan, Haider and Bukhari (2016) suggest that what people learn depends not only on what they are taught but on how they are taught, their interests, development level, and experience. Teaching strategies are thus basic tools of teachers to attain their focal objective which contributes to the intellectual growth of the learner (Meador, 2019). They are orientations or guidelines that promote learning tasks designed in the curriculum. This makes a strong connection between content in the curriculum and teacher's teaching strategies. These teaching strategies can be employed before the lesson, through the lesson, and after the lesson (Amparo, Enriquez, Valencia & Oliveira, 2018). This makes teaching strategies a range of activities that aim at delivering mathematics content to the learners.

Designing and preparing a lesson is a teacher's responsibility. Fasasi and Yahya (2018) opine that the teachers' sole responsibility is to decide how the lesson will be delivered, what material to be used, and how a student will be evaluated to determine the performance of the students on the content taught. This process requires intellectual reflection by the teacher to foresee his lesson delivery. The use of various teaching strategies is dependent of the teacher's knowledge of different pedagogies. Antony and Walshaw (2009) opine that teachers with in-depth knowledge have clear ideas about how to build procedural proficiency and how to extend, and challenge student ideas. They use their knowledge to make multiple decisions about tasks, classroom resources, talk, and actions that feed into or arise out of the learning process. Teachers with limited knowledge tend to

structure teaching and learning around discrete concepts instead of creating wider connections between facts, concepts, structures, and practices.

The teacher implementation of teaching strategies is fasted on professional development and follow-up programmes to aid in assessing their performance (Osena, 2007). Linde (2020) points out that mathematics is continuously evolving and that fresh trends and methods of teaching are evolving often. Mathematics teachers should therefore, attend professional progression course that gives them fresh insights into the field.

According to Bredeson (2000), the school principals have a substantial impact on teacher effectiveness in teaching mathematics because they are instructional leaders, have the responsibility of creating a good learning environment, they are directly involved in the design and delivery, professional development, and are in-charge of the assessment of professional development outcome. It is noted however that the professional development of mathematics teachers has not been emphasized and majority schools lack mathematics teaching and learning resources that end up affecting the use of different teaching strategies in mathematics (Osena, 2007). Murray (2013) reveals that teaching strategies and academic resources are the best predictors of mathematics performance in the school.

Despite varied interventions made in improving teaching strategies, Fasasi and Yahya (2018), pointed out that students still complain about mathematics lessons being dull, boring, difficult, and useless. Besides, Fuma (2018) further points out that those students still perceive mathematics as a nonconcrete subject which limits their ability on how it relates to the world, and mathematics is an incomprehensible subject that causes anxiety during the examination.

Fasasi and Yahya (2018), further point out that the mathematics teacher still complains of excessive workload and lack of facilities in the form of aid and equipment, on the other hand principals and school management feel that it is the fault of mathematics

teachers who do not make the student put adequate labour for good performance of mathematics to be realized, the employers also criticize the mathematics teachers on their inability to deliver mathematical content to learners, and consequently those parents who are financially stable have resulted to send their students for private tuition. Mathematics' poor performance is a concern to many stakeholders that should be look in a perspective of teaching methodology employed in teaching the subject.

The Ministry of Education, through the Centre for Mathematics Science and Technology Education in Africa, (CEMASTEA, 2019) has the mandate to deliver continuous professional in-service of mathematics and science teachers for effective curricula delivery through the in-service training (IN-SET) organized at various level for mathematics and science teachers (CEMASTEA, 2019). Mumbi, Orero and Magu (2019) assert that the IN-SET is carried out to help the teacher become better and more effective in training the learners with skills required for the 21st century and equip the teachers with the right knowledge, skills, and attitudes in designing innovative learner-centered activities including project-based learning and ICT integration.

In Kenya, the alarming level of mass failure in mathematics is raising concerns of performance in this subject that is required for manufacturing and innovation (Wanzala, 2019). Over four years, Kenya Certificate of Secondary Education (KCSE) most of the candidates have failed to attain the quality grade that would enable them to secure a vacancy at higher learning institutions that include universities and diploma colleges.

Table 1

Country National Mathematics Performance since 2013-2019 in KCSE

Year	2013	2014	2015	2016	2017	2018	2019
Candidature	444774	481286	520274	570398	609525	631750	679222
Mean Score	27.57	24.88	26.88	20.78	25.47	25.38	22.57

Source: Kenya National Examination Council, 2020

As observed in table 1 the Country mean score of mathematics in KCSE for the form four students has been between 20.78% and 26.88% which is an indicator that mathematics performance has been poorly performed for the past seven years.

Poor performance of mathematics has also been observed in Nakuru County as indicated by Table 2.

Table 2

Nakuru County K.C.S.E. Mathematics Performance Since 2015-2019 in KCSE

Year	2015	2016	2017	2018	2019
Candidature	31245	32632	33532	35609	36319
Mean Score	2.852	3.378	2.582	3.375	2.679

Source: Nakuru County Education Office, 2021

As observed in the Table 2, the county mathematics mean score has range between 2.582 (D) and 3.378 (D+). Meaning that majority of the students dismally performed in mathematics which is raising concern of what could be ailing this core subject within the county.

The results of Bahati Sub-County have not been different either as indicated in Table 3.

Table 3

Bahati Sub-County KCSE Mathematics Performance Since 2015-2019 in KCSE

Year	2015	2016	2017	2018	2019
Candidature	2840	2966	3047	3237	3302
Mean Score	3.416	3.224	3.520	3.942	4.025

Source: Bahati Sub-County Education Office, 2020

From Table 3, mathematics KCSE results in the Sub-County range from 3.224 (D+) and 4.025 (C-) over the past five years. This dwindling result could perhaps be attributed to the manner in which mathematics instruction is being done and thus raising a concern to interrogate further the methods being employed in teaching mathematics.

Macharia (2018) observed that low-level performance in KCSE in mathematics was limiting students in the choice of careers, such as law, medicine, and science-related courses because most of the students failure to attain the cluster points required for admission in the institution of higher learning. The poor performance in mathematics have been blamed on the inability of learners to comprehend the mathematical language, symbols, terms, and structure in mathematics caused by ineffective teaching methods used by the teachers (Ndekei & Bisonga, 2018).

The effects of these poor performances of mathematic in KCSE have been observed by universities management, "… More than 90 per cent of the candidates who sat for mathematics and science subjects in KCSE failed" leading to a reduction of numbers of students who qualify for degree courses related to the science subject (Wanzala, 2019). The realization of Kenya big four agenda of 2018 of food security, affordable housing, universal health care, and manufacturing as envisioned by Republic of Kenya (2020) depend on good performance of mathematics which can lead to qualification of related disciplines at higher learning institutions. This big four agenda will only remain a pipe dream should the drop

continue. It is against this backdrop that the study seeks to investigate the teaching strategies in and students' mathematics performance in secondary schools.

1.2 Statement of the Problem

Mathematics as a field of study cuts across all the other aspects of human life. In every day of human beings' existence, we find ourselves faced with complex or simple situations that call for mathematical solutions. It is categorized by Kenya National Examination Council (KNEC) as a compulsory subject that determines the overall final grade of a student in KCSE. This subject that is required for manufacturing and innovation has been marked with poor performance in the national examination. Many stakeholders of education who include students, parents, guardians, and the government have raised concern over how mathematics is taught in school because of the poor results posted by students in internal and external examinations.

A study conducted in South Africa by Ganyaupfu (2013) indicated differential method of teaching resulted in different mean score depending on how they helped students to understand mathematics language, procedures, concepts structure, and proficiency in handling the subject. The Teaching strategies can only be gauged from the point of view on how it can enhance mathematical skills and knowledge required for good mathematics performance among the students. The learning activities, in-service training and change of teaching pedagogy need to be further checked on how they have contributed to students' mathematics performance (Wekesa, 2013).

Bahati Sub-County over the past five years (2015-2019) have posted an average mean of 3.625 (D+), which is very wanting (Bahati Sub-County Education Office). Even though the factors that have been contributed to poor performance in mathematics such as lack of teaching resources, shortage of mathematics teachers, incomplete syllabus coverage, learner's absenteeism, and poor attitude towards mathematics have been addressed, the

performance has continued to dwindle. This has prompted the current study to looked at how teaching strategies has affected the mathematics performance of students in Bahati Sub-County.

1.3 Research Questions

The following research questions guided the study:

i. What teaching strategies are commonly used by mathematics teachers in teaching mathematics in Bahati Sub-County, Nakuru County, Kenya?
ii. To what extent do the commonly used teaching strategies affected the performance of students in mathematics in secondary schools of Bahati Sub-County, Nakuru County, Kenya?
iii. How does the choice of a teaching strategy affect the performance of in mathematics in secondary schools of Bahati Sub-County, Nakuru County, Kenya?
iv. How do the challenges faced by teachers of mathematics in choosing a teaching strategy affect the performance of students in mathematics in secondary schools of Bahati Sub-County, Nakuru County, Kenya?
v. What intervention can be put in place to improve teaching strategies in secondary schools of Bahati Sub-County, Kenya?

1.4 Research Hypothesis

1. **H_0:** There is no statistically significant difference between teacher's selected teaching strategies and students' mathematics performance in secondary schools of Bahati Sub-County, Nakuru County, Kenya.

1.5 Significance of the Study

The study looked at varied teaching strategies employed by different mathematics teacher and how they have affected learners' mathematics performance. The teachers may,

therefore, stand in a position to use most effective teaching strategies in teaching mathematics that can guide learners on how to logically handle the mathematical problem and thus improve in mathematics performance.

The study may inform CEMASTEA on ways that support the innovative methods and assessment methods that should be used by mathematics teachers for good mathematics performance. It is hoped that during the in-service training these modern strategies can be taught to teachers who are experiencing challenges with delivering mathematics lessons and teachers with little experience for better performance in mathematics in the country.

The research done may enrich the Kenya Institute of Curriculum Studies (KICD) on most preferred teaching strategies that they incorporate when planning the mathematics curriculum for teacher and learner activities.

The study can benefit the Sub-County director on preparation of mathematics seminars, workshops and conferences on mathematics teaching strategies that can guide the teachers in the Sub-County for better mathematics performance in the Sub-County.

It is hoped that through the use of effective teaching strategies the students can be equipped with the skills and knowledge required for understanding the mathematical concepts and communicate these concepts logically when handling mathematical problems. This creates a platform for improvement in the mathematics performance of students in both internal and external examinations. This improvement of mathematics may not only uplift their morale in mathematics but also place them in a better position of qualifying for science-related courses offered in poly-technique, colleges and universities.

The community may benefit from this study because through the use of effective teaching strategies the performance of mathematics is expected to improve and hence students can enrolment in courses that are more beneficial to the wellbeing of the society like improved health care, innovation, agriculture, and housing.

1.6 Scope and Delimitation of the Study

According to Matula, Kyalo, Mulwa and Gichuhi (2018), delimitation has to do with identifying and specifying what the study will include and what it will leave out. The study focused on the teaching strategies and students' mathematics performance in Bahati Sub-County, Nakuru County, in Kenya. Only the mathematics teachers were selected for the study because they are directly involved in teaching mathematics and thus stood in a position to give information on how effective are the teaching strategies enhance mathematics performance in the region. It focused on selected public secondary schools within Bahati Sub-County. The private schools were not studied because most of them are not examination centres and thus do their exams from public schools that are recommended by the Sub-County education office. Due to the limitation of time and funds, it was not be possible to study a large population, and therefore only one Sub-County was selected from 11 Sub-Counties in Nakuru County.

The School principals were selected for the study because they play a key supervision role of how the curriculum is implemented in the school as well as they are accountable for the performance of the school in KCSE The Sub-County Director of Education (SCDE) helped in give information on how mathematics has been performed and information on in-service training that can equip mathematics teachers with better teaching strategies in Bahati Sub-County. Form four students were selected because they have stayed longer in school and they have had longer on the encounter with their mathematics teachers. The study involved 312 students form four students out of 3,429 form four students in the Sub-county. This study involved 17 secondary schools out of 35 drawn from Bahati Sub-County.

1.7 Theoretical Framework

Adom and Hussein (2018) point a out that theoretical framework explains the path of a research and grounds it firmly in theoretical constructs. The study was anchored on Cognitive Workload Theory (CWT) that was first designed by Sweller in 1980. The theory holds that learning occurs best under circumstances that are affiliated with human cognitive architectures (Kevin, Erin & Sue, 2015). Similarly, Kirshner, Sweller, Kirshner and Zambrano (2017) define CWT as the total working resources required to carry out a learning task.

The CWT theory has two components of human cognitive architecture. The first component is the working memory (WM). The WM holds current information and processes the information which is to be kept in the long-term memory (LTM). When teaching new information, WM is limited in both duration and capacity. Additionally, when giving out information that includes organizing, contrasting and comparing, students are probably only able to manage two or three items of information simultaneously, depending on the type of processing required (Kirschner, Sweller & Clark, 2006). Finally, new information held in working memory, if not practised, is lost within about 15 to 30 seconds (Driscoll, 2005).

The second component of human cognition involves the long-term memory (LTM). According to Artino (2008), the LTM is answerable for schema construction, and automation. The information held in LTM is prepared and stored in a domain where knowledge is arranged in a specific structure known as schemas. Schemas sort elements of information rendering how they will be used, thereby enabling schema accessibility later when they are needed for connected tasks (Sweller et al., 1998). It is in the view of Merriënboer and Sweller (2005), that human knowhow comes from knowledge kept in these schemata as opposed to the ability to engage in reasoning with many rudiments that have not been organized in long-term memory. According to Kirshner, Sweller, Kirshner and

Zambrano (2017) automation as a role of schema occurs after extensive practice. They further argue that without schema mechanisation, a recently encountered duty might be completed, but the process will probably be slow and difficult. CWT theory thus focused on identifying instructional designs that can effectively reduce the unnecessary cognitive burden on WM, thereby supporting improved learning efficiency (Merriënboer & Sweller, 2005).

There are three forms of cognitive load that include intrinsic cognitive load, extraneous cognitive load, and germane cognitive load that has been identified (Shilbli & West, 2018). Intrinsic cognitive load is inclined to the inherent manner in which information is taught to learners and the learning activities required (Merrienboer & Sweller, 2005).

Extraneous cognitive load is generated by the poor material presentation which does not aid learning. According to Allan (2018), this load is caused by an inappropriate instructional design that ignores WM limits and fails to focus on working resources on schema construction. He further points out that extraneous cognitive load also experienced by the learners when instructional strategies are used to give incomplete mathematics knowledge. The student is, therefore, unable to retrieve information from LTM and WM becomes overloaded leading to partial recall, failing to follow instructions, place-keeping errors, and task desertion. This contributes greatly to the lack of mastering of mathematics concepts and consequently to poor performance in mathematics.

Germane cognitive load is concerned with the elements of information processing and contributes to the development of the schema. Aditom (2009) points out that the schema is cognitive structures in LTM that enable learners to recognized problems according to particular categories that require a particular operation to reach a solution. Shibli and West (2018) suggest that a teacher ought to comprehend how this theory applies to their classroom. From this knowledge of three forms of cognitive load, a teacher can plan his

lesson in a manner that takes into account cognitive load. The mathematics teacher should, therefore, use teaching strategies that reduce extraneous load, manage intrinsic load, and promote germane load for better mathematics performance to be realized among the learners.

Centre for Education Statistic and Evaluation (2018) points out CWT proposes that teaching strategies should: tailor lesson in line with students current knowledge and skill for instance progressively increase independent problem-solving as students become more proficient, use lots of worked examples to teach students new skills or context, cut out unnecessary information, abridge complex information by presenting it both orally and visually, present all the vital information, and encourage students to envision concepts and procedures that they have learned.

1.7.1 Strength of Cognitive Workload Theory

Cognitive workload theory helps to organize the teaching strategies where it brings to the realization of mathematics teachers that learners have very little information about a new topic (Enser, 2019). The teacher should, therefore, present learning material in small and simple steps that allow practice after each step until they develop a greater understanding.

Kutkut (2011) asserts that CWT helps to explain the shortcoming that some students face in their learning and sheds light on the distinct difference among learners in their cognitive abilities. According to Winne (2010), CWT is a powerful tool for comprehending why learners accede to solving problems, challenges in learning, and transferring skills. This understanding of individual student helps the mathematics teacher to tailor his teaching strategies towards an individual learner so that the student can overcome the challenge being faced.

Strength of CWT resonates with the guidance it gives to teachers in designing instructional materials. According to Kutkut (2011) who quoted Sweller (1998) instructional material should aid the learners in analysing questions, solving problems in performance, and solution implementation that make learners more creative and knowledgeable. Therefore, when mathematics teachers are scheming instructional materials, they should consider the learner's cognitive abilities to process where human WM is very limited and cannot process an enormous amount of information at the equivalent time. If this consideration is ignored in the designing of instructional strategies the learner is likely to be overwhelmed and thus the learning consequences will not conform with teaching objectives leading to failure in the learning process.

1.7.2 Weakness of Cognitive Workload Theory

Huntington Research School (2019), points out that CWT like any other theory has some limitations. These limitations include: overemphasizing on teacher-led instruction rather than student-led discovery approach; social and subjective elements of the learning process are side-lined which include social-emotional development, character development, and values; if the content is oversimplified or under-stimulated can lead to distraction; the cognitive load is not measurable thus vary from one person to another; a student may choose not to engage with instructions especially if they are not concerned or they don't like the teacher which this theory assumes. In this research, the researcher explored other factors such as teacher-related factors and school-related factors to identify social-emotional development, character development, and values that have been ignored by CWT. The researcher explored further, student-led approach and teacher-led approach and see how both approaches can be integrated for better mathematics performance.

1.7.3 Justification and Application of the Cognitive Workload Theory

In developing teaching strategies, a teacher should develop relatively easy tasks starting from simple and less complex materials, and proceed to a more detailed explanation (Permana et al., 2019). Shilbi and West (2018) assert that the teaching strategies used by a teacher should target at reducing split attention and dismissal effects, which are majorly influenced by giving multiple information of different concepts at once. This confuses learners and affects the development and assimilation of their schema. The problem-solving strategy should be increased to enhance student-learning motivation.

In choosing a teaching strategy, a teacher should ensure that his strategy should present information in a way that does not impede learning (Psychologies World, 2020). He should, therefore, avoid approaching learning in a means-end analysis of a task and thus sequence learning from simple concepts to difficult concepts. Aditom (2009) asserts that the tasks, learning objectives, and transfer tests should expose students to discovering the deep structure of a mathematical problem.

Regardless of the challenges CWT has, the theory was helpful to the researcher in looking at teaching strategies that break down curriculum content that learners can understand well in their WM and build up LTM for them to retrieve information during assignments and examination. The theory also informed the study on ways of categorizing the interactive teaching strategies and passing strategies that are commonly used by mathematics teachers.

1.8 Conceptual Frame Work

A conceptual framework is used to demonstrate what you suppose to find through your research, as well as how the variables you are considering might relate to each other.

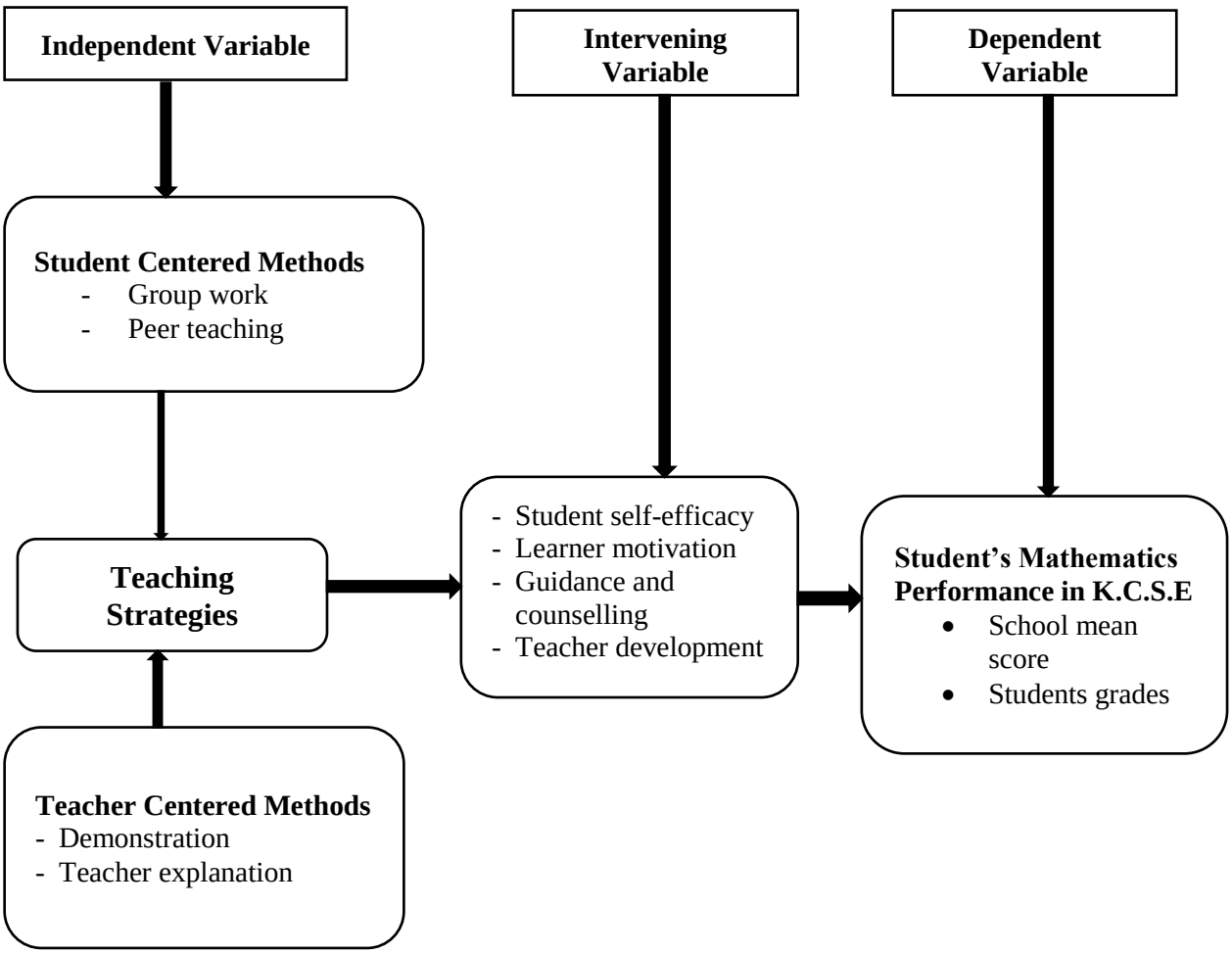

Figure 1: **Conceptual framework for teaching strategies in mathematics**

In this study teaching strategies play a critical role in determination of mathematics performance in KCSE. The teaching strategies can either be teacher centered or learner centered. In teacher centered methods, the teacher pass information by use of demonstration and teacher explanation methods. After words, he assess the students understanding of this knowledge by use of timed testing, question and answer, as well as random assessment test. From the use of these methods the teachers makes deduction whether the students have been able to understand the mathematics concepts and apply them during an examination.

The student's centered methods include the group work and peer teaching. In this student's centered methods, the student generates knowledge and is able to apply this knowledge during examination. The two methods sum up the teaching strategies that mathematics teacher can blend together during teaching and learning process.

A part from teaching strategies, there are other intervening aspects such as student's self-efficacy, learner motivation, guidance and counselling and teacher development that could affect the mathematics performance. Student with self-efficacy value hard work and is more determine to have better grades in mathematics unlike a student with no self-efficacy. Internal and external motivation of students keeps them enthusiastic about good performance. Students who are motivated even motivate the teacher to go extra mile in creating more time for teaching and assessment. In addition, teachers who are motivated feel valued and their work recognized by the institution they are serving.

Guidance and counselling remain necessary in keeping students' attitude positive dispute the challenging concepts they encounter. Students who are guided are likely to keep the focus of doing extra work and good student relationship that contribute positively towards their performance in mathematics. In addition, the teacher require a constant teacher development so that they can improve on their teaching strategies, learn alternative and emerging strategies in handling hard concepts as well as share their teaching experience to other teachers. These enrich their experience and up-to date with the new information.

Good performance can be observed when students can retain mathematical information (formulas, procedures, application) in their LTM, perform their class assignment with minimal difficulties in interpreting the mathematical question, develop a good attitude towards mathematics, completion of exams within the stipulated period, and perform well in both the internal and external examination. If not so, the students are likely

to encounter challenges like fear for mathematics, incomplete assignment, partial remembering of mathematics concept, and finally failure in the internal and external tests.

1.9 Operational Definition of Key Terms

Teacher explanation methods: This is a method of teaching where the teacher lectures on procedures, concepts and information on how to go about solving a mathematical sum. In this study teacher explanation will assume means and ways that teacher of mathematics will use to define, explain and illustrate with relevant examples the concepts used and applied in mathematics.

Demonstration: In this study demonstration was used to refer to the ability of mathematics teacher to show practically the procedures followed in solving mathematical problem. The students assimilate these procedures and use them to work out further sums by themselves.

Group work: The word group work was used in this study to refer to a situation in which the teacher put students in groups, assign the a mathematical question to be discussed, each student contribute his view on how to work the sum, student work out the sum on the agreed procedures and presents the worked sum to the teacher for confirmation or marking of the answer.

Peer Teaching: In this study the work peer teaching was used to infer to peer who are good at working certain sums teaches their fellow peer in class.

Self-efficacy: Student's personal efforts to do extra work for the purpose of becoming the best in mathematics. The extra work can be demonstrated by doing more practise, teacher consultation among others.

Teacher development: These are extra trainings in mathematics that teachers undergo such as seminar, workshops in order to perfect their teaching skills and improve on their teaching methodology.

Guidance and counselling: This entails giving advice and direction to students on how to study mathematics and on how to overcome challenges associated with studying. Their main objective is to keep the student with a positive attitude required and not to lose hope in mathematics.

Performance: It is the actual grade that a student gets in mathematics at the end of a certain period of learning. The performance can either be above average, average, or below average

Teaching strategies: These are approaches used by mathematics teachers to pass the knowledge of mathematics to the learners. In this study teaching strategies are road map, which the teacher used to pass concepts and knowledge to the students.

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE

2.1 Introduction

In this chapter, the study reviewed different scholarly articles that were related to the teaching strategies and mathematics performance in secondary school. In particular, it focused on related studies that have been done on review of related theories, teaching strategies and mathematics performance, how teaching strategies do affect student's performance in mathematics, factors affecting the choice of mathematics teaching strategies, challenges facing mathematics teachers in choosing teaching strategies, and measures for improving teaching strategies.

2.2 Review of The Related Theories

Theories that are related to the study include Piaget's theory of cognitive development and Vygotsky's theory of learning.

2.2.1 Piaget's Theory of Cognitive Development

Piaget's theory of cognitive development was first developed in 1936 by Jean Piaget's who asserted that cognitive development occurs owing to biological mutation and interface with the environment (Mcleod, 2018). According to Lefa (2014), Piaget's theory adopts that all children undergo the same order of development but at a diverse rate. The teacher role is, therefore, to offer classroom individual learning activities and small groups rather than for the whole class group (Graduate Student Instruction, 2016). The student on the other hand is given an environment to construct their knowledge during the interaction. Comparing this to CWT, Jean Piaget's theory of development is not particular on how a teacher should organize his/her teaching strategies so that they do not cause a cognitive load

to the learner. CWT is keen at looking at how a teacher should organize teaching strategies bearing in mind that students are new to the content, which should be delivered logically.

Another argument of cognitive development theory is that knowledge encompasses an active system of internal intellectual illustrations resulting from a past learning experience (Graduate Student Instruction, 2016). Therefore, each learner interprets and organizes experiences and information in the light of their existing knowledge, their stage of mental development, their cultural background, and their individual history to construct new knowledge. It is in the view of the researcher that some concepts in mathematics are very new to learners' knowledge. This implies that mathematics teachers have the responsibility to introduce these new concepts to learners. It is, therefore, recommended that they use effective teaching strategies that help the learner grasp the basics. This is what CWT recommends, that content should be taught from simple concepts to complex concepts for the understanding of the learners.

2.2.2 Vygotsky's Theory of Learning

Vygotsky's theory of learning was developed in 1978 by Lee Vygotsky whose main argument was that children learn from their interaction with society and their culture and that with help, they can learn from the environment (Graduate Student Instruction, 2016). According to UNESCO (2017), Vygotsky suggests everything is learned in two-levels. The first level entails interface with others and then the knowledge is integrated into an individual's mental structure. The first level of learning can be compared to construction of scheme recommended by CWT in the short term memory that can letter be stored in the long term memory that can be retrieved by the students during the problem solving. CWT theory comes in handy to aid in information acquisition.

Secondly, the potential for cognitive development is restricted to a zone of proximal development (ZPD). In this instance, UNESCO (2017) in Briner (1999) opines that this zone

is an area of examination for which the student is cognitively ready but requires assistance and social collaboration to fully develop. In the opinion of the researcher, the help required by the students ought to be logically arranged in the strategies used by the mathematics teachers to bring out logical understanding in learning which is advocated by the CWT. Depending on the strategies used for information construction, the student is able to overcome the challenges of forgetfulness if the strategies used enforced memory storage or could otherwise challenge the learners.

2.3 Review of Empirical Studies

The research reviewed studies in relation to teaching strategies and mathematics performance, how teaching strategies go affect student's performance in mathematics, factors affecting the choice of teaching strategies in mathematics, challenges facing mathematics teachers in choosing teaching strategies, and measures for improving mathematics teaching strategies.

2.3.1 Learner Centered Strategies and their Effect on Performance in Mathematics

The two student centered teaching strategies include the group work and peer teaching among others strategies

2.3.1.1 Group Work and its Effect on Performance in Mathematics

Enríquez, Valencia1 and Oliveira (2018) conducted a study on strategies used by teachers of mathematics in the implementation of tasks in Columbia. The study sought to identify and describe the strategies used by mathematics teachers in implementing a task. Three mathematics teachers at elementary and secondary education were observed teaching in the various classrooms. Qualitative data were collected through open-ended questionnaires and direct observation. The data were analyzed thematically and meaning drawn from the statements made.

The study revealed that the teachers categorized teaching strategies into, co-instructional, pre-instructional, and post-instructional. Within the pre-instructional strategies, they located all those strategies three that teachers used before implementing the task, which included: organization of students in small groups, stating the objective of the task and sharing reading of the task. This set of strategies strengthened the beginning of the development of the task; since they motivated, informed, guided, and encouraged the students to explore the proposed task. In this research study, the researcher sought out whether teaching strategies have been classified in the same category and what were specific tasks geared toward pre-instructional strategies.

The second tradition of co-instructional teaching strategies was used during the task. This tradition of teaching strategies had a wide diversity of strategies such as usage of irregular questions, elevation of collaboration between students, analogies linked to everyday life, legitimize the answers obtainable by students, everyday expressions over mathematical reiterations, and provide hints through the task, daily expressions through mathematical reiterations. At this point the uses of these strategies rest upon the teacher's methodologies.

The third set of instructional was post-instructional involves finding strategies such as socialization of the assignment and clear of doubts, both are closely related since it was through the socialization of the assignment that the students voice out their different doubts about the progress of it. In this research, the researcher found out how mathematics teachers organized instruction for mathematics in secondary schools of Bahati Sub-County.

2.3.1.2 Peer Teaching and Its effect on performance in Mathematics

In Western Oregon University, McAfee (2012) conducted a study on teaching strategies for the high school mathematics classroom that focused on two teaching strategies: Inquiry-Based Learning (IBL) and the use of Real-World examples. The study

focused on the creation of two unique lesson plans where one was inquiry-based learning and the other one used real-world examples. In the view of the researcher IBL and real-world example strategies can be applied to most intermediate school or high school mathematics classrooms. Both IBL method and Real-World applications enthusiastically engage students in what they are learning and thus, allow them to create meaningful learning experiences. Further findings from this study indicated that effective teaching and learning strategies in mathematics and science employed by IBL develop the core competencies that help learners become more creative, more positive, and more independent. The outcome of the use of IBL and real world example challenged the researcher to interrogate the teaching strategies used in Bahati Sub-County whether they empowered students to be creative, positive and independent in solving mathematics.

Another study done in Kenya by Kathare (2012) looked at effect of teaching methods on academic performance in mathematics among learners with hearing impairment in Meru County. The study was based on Burhurs Fredric Skinners' theory of motivation in learning. This study was guided by a descriptive survey design. The target population consisted of head teachers, quality assurance and standard officers, and teachers teaching mathematics to hearing impaired learners. The researcher used purposive sampling procedure to sample participants from the population. The data was collected using questionnaires, interview guides, and observation checklists. The reliability was tested using test-retest method during piloting stage. Data collected in the field was sorted out, coded and analysed in form of tables, charts frequencies, percentages and text.

The study found out that the teachers, to alleviate specific mathematics difficulties in learners use interactive teacher-learner aspects, such as peer tutoring. These interactive methods were possible because of effective communication, availability of learning /teaching resources, effective training and student attitude. The study contributed

tremendously in this study for it helped the researcher look at how languages in which mathematics concepts are delivered have any effect on the students' performance.

2.3.2 Teacher Centered Strategies and their Effect on Performance in Mathematics

The two teacher centered teaching strategies include the teacher explanation and demonstration among others strategies

2.3.2.1 Teacher Explanation and its Effects on Performance in Mathematics

A study conducted in Madrid Spain by Cordero, Cristobal and Gil (2015) on teaching strategies and their effects on students' achievement distinguished between contemporary dynamic learning that entails endorsing the engagement of students in their learning by means of practices such as group-work, use of communication technology, student self-assessment, and traditional instruction based on repletion, lecturing, and memorization. The study used questionnaires for teachers that sort information on their background and instructional activities. The fallouts specify that traditional teacher-centered strategies have a constructive and significant consequence on student achievement, while the consequence of contemporary strategies is lesser and concentrated in high achieving students. The result of this study seems to be in favour of teacher centered methods of learning especially for poor performing students. In this study, the research sought to find out which mathematics strategies were used by the mathematics teacher, and why different schools use a particular strategy.

A desk research study by Sarode (2018) on teaching strategies, styles and qualities addressed essential qualities of a good teacher with focus on teaching strategies, styles, and activities which were useful in higher education. The study suggested various categories of teaching strategies to improve quality of higher education such as effective teaching strategies, balanced and integrating the curriculum, use of digital technology in the

classroom, and best practices teaching strategy. The study further observed that teaching differed from teacher to teacher and also from students to students. There are various teaching styles used in teaching learning process such as the authority or lecture style, the facilitator or activity style, the delegator or group style, and the hybrid or blended style. Although the study was done in higher education it helped the researcher investigate more on the teaching strategies employed by the teaching in secondary school level especially on their effectiveness, integration and efficiency in teaching mathematics.

In Bomet, Bii, Mukwa and Too (2019) conducted a study on the consequence of Collaborative Concept Mapping (CCM) teaching strategy on secondary school students' development of the cognitive and affective domain. Precisely, the study hunted to find if there were any alterations in students' achievement in mathematics, as gender-wise and as a group, and conventional methods of instruction and students' attitudes towards using CCM teaching strategy and. The study was guided by the constructivist theory, which views learners as active constructors of meaning from input by processing it through existing cognitive structures and retaining it in the long-term memory. The study employed a quasi-experimental Solomon Four-Fold research design. The sample comprised of 161 for three students and 4 mathematics teachers who were randomly selected. Students' attitude towards mathematics questionnaire (SATMQ) was used to collect data.

Descriptive and inferential statistics were cast-off in data analysis, which encompassed of ANOVA, means, and t-test. It is in the view of the researchers that the level of attainment in the attitude towards mathematics and learning of mathematical scored higher when the students are taught using the CCM teaching strategy than when the conventional method is used. It was the view of the researcher that gender has minimal influence on the teaching strategy employed. These findings are significant to this research because they helped the researcher compare the conventional methods employed by the

teacher and CCM methods. The study also helped the researcher to find out the attitude of the learners on teaching strategies used by their teachers.

2.3.2.2 Teacher Demonstration and its Effects on Performance in Mathematics

In Turkey, Ünal (2017) did a descriptive study on teachers' preferred pedagogical methods and techniques in mathematics. The objective of the study was to determine teachers preferred techniques and pedagogical methods in mathematics. A qualitative research design was employed where a primary case study method was used. The researcher randomly selected 40 teachers from several secondary schools during the 2015-2016 educational terms. Data was collected via a semi-structured interview. The validity of the research was determined by evaluator's objective while determining the data source clearly ensured the reliability. A categorical descriptive analysis technique was used in which participants' views were divided into groups and sub-groups, and quotations were included to ensure opinions were reflected accurately.

The analysis revealed that teachers preferred techniques such as "Question and Answer" and "Demonstration," that offered relative ease of use. Techniques such as "Scenario" and "Case Study" were out-dated, as they required better groundwork and usage of educational materials. This study conducted by Ünal (2017) is important because it will inform this study on the qualitative method to be used and at the same time help the researcher to investigate the effectiveness of the "Question and Answer" strategy as well as "Demonstration" approach in teaching and learning mathematics. This study on the other hand, only focused on "Question and Answer" and "Demonstration". It did not look at how these teaching strategies played in enhancing of students' performance, which is the focus of this study.

A study conducted in Zambia by Mukelebai and Marvin (2020) assessed the effectiveness of teaching methodologies of mathematics on learners' performance in

mathematics at senior Secondary. The specific objectives were to assess the different types of teaching methodologies of mathematics, to examine learners' performance in mathematics at senior secondary school level, to determine the challenges learners face in mathematics at grade 12 and to determine the role of the government through the ministry of general education in mitigating the challenges learners face.

The study adopted a case study research design and target population was 83 comprised of 40 pupils, 30 parents, 8 teachers, 4 head teachers and DEBS officer. The study employed purposive sampling procedure in the selection of head teachers, DEBS and teachers while simple random sampling was used to select parents and pupils. The primary data collection procedure was by the way of interview guide and questionnaire for respondents. Secondary data were collected from journals, textbooks and other online publications from the web. The open-ended responses were analyzed thematically while closed ended responses were analyzed by the use of Anova and statistical package version 20.

The study findings showed although teachers employed various methods in teaching mathematics such as inquiry, discovery, group work and demonstration, teachers often began instruction without tapping on the learners' prior knowledge to connect previous learning to the new mathematical skills. Consequently the learners we noted to compute at a very low pace that was slow and laborious due to this kind of teaching approach. The strategies although were good but how they were used didn't yield to the good performance of the students. The study findings also showed that other contributory factors leading to poor performance in mathematics were home background, lack of textbooks in homes, poor reading culture and teaching methods employed by teachers. This study aided the research on investigating the effectiveness of teaching strategies on mathematics performance of students in Bahati Sub-County. Although the recommendation of the study was the

government to train more teachers, this study recommend that more teachers should be employed since the county has enough teacher graduates waiting for employment.

2.3.4 Teaching Strategy and Students' Mathematics Performance

In Asia, Pagtulon-an and Tan (2018) conducted a study on students' mathematics performance and self-efficacy beliefs in a rich assessment tasks environment. The purpose of the study was to investigate the students' mathematics performance and self-efficacy beliefs in a rich assessment tasks environment (RATE) in Central Mindanao University Laboratory High School. The target population was grade 8 students. The research used a quasi-experimental research design where experimental group were exposed to rich assessment tasks environment while the non-experimental group were not. Students in both groups were given pre-test on mathematics and self-efficacy beliefs before the conduct of the investigation. The research instrument used was a questionnaire. Analysis of covariance (ANCOVA) and descriptive statistics were utilized to analyze the data.

From the research findings students from both groups had low performance in their pre-test but marked high performance in both post-test and retention test after intervention period. Students were observed to have positive self-efficacy beliefs before and after intervention. The analysis of covariance indicated students who were exposed to RATE performed better than those exposed to non-RATE. The study concluded that RATE potentially increase the performance and improve the self-efficacy beliefs of the low performing students. This study done by Pagtulon-an and Tan (2018) used experimental design to look effect of RATE on student performance and also the self-efficacy while the current study looked at students' mathematics performance and the strategies used in teaching mathematics using a cross-sectional survey design. Although the study looked at how student's self-efficacy influences the performance of students it was importance in

investigating how teaching strategies in mathematics have also influence students mathematics in Bahati Sub-County.

In Australia, Alzahrania and Stojanovskia (2019) conducted a study on the evaluation of Mathematics teaching strategies in Australian High Schools. The study explored aspects of teaching which include classroom management, student-teacher relations, teacher support, cognitive activation, disciplinary climate, formative assessment, teacher-directed instruction and student orientation. Parent economic status and education level were also considered as possible stimuli of performance and were found to have noteworthy effects on mathematics performance with students whose parents were more highly educated recording advanced results, on average.

The findings of Alzahrania and Stojanovskia (2019) revealed that student-teacher relations cognitive activation, vignette classroom management and disciplinary climate were found to have a noteworthy positive influence on mathematics performance. Student orientation had a noteworthy negative effect on mathematics performance and greater use of it was associated with lower mathematics achievement. The results of this study can offer valuable understandings into how teaching strategies, sideways with other factors, can be amplified to help improve confidence in, and hence, performance in mathematics.

A study was done in South Africa by Arends, Winnaar and Mosimege (2017), and it looked at teacher classroom practices and mathematics performance in South African schools: A reflection on TIMSS 2011. The study used a two-stage stratified systematic sampling method with schools selected in terms of probability to size at the first stage and intact grade nine class random selected at the second stage. The data was collected using questionnaires that sort information about teacher practices that included teacher clarity, classroom discussion, feedback, formative assessment, problem solving and metacognitive strategies, and collaboration. From the research finding, there is a positive association

between teachers' high endorsement of the selected classroom practices and learner performance. Although this study looked at high endorsement, it didn't look at how the teaching strategies could be affecting students' mathematics performance. The study also didn't look at the effect of low endorsement of students' mathematics performance. This current study looked into how teaching strategies is affecting students mathematics performance in secondary schools of Bahati Sub-County.

In Nigeria, a study was conducted by Akanmu, Abinde and Fajemigadba (2014) on teaching strategies and student mathematics performance in junior secondary school. The study looked at teacher teaching strategies and students performance in mathematics in senior secondary schools. A quasi-experimental design was used and the data was collected using mathematics academic performance test which consisted of 5-items theory questions on simple equations and variation drawn from West Africa Senior School Certificate Mathematics Examinations past question.

The finding of the study revealed that a significant difference in favour of those exposed to simulation method compared to those taught using simulation method. The study findings showed that the simulation teaching strategy was beneficial to all ability levels irrespective of the academic standard of whether students were weak or not. The study recommended that simulation method of teaching can be adopted in teaching only simple equations and variation but to teacher other concepts in mathematics. The study conducted by Akanma, Abinde and Fajemigadba (2014) looked at teaching strategies and students mathematics performance in junior secondary school. The study did not specify the teaching strategies that were used for simulation but in this current study on teaching strategy and students' mathematics performance was very specific on the strategies used.

In Ghana, a study was conducted by Awoniyi and Butakor (2021) on the role of teacher-student relationship on performance in mathematics of the eleventh graders in the

Cape Coast metropolis. The study focused on component of teacher-student relationship that would make a difference in the performance of the eleventh grade. A sample size of 2,575 students was randomly chosen to fill a questionnaire on teacher-student relationship and write an achievement test in mathematics.

Findings revealed that trust, fear and lack of respect negligibly and statistically correlated with achievement scores; unhealthy context and challenge correlated negligibly (but not statistically), while support did not correlate. The sub-constructs jointly shared a variance of approximately 8% with achievement scores. With a focus on developing critical minds and democratic future leaders, there is a need for pre-service and in-service training on the teacher-student relationship. The study looked on teacher-student relationship on the performance of students in mathematics. The current study was keen to be look specifically on teacher teaching strategies and mathematics performance of students in secondary schools of Bahati Sub-County.

A study was conducted in Rwanda by Gichuru and Ongus (2016) on the effect of teaching quality on student performance in mathematics in the primary 6 national examinations. A correlation comparative research design was used and a multi-stage random sampling technique was employed to select the sample size of 63 mathematics teachers, 28 head teachers, and 302 pupils. Five teacher qualities were studied: communication skills, teacher preparedness, teacher qualification, teacher practise, teacher experience, and teaching practice. The study employed a correlation with comparative research design. Questionnaire and interview guides were used as data collection instruments. Data were analyzed using multiple regression analysis, frequencies, weight means, standard deviations, and percentages. The interview guide was analyzed using content analysis. Quantitative data was analyzed using Statistical Package for the Social Sciences Version 21.0 (SPSS V.21.0) software as a tool of analysis.

From the study findings done by Gichuru and Ongus (2016), it was distinguished that teachers with effective teaching practice recorded a higher student performance as contrasting to teachers who resort to ineffective teaching practice. Additionally, teachers with more teaching experience influence pupil's performance than fresh graduates. Equally, teachers' communication skills recorded a higher pupil's performance. There bettered performance in mathematics in those schools where the teachers were loyal to their duties, had a positive attitude towards mathematics, prepared well before going to teach, used lots of teaching resources that are relevant, and involved their pupils through evaluation and assessment. This study looked at how good practises and qualities affected the students' mathematics performance but the current study was keen at looking at how teaching strategies had affected students' mathematics performance.

Mbugua, Kibet, Muthaa and Nkonke (2012) studied factors contributing to students' poor performance in mathematics at Kenya Certificate of Secondary Education in Kenya: A Case of Baringo County, Kenya. The study determined the school-based features that affect students' performance in mathematics in secondary schools, and established the strategies that can be used to improve performance in mathematics, and their influences that affect performance in mathematics. A descriptive survey research design was adopted for the study. The target population was 1876 respondents which comprised of Form Three secondary school students in Koibatek District, 132 Mathematics teachers, and 9 head teachers. The data for the research were collected by the use of three questionnaires; head teachers, students, and teachers' questionnaires.

From the study conducted by Mbugua, Kibet, Muthaa and Nkonke (2012) poor performance was a feature of lack of motivation, inadequate learning and teaching resources understaffing, and poor attitudes by both students and teachers, degenerating practices. A remedy to this poor performance required sensitization of the local community to reject

practices that inhibit student's effective partaking in learning mathematics. This study looked on how school related factors affected student mathematics performance while the current study is looking on teaching strategies and mathematics performance of students in Bahati Sub-County.

In Kenya, Wekesa (2013) conducted a study on factors affecting students' performance in mathematics at KCSE level in secondary schools in Kakamega County. The study was anchored on Bruno's theory of Knowledge and Organization. The study utilised the survey design and data were collected using observation schedules, interview schedules, and questionnaires. The data was coded manually and descriptive statistics used for analysis. The statistical package for social sciences SPSS was utilised to analyse data and to establish the correlation coefficient of each independent variable on the stepwise multiple regression analysis as well as the interactive effect of independent variables. A pilot study was used to validate the appropriateness of the research instruments before the real research began. The research utilised a split-half method to determine the reliability of the research instruments which scored, r = 0.78. Qualitative and quantitative data were collected and the findings were presented by the use of percentages, frequencies, and descriptive narrative.

The study revealed that there was a robust positive association between the teacher's level of instructional strategies, classroom preparedness, and practice, which influence the students' academic performance in Mathematics. The study further indicated that personal character and attitudes of students towards Mathematics was strongly affected by fellow students' perception of the subject. Additionally, teacher's experience affects the choice of a teaching strategy to a great extent. The student-teacher ratio and student-textbook ratio did not directly impact student performance in Mathematics. From the results, the study concluded that teachers seldom incorporated varied learning activities in Mathematics lessons; their teaching methods and strategies were inefficient and ineffective. This study

conducted by Wekesa (2013) shaded more light in this study by showing the relationship between teacher's characteristic, attitude and lesson preparation have impacted on student's mathematics performance in secondary schools of Bahati Sub-County. This study, however, will not look at how the personal character of mathematics teachers affects the performance of students.

In Kenya, Odiembo and Simatwa (2014) conducted a study in Muhoroni Sub-County on the relationship between secondary mathematics teacher's gender, age, and students' achievement in mathematics. A descriptive survey design and correlation research design were employed. The study population consisted of 22 principals, 41 mathematics teachers, and 1344 form four students of which a sample size of 21 principal, 31 mathematics teachers, and 300 forms four students were selected through the saturated and random sampling respectively. The data collection equipment included questionnaires, document analysis guides, and interview schedules. The quantitative data were analyzed by means of descriptive statistics and inferential statistics while the qualitative data were analyzed was transcribed, analyzed, and reported in emergent themes and sub-themes.

The study revealed that age had very little influence on teachers' performance and what matted most were the competence, commitment, and responsibility that an individual teacher had. It was noted that some younger teachers performed better because they were able to establish a good rapport that influences learning outcomes as compared to senior teachers. It was further established that most of younger teachers repeatedly found teaching fascinating and become extra enthusiastic and have more up-to-date knowledge on their subject than older teachers. However, they may not be taken seriously by students because of their age and therefore disadvantaged as mathematics teachers.

It was in the view of the researchers that male teacher outperformed the female teachers because they use their stamina to assert their authority in teaching mathematics as

most of the students fear mathematics and try to find a lot of excuses for their poor performance. This researcher will help establish whether there is a difference in the performance of students in mathematics based on the age, and gender of the mathematics teachers. It also looked at how rapport between teacher and student affected the understanding of mathematics subject. This enlightens the researcher to look at how the good relationship between teacher and learners could lead effectiveness teaching strategies for enhancing performance in the subject. The study however did not show how commitment, competence, and responsibility could lead to choosing mathematics teaching strategies for good performance.

In Kenya, Mwololo (2017) conducted a study on strategies for enhancing performance in mathematics for learners with hearing impairment in primary schools. The target population comprised of the 9 teachers and all the 28 learners with hearing impairment from class 1-8. The researcher purposively sampled mathematics teachers and classes 5-8 learners who were mature enough to be interviewed to give the needed information. Questionnaire and interview schedule were constructed to collect data from mathematics teachers and learners with hearing impairment respectively. Data collected was analyzed using both Quantitative and Qualitative techniques using the Statistical Package for Social Sciences (SPSS) to get descriptive statistics such as percentage, frequencies and tabulations.

The study found out that gestures were used by teachers in teaching Mathematics to class 5-8 learners with hearing impairment instead of using multiple methods which are core to improving learners' holistic understanding of mathematical concepts and eventually enhancing their performance in the subject. It was also found that most of the mathematics teachers had difficulties in translating mathematics into sign language despite their qualification in special needs education. Similarly, learners with hearing impairment found it difficult to understand mathematical sign language due to limited mathematical

vocabulary. The study recommended that teaching methods should be interesting to stimulate learners' interest in mathematics and there should also be organized regular in-service trainings for mathematics teachers for class 5-8 learners with hearing impairment. It also recommends measures to increase teacher's motivation as well as undertaking proper follow-ups on teaching methods and resources. Although the study was conducted among students with hearing competence, it was necessary to conduct a similar study for students who are not physically challenged but experience challenges in understanding mathematics concepts and following mathematical procedures that could be affecting their mathematics performance.

A study was done in Kenya, Garissa County by Muema, Mulwa and Mailu (2018) on relationship between teaching method and students' performance in mathematics in public secondary schools in Dadaab Sub-County. The study was based on a conceptual model developed by Shavelson, McDonwell and Oakes (1987). The study adopted experimental research design with mixed approaches of data collection and analysis. Target population comprised of all head teachers, all mathematics teachers and form two students in ten secondary schools in Dadaab Sub-County. A total of 155 respondents were selected. Five school principals, all mathematics teachers and 30% of the students' constituted the study sample. Purposive sampling was used for the principals and mathematics teachers. Stratified random sampling and simple random sampling were used to determine student sample and subsequently place them into the research groups. All mathematics teachers and principals in each of the sampled schools were purposively included in the study.

Achievement tests, structured questionnaires, and interview guides were used to collect both qualitative and quantitative data from respondents. Qualitative data was thematically coded and quantized then entered in statistical package for social science (SPSS) alongside the quantitative data then was analyzed descriptively and inferentially and

presented using statistical tables, charts and graphs. The study established that there is a positive correlation between teaching methods and students' achievement in mathematics. This study did not look at specific teaching methods and how they helped the students to achieve good performance in mathematics. This study on teaching strategies and student's mathematics performance was keen at looking how each strategy used by the mathematics teacher impacted on the performance of mathematics.

Teaching using ICT's was strongly correlated to students' achievement than traditional methods of teaching. This indicated that teaching using ICT's could improve learners' performance. The study recommended that the government through the ministry of education should ensure that ICT resources in schools should be adequate enough in order for teachers and students to utilize them in the teaching learning process. The ministry of education to organize forums and create platforms that can be used to sensitize teachers on the importance of ICT in teaching. This would ensure teachers embrace ICT's and use them appropriately and frequently in their schools. The results of this study helped the researcher to find how far the ministry of education has been implemented the uses of modern methods of teaching and teacher development to enhance their teaching strategies in schools.

2.3.5 Factors Affecting the Choice of Mathematics Teaching Strategies

A study conducted in USA by Adhikari (2017) investigated the factors influencing the selection of English language teaching methods in a Nepalese EFL context. This study surveyed those aspects, influencing the teachers' selection of teaching methods in a Nepalese EFL setting. It also explored the perceived difficulties of English language teachers in the course of implementing CLT along with the strategies that the teachers have been practicing to overcome the existing problems in their English classrooms. The data were obtained online from the English language teachers in Nepal by employing a

questionnaire and a semi-structured Skype interview guideline as research tools. The information collected was reviewed and analyzed quantitatively as well as qualitatively.

The results of the finding revealed that the curriculum prescribed by the government is not the only factor that guides the selection of teaching methods and techniques among secondary level English language teachers in Nepalese EFL context. The number of students in a class, examination, teachers' beliefs regarding language teaching, the amount of time available to teach English, and the availability of resources including technology are the major factors influencing the selection of teaching learning activities in English classrooms. The other influencing factors are: students' interest, a total number of teaching hours assigned to the teachers, teaching experience of the teachers, and the role of school management. Although the findings of the study were more applicable in English as a subject, this study addressed the teaching strategies in mathematics and students performance in mathematics in Bahati Sub-County.

In India, Mondal and Majunder (2020) researched on factors that determine the choice of instructional strategies in teaching at secondary schools. The study adopted an interpretive paradigm where a qualitative research approach and a multiple case studies were used. Schools and teachers were purposively sampled. The study used face-to-face interviews as a primary research instrument, document analysis and observations that supplemented the interviews. Thematic analysis was used to analyze data.

The findings of the study revealed that learners who were highly responsive to instruction easily comprehend, when taught in complex ways. The study revealed that once the learners perform well, teachers used routine instructional methods. The study was not specific to what the complex ways were, and what the routine strategies that mathematics teachers adopted were. The current study looked at teachers' teaching strategies in mathematics and students' performance in secondary schools of Bahati Sub-County.

The study concluded that most teachers struggle in selecting appropriate teaching strategies when teaching. It was recommended that school administrators should engage subject specialists who will assist teachers in selection of appropriate teaching strategies for the types of learners they have. It was also recommended that school administrators should allocate only teachers who are qualified and experienced in teaching. Although the recommendations of this study were for school administrators to engage subject specialists in selection of teaching strategies, this study looked at how the Sub-County education officers were engaging teacher in the in-service training to improve on the teaching strategies.

A study conducted in Nigeria by Akani (2017) looked at factors that influence teachers' choice of teaching strategies in teaching chemistry in secondary schools. Two research questions guided the study, two hypotheses were stated and tested at 0.05 level of significance. The population of the study comprised all the 210 chemistry teachers. The instrument used for the data collection was a closed response questionnaire developed by the researcher and validated by 3 experts, it was pilot tested and it yielded alpha value of 0.90. The data analyses were done using mean, Z-test and one-way analysis of variance.

The results showed that lack of ICT knowledge, number of staff, availability of instructional materials, class size, availability of physical facilities, poor staff remunerations, professional training/qualification of teachers, the nature of topic being taught and inadequate educational funding were the major factors that determined the choice of teaching strategies. This study considered both public and private schools but in this study only the public secondary schools were studied. It was also observed that there is significant difference between the responses of the male and female chemistry teachers on thirteen items, while inter-zonal differences were also observed among teachers in the 3 education zones of the state. Although gender was a contributing factor on the choice of teaching

strategy, this study of teaching strategy did not focus on strategies used based on gender but on school categories. The researcher made the following recommendations based on the findings. The chemistry teachers and indeed all the science teachers should be encouraged to go for information communication technology training, more chemistry teachers should be employed to enhance the performance of students in the subject, both the state government and the ministry of education should build more classroom blocks and provide enough furniture and other necessary equipment in the school, among others. The recommendation made helped the researcher look at how far the ministry of education in Bahati Sub-County has been able to provide schools with both human and material resources that enable mathematics teachers choose the most appropriate teaching strategy.

In South Africa, a study done by Preez (2018) looked at the factors influencing mathematics students to choose teaching as a career. The study was impelled by the shortage of competent teachers in mathematics and poor state of mathematics education in South Africa. The sample size consisted of 40 postgraduate students doing mathematics as a major subject in three universities in Western Cape Province. The postgraduate students were asked to articulate reasons for their career choice by answering an open-ended question and completing an internationally validated FIT-choice questionnaire. Self-Determination Theory (SDT) and Expectancy Value Theory (EVT) guided the study.

The finding of the research revealed that student's motivations were remarkably consistent, regardless of the respondents' home language or social class. The choice of mathematics as a teaching subject in university was attributed to intrinsic motivation. This pointed out that understanding student's choice with respect to mathematics teaching as a career assists in planning and management of recruiting and retention of quality mathematics teachers. Most of the students who choose mathematics as a career are driven by their passion in the subject unlike the secondary schools where every student is

compelled to study. From the research finding of the current study, it was evident that motivation towards mathematics subject instigated the teachers to urge to use most appropriate teaching methods and even make plans on how to handle students in mathematics for better performance.

In a research conducted in Swaziland by Sithulisiwe, Zodwa and Nxumalo (2019) on factors that determine the choice of instructional strategies in teaching the SiSwati language in primary schools adopted an interpretive paradigm and a multiple case study. The main objective of the study was to establish factors that determine the choice of instructional strategies in the teaching of Siswati as a first language. The study was guided by Robert Gagne's model of instructional design of 1986. A purposive sampling procedure was used to select schools and teachers who participated in the study. The study utilized face-to-face interviews as a primary research instrument, observations and document analysis that supplemented the interviews. Qualitative data was analysed thematically.

Zodwa and Nxumalo (2019) observed that learner performance was the most predominant yardstick in the selection of an effective instructional strategy. The teacher use learner performance as a barometer of checking the best strategies and once a specific method is found to be producing results the teacher is not likely to change. This research did not attempt to contrast teaching strategies on selection of teaching strategies but placed learners' engagement as the main factor that determined the choice of teaching strategies. In the view of the researcher, the learner engagements and learners' comprehension should be the focus on the type of strategy used

A study done by Agango (2014) in Kenya looked at influence of interactive methods achievement in mathematics. The study gap showered that mathematics teachers teach mathematics without knowing enough about the subject or about the current ideas of teaching it. The aim of the study was to look at influence of interactive teaching methods

on Pre-school children's achievement in mathematics. The study adopted an *expost facto* research design. The study targeted a population of 18 preschools, 54 teachers, and 720 children. The instruments for the study were questionnaires, interview for teachers and document analysis guide. Data were analyzed using descriptive statistics. The statistics calculated were frequencies, means and percentages.

The findings of the study established that interactive methods greatly promoted the achievement of the child in mathematics activities. Most children who were involved in using interactive methods in learning recorded high mean scores in number work activities. This study didn't particularly showed which were the interactive methods used for students' improved performance. This current study on teaching strategies looked at the specific teaching strategies that were preferred by mathematics teachers. It further sorted more information why the mathematics teacher preferred these particular teaching methods in teaching mathematics. The recommendation of the study indicated that more teachers to be deployed in school since they would directly impact on children's achievement through change in teaching methods. From the current finding, it was observed that teachers' work load affected the choice of teaching strategies. The more the workload the more the teacher centered methods used to be able to manage the large class population.

Another research study done by Njiru, Karuku and Nyanga (2020) looked at performance ranking in school mathematics in Kenya; a device that concealed and naturalizes inappropriate teaching strategies. The purpose of the study was to demonstrate how performance ranking disguised and legitimized inappropriate mathematics teaching strategies. The study population consisted of secondary schools in Embu County in Kenya were a sample size was drawn. A simple random sampling procedure was used to select students and teachers of eight public secondary and two private secondary schools within the county. The research instruments included face-to-face semi-structured interview and

focused group discussion. Data collected were transcribed and subjected to qualitative data analysis.

The research finding indicated that competition by teachers to achieve a higher mean score was the main cause of examination malpractices such as leaking examination questions to students. In addition, teachers' desire for excellence in their subjects, and achieving top rank to receive prizes was found to be another reason behind teaching students to pass examinations rather than for conceptual understanding. This was an indicator that proper mathematics strategies were compromised for shortcut methods that left the students with shallow content in mathematics. Due to ranking promotion for individual teacher, the teachers resorted to private tuition to offer assistance to the weak students in mathematics to improve performance in the subject. The current study didn't look at how performance ranking affecting the teaching strategies since school ranking had been scrapped off. However, this study shaded a lot of insights on why teachers used inappropriate methods in mathematics instructions and why students had inadequate mathematics concepts.

2.3.6 Challenges Facing Mathematics Teachers in Choosing Teaching Strategies

A study conducted by Rameli and Kosnin (2016) in Malaysia on challenges in mathematics learning employed qualitative research using case study design, a stratified random sampling technique was used to select students in form four and form two, and an open-ended questionnaire was also used. The study revealed that the sources of challenges can be classified into five main themes and: the first theme is students' self-factors that can be subdivided into negative perception and low self-regulation. In negative perception, the students were noted to be bored in a maths lesson, sleepy, lacked interest, and having the wrong perception in the subject. On the other hand, students had low self-regulation that led to poor time management, lack of motivation, carelessness, lack of understanding, and experienced difficulty in doing mathematics. In this current study the researcher was able

interrogate further on teaching methods used by mathematics teacher as they contribute to students' positive perception of mathematics subject.

Secondly, teachers' theme that touched on teachers' behaviours, practices, and characteristics. Teacher behaviours are the behaviours that are shown by the teacher to the students including negative actions and negative talks. Teaching practices related are to teacher's regular behaviours during the teaching process that affects students' learning. While teacher characteristics are teacher personality and physical appearance. It was important to interrogate whether teacher's behaviour overshadowed the methods used in teaching mathematics that could be affecting their performance. Thirdly the theme of parents includes a lack of cognitive, emotional, and financial support. Lastly the theme of friends that resonates about negative attitudes, bad behaviours, lack of support and other factors caused by the nature of math and assessment pressure.

Rameli and Kosnin (2016) point out that these factors have great implications for practitioners and also researchers in assisting students to deal with their challenges, obstacles, and difficulties in daily school life specifically in learning mathematics. In this study, the researcher investigated the source of challenges that face mathematics performance in Bahati Sub-County and compare it with those from Malaysia.

In the USA, Barker and Townsend (2006) did a study on algebraic generalization strategies; factors influencing students' strategy selection. An experimental design was employed. The study sample consisted of 8 fifth grade students were purposively selected from a population of 80 students. The observation was done on how different students interact with their teacher leaders. From the research done, the researchers highlighted the complex factors that influence student strategy used which included: input value, the mathematical structure of the task, prior strategies, visual imagination of the situation, and social interactions with the teacher and other students. In this study, the researcher focused

on the student-related challenges that will influence the choice of teaching strategies that was employed by the teacher. The complex nature of factors influencing these strategies demonstrates that they exist in encouraging students to move towards more sophisticated strategies.

Another study conducted by Umugiraneza and Bansila (2017) in Kwazulu-Natal Schools in South Africa concentrated on exploring teachers' practices in teaching mathematics and statistics. To solicit the information from the participants, the researcher employed a questionnaire that consisted of open-end questions and closed-end questions to 75 mathematics teachers who taught from grade four upwards.

The research finding revealed that most teachers used a single strategy in teaching and assessing the students. This article brought into light that most of the teachers were inadequately equipped with current teaching methods and thus preferred teacher centered methods in teaching and assessing students. It also solicited more information on demographic factors such as gender, age, in the professional development course, and choice of a variety of teaching and assessment methods in student performance in mathematics. This study was relevant to this study for it helped the researcher to find whether in-service training were held in Bahati Sub-County and also find whether those training had any impact on their teaching and assessment methods.

In Uganda, Opolot-Okurut (2010) conducted a study on factors that hinder opportunities to study mathematics in primary schools in Uganda. The study comprised 36 diploma teachers from various parts of the county. Open-ended questionnaires were used to solicit information on challenges facing mathematics teaching and a face-to-face interview on the similar subject. The study findings unearthed challenges facing mathematics teachers as overcrowded classrooms, features of the pupils, the personality of the teacher, nature of the syllabus and curriculum, government policies on education, learning, and assessment

environment. The study recommended that these factors should be addressed to enhance the academic performance of the pupil. Although this study was done in the primary school level, it assisted the researcher to look at challenges facing student performance from the teacher, students, curriculum content, and the learning environment at the secondary school level.

A study was conducted in Tanzania by Isack (2015) on factors leading to poor performance in mathematics subjects in Kibaha secondary schools. A random simple sampling procedure was employed to select 4 secondary schools, 8 mathematics teachers, and 60 secondary school students. A purposive sampling procedure was employed to select 4 academic masters and 4 head of schools from the four-secondary school. Data was collected using questionnaires, focused group discussions interviews, documentary analysis, and observations. It is the view of the research findings that teaching and learning mathematics was experienced challenges such as poor teaching environment, mathematics department was not functioning well, insufficient self-practice, and students poor background in mathematics.

The researcher recommended that teachers should assess the background of their students before deciding teaching methods that can help students perform better in mathematics. Besides, students should put self-efforts and practice in learning mathematics. This study shaded more light on how school background and student background affect the performance in mathematics. It also challenges the study to look at how student self-efficacy has contributed to the mathematics performance of students in different schools in Bahati Sub-County.

Rotumoi and Too (2012) investigated the influence of resource availability on the choice of teaching methodology by the pre-school teachers in Baringo District. Exact objectives were to the determine the influence of teachers' professional training on teaching

approaches, determine pre-school teachers' characteristics, the influence of class factors on choice of teaching strategies, and the influence of play activities on the choice of teaching methods. The study was based on Piaget's theory of learning, which proclaims that children's mental concepts are established through their involvements in the environment and that involvements are necessary for intellectual development. The study was done among the ECDE children. The sampling procedure involved both simple random sampling and stratified sampling to select a sample size of thirty percent from 103 schools that consist of both public and private schools. Two teachers from the sample were selected to fill in the questionnaires.

The research revealed the accessibility and suitability of space and the number of ECDE children had a great impact on the teaching methods teachers adopted. Insufficient finance, poor storage facilities, and absence of commitment were sighted as the reason for the failure of the use of child-centered methods of teaching. Also, most rural pre-school centers were managed by primary school teachers who showed less concern. In this research, the researcher also found whether the availability of resources influences the choice of mathematics strategies for secondary school.

2.3.7 Measures for Improving Mathematics Teaching Strategies

In a study conducted by Halton Catholic Board (2017) on the mathematics action plan, it was noted that an increase of mathematical content and pedagogical expertise would have a great understanding of mathematical thinking. Engaging in responsible mathematics programs such as sound assessment practices would lead to greater ownership of student learning and therefore increase confidence and ability to use and apply mathematical knowledge, skills, and processes in a meaningful way. Monitoring learning, which involves early and on-going interventions, would help to identify student's misconceptions that teachers need to respond, target to instruction, and minimize gaps in understanding.

In a Brunei school located in Borneo Island Southeast Asia, a study was conducted by Mundiaa and Metussin (2019) on exploring factors that improve achievement in Brunei school. The study utilised a field survey to select participants. The study resolute the extent to which study approach, coping mechanisms, self-efficacy and learning styles were connected to academic achievement in mathematics. The study involved 7 secondary schools in Brunei Darussalum where principals, deputy principals, head of the department, and upper secondary mathematics teachers from the selected schools participated in the study. Besides, two classes of secondary school students ranging from 13 to 16 years of age participated in the study.

Step by step multiple regression analysis with regressive elimination identified six statistically significant main results to variables with associations to mathematics achievement (text book reading, task-oriented coping, self-efficacy, concentration, active learning style and time management). The findings of the current study indicated that self-efficacy was linked to mathematics achievement. Students who lack self-efficacy incline to become easily demotivated. On the other hand, they may be dependent on their peers for assistance. Therefore, teachers ought to design and device curriculum, instruction, and assessments that enable the development and maintenance of mathematics self-efficacy in students.

Another study done in Asia by Mundiaa and Metussin (2019) further, suggest that teaching and learning approaches that aid and allow students to be independent and self-reliant could be used (e.g., procedures that inspire the usage of deep dispensation and events that lead to the stimulation of intrinsic motivation or internal ascriptions regarding success or failure). Moreover, psychotherapy, counselling, information campaigns (e.g., videos), and hands-on workshops could also be cast-off to aid students to advance in self-efficacy.

In relations to learning styles, the results of the present study proposed that students could advance their mathematics attainment if they become dynamic rather than passive learners. However, dynamic learning should stress the attainment of higher-order skills such as computer knowledge, understanding, computation skills, correct interpretations, synthesis, analysis, application, evaluation and critical thinking. Since learning styles are adjustable and teachable, these skills could be advanced in a diverse setting such as individual learning, classroom instruction, and cooperative learning initiatives.

Active learning would be of great beneficial to susceptible students with high urgent needs who are at the verge of failing mathematics. These study findings are important to this study because they helped the researcher find out more intrinsic and extrinsic factors of learning mathematics that mathematics teachers should be conscious of as they use effective teaching strategies for better performance of mathematics in secondary schools of Bahati Sub-County. This research was keen on looking at how mathematics blended poorly performing students with high performing students.

A study was conducted in Nigeria by Udonsa (2015) on strategies to improve Nigerian students' performance in mathematics. The study utilized a survey design. The aim of the study was to point out some of the details for the upsetting rate of failure in mathematics particularly in public examinations and the conceivable ways to overcome them. The study participants consisted of 10 mathematics teachers and 20 non-mathematics teachers from the college of education. A questionnaire that had a Likert scale was used to collect the data from the teachers. The analysis was done by means of tables and frequency counts. The hypotheses were verified using Chi-square.

The research endorsed that the qualification influenced by a mathematics teacher has a great positive consequence on the learners. However, adequacy and availability of facilities such as the mathematics laboratories and library are essential on improving

students' poor performance in mathematics. Grounded on the results of this work, the researcher anticipated that qualified and adequate mathematics teachers ought to be hired in the schools. This study enriched the current study by helping the researcher investigate whether the schools in the current study area had adequate physical and human resources required for effective teaching of mathematics. This study however focused on secondary schools only.

In Ethiopia, Demisse and Demisse (2017) conducted a study on improving students' achievement in mathematics approach small-group and whole-class discussions. Action research was employed on one section of first-year mathematics students of Mettu University. In the first session, the observation was employed on students' activity and perception of small-group learning, which in the view of the researchers concluded that the students were overloaded and had a negative attitude towards small-groups and whole-class discussions, which exhibited low achievement.

An action was taken and students were divided into control group and experimental group. In the experimental group students were exposed to two representative questions and two representative examples for the five small-group learning and the whole-class discussion with suitable time allocation followed by appraisal, while the control group was sustained as usual as on the similar instruction, topics and sections of chapters for about 4 months and their four examination marks given at the end of each month, were analyzed using independent sample t-test.

The study exposed that only suitable and relevant small-group learning and whole-class discussion activity with clear classroom demonstration, equitable activity followed with classroom evaluation and time allotment can improve student's mathematics attainments than loading student with full of assignment and classroom instructional obstacle. Giving students' assignment has been viewed as cumbersome and burdening to

students, which in the view of the researcher could be an easy way created for students not having self-efficacy. This study was however relevant because it helped the researcher to explore more on how small-group discussions and whole group discussions are conducted in schools of Bahati Sub-County.

Majo (2016) did a study on factors influencing poor performance in science subjects in secondary schools in Shinyanga Municipality, Tanzania. The study employed a survey research design by applying the qualitative technique. Six public secondary schools out of 18 public secondary schools participated in the study, and a sample of 415 respondents were also selected from sample school. Constructive learning theory guided the study. Structured questionnaires were used to obtain information, and the criterion used in sampling was a simple random method.

The study concludes that the shortage of capable science subjects' teachers and insufficient teaching and learning materials were the main factors influencing poor performance in science subjects in secondary schools in the Shinyanga municipality. The study endorsed the following; the ministry of education should safeguard sufficient competent science subjects' teachers in secondary schools, and ensure there is enough teaching and learning materials like specimen, books, teaching aids, chemicals, and laboratory apparatus, with favourable learning and friendly environment at schools. Although the study was done on science subjects, it still had relevance because it helped the researcher look into resources that are required to help the mathematics teachers employ effective teaching strategies to enhance good performance in mathematics in secondary schools of Bahati Sub-County.

A study conducted in Busia County, Kenya by Jolif (2016) focused on factors contributing to poor performance on science subjects; a case of secondary schools in Busia County. The study used a cross-section research design. A total of 110 students from six

schools in the county, 15 students from three schools outside the county, and 45 science teachers were involved in the study. The study did not use any theory to support the study. Questionnaires and structured interview guides were used to collect the data. Data analysis was achieved by the use of Microsoft Excel and SPSS.

The findings of the study revealed that poor methodology, the negative attitude among the learners, unfavourable home environment and family background, chronic absenteeism, admission of weak students at form one entry, inadequate of instructional facilities and physical facilities as the main cause of poor performance in a science subject. On the other hand, the study recommended that schools should be equipped with necessary materials; teachers should use the modern techniques of teaching science subjects to motivate and sustain students' interest in the subject. Although the study findings were done on science subjects, they will be relevant in looking at whether the mathematics teachers in Bahati Sub-County are using effective teaching strategies that are motivating for good performance to be realized.

In Nairobi, Awour (2012) undertook a study on the factors influencing girls' performance in science subjects in the national examination of Kenya Certificate of Secondary Education in secondary schools in Westlands District, Nairobi County. A descriptive survey research design grounded on cross-sectional descriptive research was utilised and data was gathered using questionnaires administered to 218 students, teachers, and head-teachers of 10 secondary schools in Westlands District, Nairobi County. Data were analyzed using SPSS. From the research findings, it was observed that parental participation, consistent evaluation tests, in-service course and workshops for teachers, facilitations of adequate teaching resources, career counselling were effective approaches which can were used to improve the girls' performance in mathematics and science subjects.

2.4 Summary of Reviewed Literature and the Knowledge Gap

The researcher looked into literature on the teaching strategies and performance of students in mathematics. The literature specifically looked into teaching strategies used by mathematics teachers, how teaching strategies do affect student performance, factors affecting the choice of mathematics teaching strategies, challenges facing mathematics teachers in choosing teaching strategy, and measures for improving teaching strategies in mathematics.

Cordero, Cristobal and Gil (2015) looked into teaching strategies and their effects on student achievement. The teacher-centered method of teaching was observed to have positive and significant effects on student mathematics achievements. This study contradicted another study conducted by Ganyaupfu (2013) on differentiated effective methods on student mathematics performance which showed that student-centered methods and student-centered methods were more effective as compared to the teacher-centered method. This study was able to establish which teaching strategy employed by mathematics teacher is best for better mathematics achievement. Student-centered methods such as group work have been use because of their ability to help learners master the content of the course and apply content in particular context.

The study conducted by Bates (2019) on basic maths teaching strategies showed a variety of teaching methods such as repetition, group work, time testing, math games, and manipulation of tools. This study, however, did not indicate the education level and the specific topics in which these strategies are best used. The use of varied teaching in teaching mathematics is used since different topics in mathematics have different ways of structuring and thus require different approaches for learners to understand.

Ekwueme, Ekon and Nebife (2015) investigated a hands-on approach on students' academic performance and students' opinions about activity-based methodology. The

hands-on approach showered that there is an improvement registered when this approach was used. However, the study did not point out the specific activities and tools that were used in this approach. Hands on approach involve student-centered approach where students need to get engaged to varied activities for them to understand and handle a concept. It therefore involves different strategies that are more of learner centered.

Mukelebai and Marvin (2020) assessed the effectiveness of teaching methodologies of mathematics on learners' performance in mathematics at senior secondary school. Although mathematics teachers used varied teaching methods, they did so without connecting the previous knowledge to the new mathematics skills. Dispute of use of varied teaching strategies; students' still record dismal performance. The theory used in this study was insufficient on how to deal with linking previously learned knowledge, which the current study was able to look into.

In the study conducted by Adhikari (2017) looked at factors influencing the selection of English language teaching methods. It highlighted that although the curriculum prescribed by the government guided the selection of a teaching strategy, there were more factors that included class size, teachers' belief, time allocation, availability of resource among other that guided the teacher on choice of a teaching strategy. This study agreed with another study done by Akani (2017) that pointed out that workload, class size, resources, teacher qualification, nature of the topic, and teacher motivation are some of the factors that could contribute to a teacher choosing a particular teaching strategy. In addition, Mondal and Manjunder (2020) admit that school administrator should engage subject specialist in assisting teachers in selection of teaching strategy. The current study further investigated on the same area on how in-service courses, workload, school administration, teaching experiences among others have contributed to the choice of a teaching strategy. It is evident that the implementation of teaching strategies is affected by different other factors that

resonate around resources, class sizes, working environment that could affected the performance of mathematics in secondary schools.

Barker and Townsend (2016) pointed out challenges facing teaching strategies as emanation from the in-put value, structure of the task, prior strategies, visual imagination and social interaction. These challenges differ from Opolot (2010) who attributed that challenges of choice of teaching strategies are caused by overcrowding in class, nature of the syllabus, teacher personality, and government policies on education, learning and assessment. Isack (2015) observed that poor teaching environment, disorganization in mathematics department, insufficient self-practice and poor students background were the main challenges facing teaching strategies in mathematics. The findings were not generalized due to different social and geographical characteristic of areas where the studies were carried out compared to the current area whereby the research was conducted.

CHAPTER THREE

3.0 RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the research design and methodology that the researcher used to conduct the study to generate answers to the research questions. It is organized under the following headings: research design, the location of the study, target population, sampling procedures and sample size, description of data collection instruments, validity, piloting testing, and reliability of research instruments, data collection procedures, data analysis procedures, and ethical considerations.

3.2 Research Design

A research design is the master plan, which situates the researcher in the empirical world and connects the research question to data (Matula, Kyalo, Mulwa & Gichuhi, 2018). In this research, the researcher adapted a convergent parallel mixed-method research design. This is an approach to inquiry that combines both qualitative and quantitative methods almost equally (Creswell, 2014). In this design, while the quantitative design helped the researcher to find patterns, test causal relationship and generalize results to a wider population, the qualitative design helps to conduct an intensive in-depth investigation on the teaching strategies used in Bahati Sub-County secondary schools.

Precisely, to take care of the quantitative part of the study, a cross-sectional research design was used. According to Setia (2016), in the cross-sectional research design the investigator measures the outcome and the exposures in the study participant at the same time. The researcher, therefore, collected information from the study participant at the same time and analysed the information collected on teaching strategies that were used in secondary schools of Bahati Sub-County. The cross-sectional research design was used in

the collection of demographic information that included characteristics of mathematics teachers, teaching strategies, and students' performance. The fundamental quantitative research methods were based on the philosophical postulation that the world is moderately stable, unvarying, and articulate that the researcher could measure, describe, and make generalizations (Gay, 2009). Numerical data was utilized to perform statistical analysis as maintained by (Creswell & Clark, 2014) and consequently the results used to make generalizations to the entire population.

A phenomenology research design was used to collect qualitative data. Qutoshi (2018) opines that the phenomenological approach provides a theoretical guidance to researchers to comprehend phenomena at the level of subjectivity realities. Using this approach, the researcher used bracketing in describing the natural way of the appearance of phenomena to gain insights into lived experiences and interpret for meaning. The researcher thus used a phenomenological approach to gain insight into how different mathematical strategies are employed in teaching mathematics and the effect of each strategy on mathematical performance. The phenomenology was used in probing more on how school factors and student characteristics have affected the performance of mathematics in Bahati Sub-County.

3.3 Locale of the Study

This study was carried out in Nakuru County. Nakuru County is county number 32 out of the 47 counties in Kenya. It is located in the Great Rift Valley as indicated in the Appendix V. Nakuru County consists of 11 Sub-Counties of which Bahati is one of them (Nakuru County, 2019). The total area of Bahati Sub-County is 375.4 km^2 that is located between Nakuru town and Subukia Sub-County (Appendix VI). The Bahati Sub-County consists of 35 public secondary schools of different categories that include National, Extra-

County, County, And Sub-County. The study included all categories of public secondary schools within the location.

3.4 Target Population

The term population is defined as a cluster of people having a similar characteristic (Selvam, 2017). The target population describes those sets of units in which the results of survey data are to be used to make inferences and generalization (Cresswell, 2014). For this study, the target population comprised of 35 principals, 176 mathematics teachers, 1 Sub-County education officers, and 18,877 students in the 35 public secondary schools within Bahati Sub-County (Bahati Sub-County Education Office, 2020). The choice of Bahati Sub-County because this Sub-County has continuously been registering poor performance in mathematics subject at the KCSE level as indicated in table 3 in chapter one.

3.5 Sampling Procedures and Sample Size

A sample is a limited part of a statistical population whose characteristic are studied to advance information about the whole (Kothari, 2004). Selvam (2017) opines that the ultimate test of a good sample is how well the sample represents the characteristic of the population it portrays. On the other hand, Mugenda (2011) advocates that a researcher should take a bigger sample where time and resources allow avoiding sampling error which results from a small sample. The issue with a small sample is that they do not produce the salient characteristic of the accessible population to an acceptable degree. In this study, therefore, the researcher used both probability sampling techniques and non-probability sampling techniques to select secondary schools, Sub-County Education officer, Principals, heads of department mathematics (HODs), mathematics teachers, and students.

3.5.1 Sampling of Schools

The selection of the sample size of the school was done using the formula proposed by Krejcie and Morgan (1970).

$$S = [(X^2NP(1-P))]v?\,[(d^2(N-1)) + (X^2P(1-P))]$$

Where

S = required sample size

X^2 = the critical value obtained from the chi-square table for one degree of freedom at the desired confidence level (3.841)

P = the population proportion (assumed to be 0.50 since this would provide the maximum sample size)

d = the degree of accuracy expressed as a proportion (0.05)

N = population size

$$S = [3.841^2 \times 35 \times 0.5(1-0.5)] \div [(0.05^2(35-1)) + 3.841^2(1-0.5)$$

S = 17.3006

S = 17

Therefore, from the formula, a sample of 17 schools was selected to participate in the study. The schools were categorized into National schools, Extra County schools, County schools, and Sub-County schools. Only one national school existed in Bahati Sub-County, which was a girls' secondary school, and therefore it was purposefully sampled for the study. The national school was purposively sampled because it helped the researcher do a comparison to other categories on mathematics performance and strategies used by mathematics teachers in that school. The three Extra County schools consisted of two girls' secondary schools and one boys' secondary school. All three schools were selected purposefully for the study to show the comparison of the performance of boys and girls in

mathematics as well as to bring out the strategies used by mathematics teachers in these schools.

There was only one County school; it was purposefully selected for the study to show how mathematics subject has been taught at this category and the strategies that were used by mathematics teachers. For the Sub-County schools, a simple random sampling was employed on 30 Sub-County schools. According to Selvam (2017), the researcher should identify the sampling frame and assign a number to each element. The researcher wrote names of schools in small pieces of paper which were the folded and then put in a container. After which the papers were thoroughly mixed before they were randomly picked. The process resulted in 14 Sub-County schools that participated in the study. Other considerations that were made to determine the aptness of the schools to be involved in the sampling frame were gender boarding and whether the school was boarding or day schools. A total of 17 schools were sampled for the study as shown in table 4.

Table 4

Sampling of Schools

Schools	Target Population	Sampling Technique	Actual Sample	Percentage
National School	1	Automatic inclusion	1	100
Extra County school	3	Automatic inclusion	3	100
County School	1	Automatic inclusion	1	100
Sub-County School	30	Simple random sampling	12	40

Source: Bahati Sub-County Education Office, 2021

3.5.2 Sampling of Mathematics Teachers

The mathematics teachers were selected on the basis that they are experts in mathematics and because they can give in-depth information about how students perform after using different teaching strategies. Since the schools do not have the same number of

mathematics teachers, Krejcie and Morgan formula of 1970 was used to calculate the sample size requires as follows:

$$S = [3.841^2 \times 88 \times 0.5(1-0.5)] \div [(0.05^2(88-1)) + 3.841^2(1-0.5)$$

$$S = 42.7398$$

S = 44

A sample of 44 teachers was sampled for the study.

To determine the number of teachers who were to participate in the study from each individual school, the researcher used proportionate stratified random formula: (sample size/population size) x stratum size. To pick on the individual teacher a simple random sampling procedure was employed. Matula, Kyalo, Mulwa and Gichuhi (2018) assert that simple random sampling safeguards that each element in the population have an equivalent chance of being involved in the sample. The researcher was keen to balance the number of male and female teachers that were selected so that each gender is represented. In case one gender was less than the other was, it means that gender was purposefully selected while the rest were subjected to simple random sampling. A total of 44 teachers were selected to participate in the study as shown in table 5 according to each school category.

Table 5

Sampling Matric of Mathematics Teachers

Teachers in the School Categories	Target Population	Sampling Technique	Actual Sample	Percentage
Teachers in National Schools	10	Proportionate sampling	5	50
Teachers in Extra-County school	20	Proportionate sampling	12	60
Teachers in County School	14	Proportionate sampling	6	42
Teachers in Sub-County School	44	Proportionate sampling	21	47

Source: Bahati Sub-County Education Office, 2021

3.5.3 Sampling of the Heads of Department Mathematics

Purposive sampling was used to select the 17 heads of the department (HODs) of mathematics. According to Cohen, Manion and Morrison (2011), purposive sampling is done to those who have in-depth knowledge about specific subjects maybe by the virtue of their specialized role, power, and access to work experience or expertise. The mathematics HODs were selected because they are in charge of the department and thus had all the information on strategies used in teaching mathematics, mathematics performance record, subject allocation, mathematics targets, challenges facing the mathematics department, and strategies they are using to improve mathematics performance in the school. Besides, the mathematics HODs was answerable to the principal on the progress of their department. A total of 17 mathematics HODs were selected as shown in table 6.

Table 6

A Sampling Matrix of Mathematics HODs

HODs in the School Categories	Target Population	Sampling Technique	Actual Sample	Percentage
Teachers in National Schools	1	Automatic inclusion	1	100
Teachers in Extra-County school	3	Automatic inclusion	3	100
Teachers in County School	1	Automatics inclusion	1	100
Teachers in Sub-County School	12	Automatic inclusion	12	100

Source: Bahati Sub-County Education Office, 2021

3.5.4 Sampling of the School Principals

The school principals of the 17 sampled secondary schools in Bahati Sub-County were purposefully selected. The school principals were selected because they gave information on mathematics performance, the strategies the school have put in place to improve mathematics performance, and the challenges affecting the mathematics performance in the school. The sample picked was as shown in table 7.

Table 7

Sampling Matrix of Principals

Principals in the School Categories	Target Population	Sampling Technique	Actual Sample	Percentage
Teachers in National Schools	1	Automatic inclusion	1	100
Teachers in Extra-County school	3	Automatic inclusion	3	100
Teachers in County School	1	Automatics inclusion	1	100
Teachers in Sub-County School	12	Automatic inclusion	12	100

Source: Bahati Sub-County Education Office 2012

3.5.5 Sampling of Sub-County Education Officer

The Sub-County Education Officer was purposively selected for the study. Sub-County Education Officer has a direct role of in-service training of teachers of different subjects at the Sub-County level where varied approaches of teaching are emphasized. They also have a record of how mathematics has been performed for schools within Sub-County. The table 8 shows the sampling matrix of sub-county education officer.

Table 8

Sampling Matrix of Sub-County Education Officer

Sub-County Education Officer	Target Population	Sampling Technique	Actual Sample	Percentage
Teachers in National Schools	1	Automatic inclusion	1	100

Source: Bahati Sub-County Education Office, 2021

3.5.6 Sampling of Form Four Students

Form four classes were purposively selected for the study. According to Dudovskiy (2018), points out that purposive sampling is a sampling technique in which researcher lies on his or her own judgment when choosing members of population to participate in the study. The choice of form four classes was justified because they had covered larger content in mathematics and at the same time have had a longer period of interaction with different teaching strategies used by their mathematics teachers. It was, therefore, possible for them to point out the strategies that had been used by their mathematics teachers and also give an account of their performance.

To come up with sample size, the researcher used a Krejcie and Morgan formula of 1970. A sample size of 312 students was selected for the study. A stratified random sampling procedure was used to select the form four students who participated in the study from various schools. The schools were grouped into strata as national school, extra county

schools, county schools, and sub-county schools first. Since different schools have different population of form four students and varying number of streams, the researcher employed proportionate stratified random sampling formula to come up with sample size for each school.

The Formula for sample size: $n = \frac{N}{1+N(e)^2}$

Where: n = Sample size to be studied

N = Population size

e = margin of error

To pick the individual students who participated in the study a simple random sampling procedure was used. By the end of the sampling exercise the sample participants were as shown in table 9 according to each school category.

Table 9

Sampling Matrix of Form Four Students

Schools Categories	Target Population	Actual Sample	Percentage
National School	192	31	16.1
Extra County school	340	92	27.0
County School	189	33	17.4
Sub-County School	610	156	25.5

Sources: Bahati Sub-County Education Office, 2021

3.6 Description of Research Instruments

The Researcher used the questionnaire, interview guide, and document analysis guide in collection of information from the respondent's teaching strategies that have been used in enhancing student's mathematics performance in Bahati Sub-County.

3.6.1 Questionnaires

The researcher developed two sets of questionnaires: one questionnaire for the mathematics teachers and the other questionnaire for students. The questionnaire had both

open-ended and close-ended questions to facilitate the collection of qualitative and quantitative data. As Orodho (2012) argues, a questionnaire usually has better reliability because it permits the assortment of all areas and representative samples. The questionnaire enabled the researcher to ask a large group of teachers and students questions related to the teaching strategies that were used to enhance mathematics performance in schools in Bahati Sub-County. The questionnaire facilitated the researcher to generate answers to research questions from teachers and students for a full variety of possible answers, as asserted by Creswell (2014).

The questionnaire for teachers and students had items that were both closed-ended and open-ended questions although different questions were asked. The questionnaire was divided into six sections labelled A, B, C, D, E, F and G. Section A consisted of demographic information items. Section B solicited information on strategies used by mathematics teachers in teaching and learning mathematics. Section C sought more information on how teaching strategies affect students' performance in mathematics in secondary schools of Bahati Sub-County. Section D solicited information on what affects the choice of mathematics teaching strategies in schools. Section E assessed the challenges facing teachers in choosing teaching strategies. Finally, section F looked into measures that can be put in place to improve teaching strategies in secondary schools of Bahati Sub-County.

3.6.2 Semi-Structured Interview Guide

According to Denscombe (2010), an interview guide can be used by the researcher if they need to gain insight into things such as people's opinions, feelings, emotions, and experiences. In this study, the researcher used a semi-structured interview guide for HODs mathematics, the school Principal, and Sub-County Education Officer to solicit information on the teaching strategies used in teaching mathematics in Bahati Sub-County. Nigel (2010) points out that the researcher should have a list of questions or specific topics to be covered.

The researcher, therefore, prepared a list of questions that revolved around the teaching strategies used in teaching mathematics, how teaching strategies affect students mathematics performance, what affects the choice of mathematics teachers in choosing a teaching strategy, challenges faced by mathematics teachers in choosing a teaching strategy, and possible measures that should be put in plane to improve teaching strategies in secondary schools of Bahati Sub-County.

3.6.3 Document Analysis Guide

Kothari (2011) observes that documents are becoming an important primary source of data for qualitative research. The researcher used a document analysis guide to offer some answers that may not have been obtained from the questionnaire or interviews for more factual information. The researcher analyzed professional documents which include; performance of students in K.C.S.E. for the last five years, workload for mathematics teachers, and number of students in each class.

3.7 Validity, Pilot Testing, and Reliability of the Instruments

This section dealt with validity, pilot testing, and reliability of the instruments. According to Selvam (2017), the researcher must ensure that the validity and reliability of the data collection instruments are carried out by running a trial run of the instrument on a smaller sample. This ensured the credibility of the research findings. The validity, pilot testing, and reliability of the instruments were presented in the following sections.

3.7.1 Validity

Validity is the accuracy and meaningfulness of inferences, which are based on the research results (Mugenda, 2011). The researcher tested the face validity, construct validity and criterion validity of the research instruments. In the view of Oluwatayo (2012) face validity refers to researchers' subjective assessments of the relevance and presentation of

the measuring instrument as to whether the objects in the instrument seem to be reasonable, relevant, clear, and unambiguous. In testing, the face validity of the research instruments, the researcher requested the subject specialist to read the questionnaire to check layout and style, clarity of wording and ability of respondents to answer questions. Their comments were used to correct the instrument before data collection is done.

The researcher involved her two supervisors in testing the content validity of the items present in the research instruments. Taherdoost (2016) points out that, content validity involves literature reviews and then follow-ups with the evaluation by expert judges or panels. The procedure of the judgemental approach of content validity requires researchers to be present with experts to facilitate validation. The involvements of the two supervisors were thus informed by the knowledge on the construction of instruments and are versed with the literature required for the study.

Criterion validity refers to the use of a measure in assessing subjects' behaviour in a specific situation (Mugenda, 2011). Two types of validity can be tested in criterion validity: concurrent validity and predictive validity. Concurrent validity refers to a comparison between the measure in question and an outcome at the same time while predictive validity refers to the ability to predict something that we expect to occur (Selvam, 2017). Criterion validity tested by administering the research instrument to the two schools and data from the instrument obtained was evaluated whether it has elicited the right responses required.

3.7.2 Pilot Testing

Pre-testing was done to ensure that items in the questionnaires were stated clearly and hold the same meaning to all participants. A trial run of instruments was a necessary part of the preparation to go to the field. This was one of the most appropriate ways to ensure the accuracy of the tools that were used in both quantitative and qualitative data collection

processes. It was important to make such a trial run to identify problems associated with the research process. Furthermore, it significantly increases the trustworthiness of the findings for a study that has been piloted than a one-time study (Donald & Theresa, 2013).

The pilot testing was conducted in two secondary schools in Bahati Sub-County whereby, questionnaires were piloted in the two schools that didn't participate in the actual study. In the pilot schools, two principals and two HODs were interviewed using the instruments before they were finally used to collect the data. The questionnaires were also administered to six teachers and ten students from the two schools. This was done after the approval of the proposal. The returned instruments were used to check for typographical errors, spelling mistakes, ambiguous questions, and length of administration, layout, format, and appropriateness of items. Based on the observations and feedback, the instruments were revised and adjusted accordingly.

3.7.3 Reliability of the Instruments

Reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trials (Orodho, 2012). The lesser the variations produced by an instrument on subsequent trials, the more reliable it is. Reliability of measurement concerns the degree to which a particular measuring procedure gives a similar result over several repeated trials (Orodho, 2012; Cooper & Schindler, 2006). The reliability of the quantitative instruments was tested from two public secondary schools that were chosen for pilot testing. Internal consistency reliability was used to test the reliability of the questionnaires. The questionnaire for the teachers was tested on 6 teachers and the questionnaire for the students was tested on 10 students separately to get the correlation coefficient for each instrument. The results were analysed using the following Cronbach's alpha formula in the SPSS and presented in table 10.

Table 10

Cronbach's Alpha Analysis

Variables	Number of Items	Cronbach's Alpha
Student-Centred methods	16	0.828
Teacher-Centred methods	16	0.832

Source: SPSS Out-Put, 2021

From the calculation done using SPSS to establish Cronbach value, α=0.83 was found. Keith (2011) suggests that Cronbach alpha α=0.7 is fairly reliable. The researcher involved two Principals from pilot schools to check the reliability of instruments that solicited qualitative data.

3.8 Data Collection Procedures

The researcher was obtained a letter of introduction from the department of Post Graduate Studies in Education, at the Catholic University of Eastern Africa. She then proceeded to collect a permit to allow her to collect data from the National Council for Science Technology and Innovation (NACOSTI). The researcher further obtained permission from the Nakuru Education office to research in the Sub-County. The researcher then visited the participating schools for familiarization, and booked appointments with the principals to research the schools at the agreed date and time. This helped to eliminate cases of surprise visits into schools without prior notice to clarify the intent of the visit.

The researcher administered the questionnaires in-person to all teachers and students from the sampled schools under study and gave them ample time to respond to the instruments. The filled questionnaires were then picked. For the interview, the researcher made an appointment with the Principals, HODs and Sub-County education office and held a face-to-face interview with them. The researcher took notes and recorded the information obtained in the interview accordingly.

For the document analysis guide, the researcher checked if the principals, HODs and Sub-County Education Officers have a professional document on performance of students in K.C.S.E. for the past five years, workload of mathematics teacher, number of students currently present in each class. The data obtained was coded, analysed and presented and thereafter conclusions were made about the teaching strategies and mathematics performance in the school.

3.9 Description of Data Analysis Procedures

Data in this study was analyzed using quantitative and qualitative methods. Analysis of data involves systematic organizing, summarizing, and scrutinizing responses obtained from respondents, whether in text format (qualitative data) or numbers (quantitative data), to conclude (Matula, Kyalo, Mulwa & Gichuhi, 2018). Quantitative data analysis procedures entailed data editing, coding, and entering in the Statistical Package for Social Sciences (SPSS) Version 21. The entered data in SPSS was then analyzed using descriptive statistics: means, percentages, and frequencies. Analyzed data was then presented in frequency tables, bar graphs, and pie charts. The descriptive statistics enabled the researcher to describe the effectiveness of teaching strategies in enhancing mathematics performance in secondary schools Bahati Sub-County. The inferential statistics was presented as variance, standard deviation, and P-value

The qualitative data obtained from open-ended questions, interview guide, and document analysis guide was summarized in themes based on research questions. Following the steps proposed by Creswell (2014), the researcher organized and prepared data from transcribes and field notes for analysis. Having read through the data, the researcher coded the data to generate themes and thick descriptions in the form of powerful quotes. The narrative and direct quotes were used to come up with the findings.

3.10 Ethical Consideration

Ethics in research are set of moral principles of conduct used to govern the decision-making behaviour of individual or group of individual (Agwor & Osho, 2017). These principles guide individuals in their dealing with other individual or groups and provide a basis for deciding whether behaviour is right or wrong. These included: permission, informed consent, voluntary participation, confidentiality, and protection of participants. The permission to conduct the study was obtained from respective bodies. First, the Department of Postgraduate Studies in Education cleared the researcher after defending the proposal to proceed to the next step. The researcher obtained research authorization from the Ministry of Education through the National Council for Science Technology & Innovation (NACOSTI) as evidence for proficiency to conduct. Subsequently, the researcher obtained permission and notifications to research the Sub-County Education Office in Bahati. The researcher proceeded to respective schools and asked the school administration to voluntarily allow the students and the teachers to give the information required.

That researcher sought consent from the participants to ensure that they participated in the study freely without coercion. In respect to this, the researcher didn't offer any incentive whatsoever that would have encouraged participants to participate in the study. For the participants to give informed consent and maximize freedom of participation, a briefing regarding study objectives, rationale, and confidentiality of opinion was confirmed. The researcher also informed the participants how the findings would be used so that they make an informed decision whether they were to participate or not including the option to withdraw.

To ensure confidentiality and anonymity, students and teachers selected were requested not to disclose their identities in the questionnaires. Respondents were assured

that their responses would be used solely for the study. Also, the researcher didn't record the names of respondents on the data collection sheets but use numbers. The researcher ensured that the information given by participants was accurate and used it in analysis, interpretation, and reporting only. Marshall and Rossman (2011) assert that observing ethical practices is considered an essential part of rigorous research and primary ethical obligation. They add that every research should display respect for persons to ensure that the research does not harm the safety and dignity or privacy of the people with whom they conduct research. Given this, the researcher ensured that no psychological harm was inflicted on participants, for instance by desisting from asking embarrassing questions.

Plagiarism is an ethical issue in research. The researcher run plagiarism test and established that it was at 4%. According to Mugenda and Mugenda (2011), it is a situation where a researcher uses another person's ideas without duly acknowledging the author. The researcher put mechanisms in place to curb plagiarism by ensuring that all the documents and scholarly work referred to in-text were duly acknowledged. Participants were offered the opportunity to receive the report on the findings, conclusions, and recommendations of the study.

CHAPTER FOUR

4.0 PRESENTATION, INTERPRETATION AND DISCUSSION OF FINDING

4.1 Introduction

This chapter present the findings of the study on teaching strategies and performance of students in mathematics in Bahati Sub-County, Kenya. The researcher collected information from the students, mathematics teachers, HODs mathematics, principals, and Sub-County Education Officers by the use of questionnaires, interview schedule, and document analysis guide. The data are grouped into various categories of participants following the research questions. Frequency and graphical representation are used in various tables and figures to summarize the findings for quantitative data and qualitative data were analyzed and presented in narrative into various themes.

4.1.1 Participation and Research Instruments Return Rate

The two sets of questionnaires were distributed among the 312 students and 43 mathematics teachers. The researcher was able to interview 15 HODs mathematics and 15 principals and 1 Sub-County Education Officer. The researcher too requested the HODs to provide items that were listed in document analysis guide. The study was conducted two weeks before the end of term exams and during end term exams. Although most (15) of the school accepted the research to be done it was difficult for a few schools (2) due to the time factor. The sampled participants therefore were not involved during the research.

Table 11

Instruments Return Rate of Research Instruments

Respondent	Issued	Responded	Percentage
Students	312	292	93.58
Teachers	43	40	93.02
HODs Mathematics	17	15	88.23
Principals	17	15	88.23
Sub-County Education Officer	1	1	100
Total	390	363	93.07

Source: Field Data, 2021

Table 11 shows that out of 312 students only 292 (93.6%) students respondent returned their questionnaires. On the other hand, 40 (93.02%) of the teachers responded and returned their questionnaires. Out of 17 HODs mathematics, only 15 (88.23%) were available for interview. Out of 17 principals, 15 (88.23%) were available for interview. The researcher was able to access the school's K.C.S.E track record documents. The respondent rate was 92.31%. According to Mortom, Bandara, Robison and Carr (2012), a response rate of approximately 60% should be the goal of any researcher hence, the percentage obtained was satisfactory to the researcher. The instrument response rate was almost similar to that of Jolif (2016) who had an instrument response rate of 88.56%.

4.1.2 Responses by School Category and School Type

The responses concerning respondents categorized by school category and school type were as provided in Table 12.

Table 12

Responses by School Category

School Categories	Students		Teachers	
	Percentage	Frequency	Percentage	Frequ
National School	34	11.6	6	ency
Extra-County School	107	36.6	14	15
County School	37	12.7	5	35
Sub-County School	114	39.0	15	12.5
				37.5
Total	292	100	40	100

Source: Field Data, 2021

Table 12 indicates that 34 (11.6%) of the students who participated in the study came from National School, 107 (36.6%) from Extra-County Schools, 37 (12.7%) from County school, and 114 (39.0%) from the Sub-County School. The number of students admitted in different schools differs because there were more students are admitted in National schools, Extra-County schools, and County schools. This accounts for a bigger number of students compared to the Sub-County schools. All the Sub-County schools are day schools where most of the students are outsourced from within the community around the school as compared to other categories of the schools that are boarders and outsourced from different parts of the country. This explains the low admission of students in these Sub-County schools. Similar observation have also been made by Wekesa who noted that form the area he carried out the study girls boarding school accounted for 37.8%, mixed days school accounted for 48.6% and boys boarding school accounted for 13.6% of those returned the instrument.

There were 6 (15%) of teachers from the National school, 14 (35%) from the Sub-County school, 5 (12.5%), and 15 (37.5%) from the Sub-County school. The researcher

found that the National school, Extra-County school, and County school have relatively more mathematics teachers as compared to Sub-County school. This was attributed to the big school population and more steam per form to accommodate learners. This explains why there were more mathematics teachers in those schools compared to Sub-County schools. The researcher also established that one of the Sub-County schools had only one mathematics teacher who was supposed to teach mathematics for the whole school which had a double stream from form one to three and one stream in form four. This is an indication that this school had inadequate mathematics teachers and thus required to employ more teachers to teach mathematics in the school. Similar study carried out by Awour (2017) indicated that the teacher who were employed to teach mathematics we not enough to in schools.

4.1.3 Responses by School Category and School Type

The school type indicates whether the school of the participants are boys' school, girls' school or mixed school. This information is important in making the comparison of the mathematics performance in these school types. Table 13 indicates the number of students and teachers in different types of schools.

Table 13

Responses by School Category and School Type

		School type			Total
		Boys school	Girls School	Mixed School	
School Category	National School	0	34	0	34
	Extra-County School	39	68	0	107
	County School	0	36	0	36
	Sub-County School	0	0	115	115
Total		39	138	115	292

Source: Field Data, 2021

From Table 13 there were 34 girls from a national school, 39 boys and 68 girls from an extra-county school, 36 girls from county schools, and 115 both boys and girls from sub-county school. This information on the school's type of students played a vital role in giving the composition of students verses their school categories. It was therefore easier for the researcher to identify a particular teaching strategy preferred by each school type. The finding of this study agree with those of Awour (2017) who showered disparity in the student composition that help him to make comparison.

4.2 Demographic Characteristics of the Respondents

This section describes the biographic characteristics of the respondent which may have influenced the results of the study. The demographic information for the students, teachers, HODs mathematics, principals, and sub-county education officer include gender of the respondents, age, the school category, and the school type. While the demographic information for the teachers' questionnaire includes gender, age, length of teaching, school category, and the school type.

4.2.1 Gender of the Respondents

The study sought to identify the gender of respondents to establish the percentages of students, mathematics teachers, HODs mathematics, principals, and sub-county education officer. The findings are illustrated in Figure 2 as follows

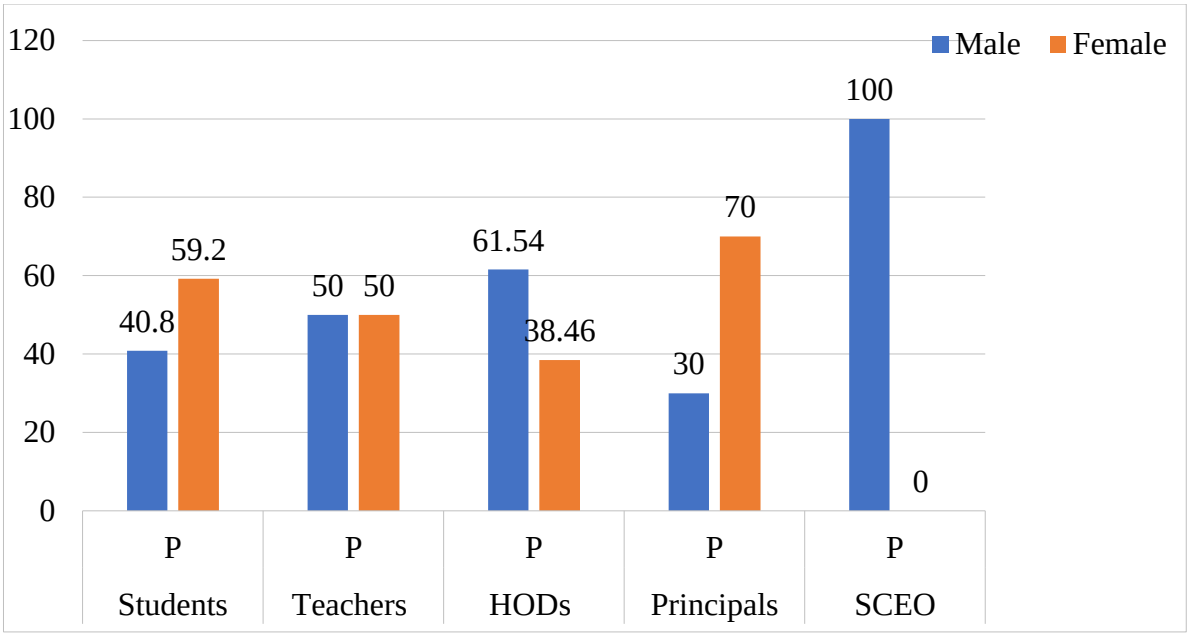

Figure 2: **Gender of the Respondents**

Based on the information in Figure 2, the students who responded to the questionnaire were 119 (40.8%) male and 173 (59.2%) female. The gender imbalance of the students was from the fact that the study was done in three girls' schools, one boys' school, and eleven mixed schools. As a result, there were more girls than boys who participated in this study. There were 20 (50%) of male teachers and 20 (50%) of the female teachers who participated in the study. This gender balance of teachers could be attributed to both male and female had been employed to teach mathematics in the schools. Among the 15 HODs who participated in study 9 (61.54%) were male and 6 (38.46%) were female. There were no criteria of gender that were used to choose the gender of the HODs mathematics in school. The majority of the school principals (70%) were female and only 30% were male. The fact that out of 15 schools, 9 (70%) schools were headed by female principals, there were more female principals compared to male principals. This leads the study to have more female principals than male principals. In addition, the Bahati Sub-County Education Office

is headed by a male SCEO. The finding of this study are similar to what Wekesa (2013) who found out there was gender imbalance between male and female in the study.

4.2.2 Respondents' Age

The responses on respondents' age were as presented in Table 14.

Table 14

Students' Age

	Responses	Frequency	Percentage
Age of the Students	16 years	1	0.30%
	17 years	51	17.50%
	18 years	143	49.00%
	19 years	67	22.90%
	20 years	25	8.60%
	21 years	2	0.70%
	22 years	1	0.30%
	23 years	1	0.30%
	24 years	1	0.30%

Source: Field Data, 2021

The results in Table 14 shows that participating students were aged between 16 years and 24 years, with the highest percentage being 18 years at 49%, 19 years at 22.9%, and 17 years at 17.5%. The spread of the respondents across the age groups provided the researcher with an opportunity to capture data across all age ranges. It is an indicator that those who responded to the questionnaire were form four students since majority were 18 years old when they are expected to be in form four. The range of age could be attributed to some of the students started schooling earlier than expected or some could have started schooling late. The finding of this study agrees with those of Mbugua, Kibet Muthaa and Nkonke (2012) who showered a range of students' age who participated in the study.

4.2.3 Experience as Mathematics Teachers

The teachers were asked to indicate for how long they had taught mathematics, and the results were as provided in Figure 3.

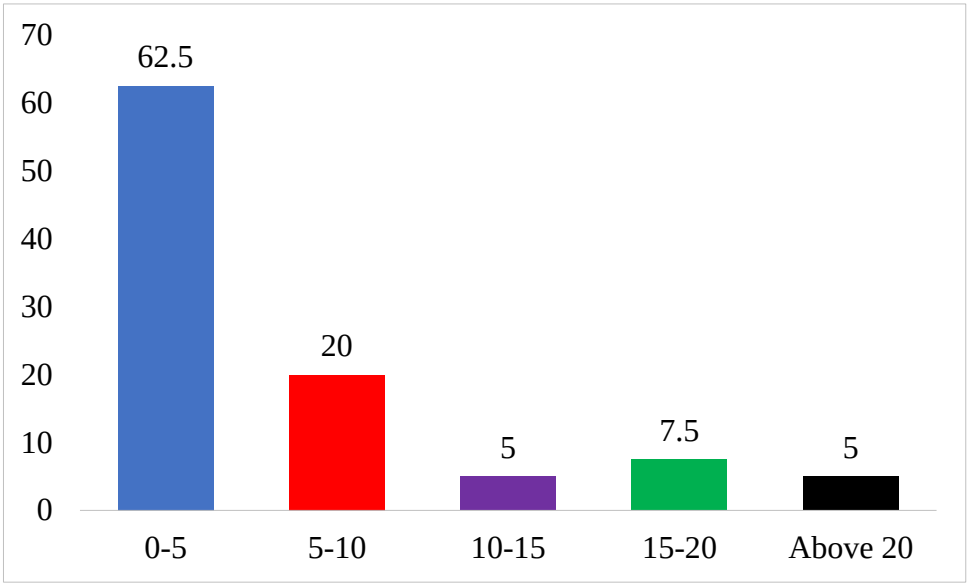

Figure 3: **Mathematics Teachers' Teaching Experience**

The results in Figure 3 show that majority of the teachers (62.5%) had taught mathematics for a period of 0 to 5 years, 20% indicated an experience of 5 to 10 years, 7.5% indicated duration of 15 to 20 years, 5% indicated 10 to 15 years, while 5% indicated they had taught this subject for duration above 20 years. This implied that the researcher was able to capture the views of teachers of varied experience and this helped eliminate possible bias based on experience. The findings of this study agree with those of Unal (2017) who had varied teaching experience in their teaching profession.

4.3 Teaching Strategies

This section presents the findings concerning the first research question which sought to establish the teaching strategies used by mathematics teachers in teaching mathematics in Bahati Sub-County, Kenya.

4.3.1 Strategies Used in Teaching Mathematics (Students' Responses)

The responses from students on the teaching strategies used in teaching mathematics were as provided in Table 15.

Table 15

Strategies Used in Teaching Mathematics (Students' Responses)

	Used Frequency	Percentage	Not used Frequency	Percentage
Question and Answer	118	40.40	174	59.60
Demonstration	123	42.10	169	57.90
Timed testing	92	31.50	200	68.50
Group work	130	44.50	162	55.50
Self-discovery	32	11.00	260	89.00
Teacher explanation	216	74.00	76	26.00
Math games	13	4.50	279	95.50
Random assessment test	142	48.60	150	51.40
Contest	5	1.70	287	98.30
Symposium	2	0.70	290	99.30
Peer Teaching	5	1.70	287	98.30
Use of ICT	1	0.30	291	99.70

Source: SPSS Out-Put, 2021

The research findings in Table 15 show that students' most utilized strategy was teacher explanation, and this was as indicated by 74% of the students. This was followed by a random assessment test at 48.6%, then group work at 44.5%, and then demonstration strategy at 42.1%. Question and Answer strategy was used by teachers according to 40.4% of the respondents. The rest of the teaching strategies, that is, timed testing, self-discovery, math games, math contest, symposiums, peer teachings, and uses of ICT were not used according to over 60% of the students. From the research findings, most of the students seem to rely on teacher's explanation. This shows students had not been exposed to other

teaching strategies in mathematics that could be limiting them in solving questions in mathematics and ultimately affecting their performance.

4.3.2 Strategies Used in Teaching Mathematics (Teachers' Responses)

The teachers were asked to indicate the strategies they use in teaching mathematics, and the response was as provided in Table 16.

Table 16

Strategies Used in Teaching Mathematics (Teachers' Responses)

Teaching Strategy	Used		Not used	
	Frequency	Percentage	Frequency	Percentage
Question and answer	25	62.5%	15	37.5%
Demonstration	21	52.5%	19	47.5%
Timed testing	14	35.0%	26	65.0%
Group work	24	60.0%	16	40.0%
Self-discovery	14	35.0%	26	65.0%
Teacher explanation	30	75.0%	10	25.0%
Math games	7	17.5%	33	82.5%

Source: SPSS Out-Put, 2021

The results in Table 16 show that 75% of the teachers indicated that they used teacher explanation strategy, 62.5% the teachers indicated that they used to question and answer, 60% used group work, 52.5% used demonstration, 35% used timed testing strategies, 35% used self-discovery, and while 17.5% of the teachers indicated that they used math games. The results show that the teaching strategies used by the majority of the teachers were teacher explanation, question, and answer, group work demonstration strategies. From these research findings, teachers seem to be inclined to teacher-centered methods as opposed to student-centered methods. The researcher opinion on use of teacher-centered methods as opposed to student-centered method could be attributed to teacher-centered methods helps the teacher cover a wide content in mathematics in a shorter time as

opposed to student-centered methods. Another reason of using teacher-centered methods is because most of the content is new to students and therefore required teacher's guidance.

4.3.3 Students and Teachers Response on Preferred Teaching Strategy

Both the teachers and students were asked on which strategy they prefer to be used during teaching and learning of mathematics. The results showing the most preferred teaching strategy by the students and teachers were as presented in Table 17.

Table 17

Preferred Teaching Strategies According to the Students and Teachers

Teaching Strategy	Students Frequency	Percentage	Teachers Frequency	Percentage
Question and Answer	35	12	10	25
Demonstration	12	4.1	8	20
Timed testing	29	9.9	0	0
Group work	41	14	7	17.5
Self-discovery	4	1.4	4	10
Teacher Explanation	113	38.7	11	27.5
Math games	11	3.8	0	0
Random Assessment test	47	16.1	0	0
Total	292	100	40	100

Source: SPSS Out-Put, 2021

The results in Table 17 show that the most preferred teaching strategy was teacher explanation according to 38.7% of the students and 27.5% of the teachers. Random assessment test was preferred by 16.1% of the students, while group work was preferred by 14% of the students and 17.5% of the teachers. Question and answer strategy was preferred by 12% of the students, and 25% of the teachers, while timed testing strategy was preferred by 9.9% of the students, and none of the teachers. The study also established that 4.1% of the students and 20% of the teachers preferred demonstration. 3.8% of the students and none of the teachers preferred math games.

From Table 17 it is clear that both students and teachers preferred teacher explanation, group-work, and demonstration, question and answer methods. However, these methods: random assessment test, timed testing and mathematics games were preferred by students and not the teachers. The results agree with those in a study by Ünal (2017) where it was found that teachers preferred techniques such as "Question and Answer" and "Demonstration," which offered relative ease of use. Group work, question and answer, and timed testing were chosen for they contributed a lot in better understanding of mathematical concepts. These findings are in agreement with research findings by Abdullah, Tarmizi and Abu (2010) who pointed that problem-based approaches better mathematical communication skills, and the students preferred stronger teamwork.

4.3.4 Student Reason for Preferring a Teaching Strategy

The students were asked to indicate why they preferred teaching strategy and their responses were as presented in Table 18.

Table 18

Students Reasons for Preferring a Teaching Strategy

Teaching Strategies	Frequency	Percentages
Demonstration	**12**	
A better understanding of concepts	9	75
Familiarization with various questions	1	8
Improves ability to solve questions	2	17
Group Work	58	
Able to discover weaknesses and improve	2	3
A better understanding of concepts	20	34
Enhances student-student relationship	1	2
Helps foster a positive attitude among learners	2	3
Improves ability to solve questions	1	2
Learners can freely ask questions to their peers Without fear	9	16
Students can learn from each other	23	40
Maths Game	18	
A better understanding of concepts	3	17
Improves ability to solve questions	7	39
It makes mathematics interesting	8	44
Question and answer	25	
A better understanding of concepts	8	44
Enjoyment associated with participation	2	11
Familiarization with various questions	7	39
Improves ability to solve questions	8	44
Random Assessment Test	64	
A better understanding of concepts	9	14
Familiarization with various questions	9	14
Improves ability to solve questions	46	72
Self-Discovery	5	
A better understanding of concepts	3	60
Improves ability to solve questions	2	40
Teacher Explanation	125	
A better understanding of concepts	122	98
Improves ability to solve questions	3	2
Timed Testing	38	
A better understanding of concepts	4	11
Familiarization with various questions	2	5
Improves ability to solve questions	32	84

Source: SPSS Out-Put, 2021

Table 18 shows why students preferred a teaching strategy. The most preferred strategy was teacher explanation as indicated by 125 out of 292 students because it offered better understanding and improve their ability to solve questions.

This was followed by a random assessment test (64), group work (58), timed testing (38), question and answer (25), math games (18) and finally demonstration (12). The result of this finding of teacher explanation as the most preferred method of teaching disagrees with findings done by Ganyapfu (2013) which showed by that the most preferred teaching method is student-teacher interactive method followed by student-centered method then finally teacher-centered method. The researcher position on the choice of teacher explanation as the most preferred method of teaching of mathematics is that the teacher needs to explain procedures that need to be followed when working out a sum in every new topic and there after give an example of how to go about the sum on the board. The use of this method does not therefore mean that other students centered methods are not used in the process because in between teacher explanation, the teacher still engages students in group discussion, timed testing, and random assessment test among others. This means other strategies are used although not noticed by the learners.

Teacher Explanation and Studnents' Performance in Mathematics

The main reason for preferring teacher explanation was a better understanding of concepts as indicated by 98% of students preferring this teaching strategy. For instance, some of the students' verbal responses include:

> "This is because through question and answers there is a better understanding of concepts the teacher is trying to teach the students of all level". Another one stated that: "When the teacher explain we get to understand easily". One of them further explained that, "Because when the teachers teach and explains, it is easy to understand". Another student said that, "The teacher's explanation also helps students to get to know new strategies of solving mathematical problems". While another one said that, "This makes it easier to understand different concepts and they enable one to approach a question from different angles." (Personal communication, March 6, 2021).

The opinion of the researcher is that the use of teacher explanation was inevitable because every time new concepts are introduced, all the learners have no much information on the topic. They thus require the teacher to explain these new concepts to understand and other teaching methods such as group discussion can follow. These findings agree with Enriquez, Valencial and Oliveira (2018) who pointed out that at the beginning of a lesson the teacher should use a set of strategies helps the learner to develop a task, inform, guide and encourage students to explore.

How Random Assessment Test Affects Students' Mathematics Performance

Random assessment test was preferred by 64 students who cited reasons such as better understanding of concepts 9 (14%), familiarization with various questions 9 (14%), and improves ability to solve questions 46 (72%). Examples of students who indicated that the strategy helps improve the ability to solve questions stated as follows:

> "Enables one to know what she doesn't know and it also exposes one to knowing and understanding how to answer some question". One of them gave three reasons stating the following: "Because it helps to discover the areas of weakness. It gives the student the morale to work and prepare for exams. It enables students to get used to exams thus no fear during exam time" (Personal communication, March 5, 2021).

On the familiarization with various questions as a reason for preferring random assessment test, the students stated as follows:

> "Random assessment test enables students to familiarise with different types of questions and to time him/herself" another one stated that: "The students get used to the questions". While another stated that: "It leads to familiarizing of the questions so when they come to examinations, they become easy". (Personal communication, March 3, 2021).

Regarding the aspect of better understanding of concepts as a reason for preferring random assessment test, the students stated the following: One of the student respondents stated that:

> Random assessment test enables one to know what she doesn't know and it also exposes one knowing and understanding how to answer some question. Another one stated that: "This is because the random assessment test will enable us to understand more in mathematics." While another one stated that: "random assessment test helps you understand where you need to put more effort" (Personal communication, March 4, 2021).

From these research findings on the preference for random assessment, the researcher felt that it is a good method that a teacher should use random assessment test to find out whether the content learned has been mastered by the students, prepare for examination, discover area of weakness, and at the same time expose students to different methods of assessment in the same topic. This finding on random assessment test also agrees with what Munyaradzi (2013) who pointed out that teaching strategies are meant to foster mathematical skills, encourage critical thinking and exploration for learners.

Group Work and Students' Mathematics Performance

Group work as a teaching strategy was preferred by 58 students who gave reasons such as one can discover weaknesses and improve 2 (3%), a Better understanding of concepts 20 (34%), enhances student-student relationship 1 (2%), helps foster positive attitude among learners 2 (3%), improves ability to solve questions 1(2%), learners can freely ask questions to their peers without fear 9 (16%), and students can learn from each other 23 (40%). The most popular reasons were students can learn from each other, and that it promoted a better understanding of mathematics concepts among learners. Some of the students who said that through group work students could learn from each other stated the following:

> "When several students gather together, they combine their knowledge and thus help one to know one difficulty or his or her weaknesses". Another one stated as follows: "When you are in groups you share your ideas." And that: "we share knowledge for each of us to understand." One of them indicated that: "group work helps the students to exchange their thoughts". (Personal communication, March 4, 2021)

On the aspect of better understanding of concepts as a reason for preferring group work, the students stated the following: One of them was quoted saying that:

> When one is exposed to a group, it makes it easy to understand and interact with others since they are of the same level and age. Another one stated that: "This is because it is easier for the students to understand each other than the teacher whereby some students can develop fear ending up without understanding the concepts" Another one was quoted stating that: "Group work enhances easy understanding on areas not understood" (Personal communication, March 7, 2021).

Some of the students indicated that through group work, learners can freely ask questions to their peers without fear. Examples of these are as follows. One of them stated that:

> Group work is helpful since no one can fear to ask questions." The other said that: "shy students may not fear asking questions to their fellow students." While another one stated that: "group work creates confidence in learners and helps improve one's ability to answer mathematics questions". (Personal communication, March 4, 2021)

The findings of this study are similar to collaborative learning suggested by Su'adu and Julius (2018). The researcher opinion is that, the use of group discussion offer an in-depth understanding of mathematics concepts to students. It also offers free environment where students can share knowledge and seek more clarification on area that were not well understood during the lesson.

How Timed Testing Affects Students' Mathematics Performance

Students who preferred time-tested strategy cited reasons such as better understanding of concepts 4 (11%), familiarization with various questions 2 (5%), and improves ability to solve questions 32 (84%). The reason for 'improves ability to solve questions' was backed by responses from the open-ended items whereby some of the respondents stated as follows:

> "One may get equipped with the required speed needed and would get acquainted to the questions and the favourable skills required to complete an exam or assignment." Another one stated that: "timed testing technique helps in time management when doing exam". For the reason of better understanding of concepts, the students stated

> the following: that: “after a teacher has taught and brings a test one can understand more” (Personal communication, March 5, 2021).

From these research findings, the researcher concluded that students should be given timed testing after every topic to evaluate their understanding and improve their speed in working out mathematical questions.

How Question and Answer Affects Students’ Mathematics Performance

The question-and-answer strategy, which was preferred by 25 of the students attracted reasons such as better understanding of concepts 8 (44%), enjoyment associated with participation 2 (11%) familiarization with various questions 7 (39%), and improving the ability to solve questions 8 (44%). Examples of students citing better understanding of concepts as a reason included: One of them was quoted saying,

> “Question and answer teaching strategy exposes students to many questions which enables them to know various tricks and also different ways of tackling different questions.” Another one stated. “It is more efficient and makes one understand certain concepts”, while on the same aspect, another one stated that: “This makes it easier to understand different concepts and they enable one to approach a question from different angles”. (Personal communication, March 6, 2021)

From the study finding, it is evident that different teaching strategies are used although at different percentages. The researcher opinion is that this brings a blending of different teaching strategies in teaching and learning mathematics in schools. The research findings of this study is in agreement with a study done by Bates (2019), who viewed the importance of blended teaching strategies in enriching mathematics learning. For instance, the use of timed testing helps the teacher to assess students' understanding and mastery of concepts, group work allowed students to work and solve problems together and eventually develops necessary critical skills in solving mathematics, while maths games make the lesson interesting and encouraging to students to remember concepts.

4.3.5 Teachers' Reason for Preferring a Teaching Strategy

The teachers were asked to indicate the reasons as to why they preferred a given teaching strategy and their responses were as presented in Table 19.

Table 19

Teachers' Reason for Preferring a Teaching Strategy

Reason	Frequency	Percentage
Demonstration	**6**	
Easy understanding by students	5	13%
It involves both the teacher and student	1	3%
Group work	13	
Convenient for slow learners	2	5%
Easy understanding by students	4	10%
Has a motivational effect	3	8%
Student confidence	1	3%
Students learn better	1	3%
Teacher effectiveness	2	5%
Teacher explanation	**12**	
Easy understanding by students	9	23%
Rapid syllabus coverage	2	5%
Teacher effectiveness	1	3%

Source: SPSS Out-Put, 2021

Table 19 shows the responses concerning the reasons why teachers preferred a given teaching strategy. The most preferred strategies according to the teachers include demonstration, group work, and teacher explanation. The responses are as follows:

How use of Teacher's Demonstration Affects Students' Performance in Mathematics

Demonstration strategy attracted responses such as easy understanding by students by 5 out of 40 (13%), and that it involves both the teacher and student by 1 out of 40 (3%). Regarding the response suggesting that demonstration was associated with easy understanding by students, the examples include:

> "It gives, in a nutshell, the whole concept needed by the students thereafter create room for more work to be done by them and hence they become self-driven" and that, "The students can understand better when a problem is demonstrated on the board" (Personal communication, 5th March 5, 2021).

From the research finding on demonstration, the researcher concluded that the teacher needs to give guidance to the students on how to go about a given mathematical problem for the students to follow. Through demonstration students are shown how to apply knowledge learned as pointed out by McAfee (2012) on real-world examples. The teachers should thus endeavor demonstrate correctly the steps to be followed when working out a questions. In addition, the teacher should give a variety of question on specific topic.

How Group Work Affect Students' Performance in Mathematics

The reasons indicated for preferring group work were: convenient for slow learners 2 (5%), easy understanding by students 4 (10%), has a motivational effect 3 (8%), student confidence 1 (3%), students learn better 1 (3%), and teacher effectiveness 2 (5%). From the open-ended items the respondents stated the following:

> "They help each other to understand better since they do not fear each other." Another one said that "It is more convenient for slow learners and those who cannot express themselves to the teacher." While one of them said that, "students can discover new methods of solving mathematical problems by themselves". (Personal communication, March 11, 2021)

From the research findings, teachers often put students into group for them to further develop their skills in working out mathematical problems. The findings of this study are similar to that of Bates (2019) who found out that group work helps the students to develop critical skills that are essential for future real life and mathematical problems.

How Question and Answer Affects' Students' Performance in Mathematics

Question and answer teaching strategy was preferred by teachers for reasons such as: allows students enough time 1 (3%), creates more time 1 (3%), easy understanding by

students 1 (3%), and teacher effectiveness 5 (13%). From the open-ended items, they stated that:

> "Students can cover a wide area within a short period." And that, "this is because the students will know his or her areas of weakness and will be forced to go back to books or consult a teacher to acquire more knowledge on a certain topic." Further, they noted that "It enables learners to gain knowledge and skills in mathematics and the basic concepts of how to answer mathematics questions from a different perspective." "It enables the teacher to make the best evaluation after he or she receives the answers from the students". (Personal communication, March 3, 2021)

It is the view of the researcher that question and answer method is used by most of the student when they are preparing for examination in order to identify the areas they are good at and also identify area they are weak at so that they can make more revision.

How Teacher Explanation Affects Students' Performance in Mathematics

Teacher explanation was preferred by teachers for reasons such as, easy understanding by students 9 (23%), rapid syllabus coverage 2 (5%), and teacher effectiveness 1 (3%). The respondents stated as follows from the open-ended items:

> "Because it is well understood by students and it helps them through asking the question" the other stated that, "The students get to interact one on one with the teacher hence discover their weak areas." And one of them said that: "Students can understand more." And one of them stated that "helps in explaining new concepts". (Personal communication, March 8, 2021)

From the research finding, the researcher opinion is that teacher explanation was very much integrated and it involves both the students and the teachers. The findings of this study are similar to contemporary dynamic learning by Cordero, Cristobal, and Gil (2015) that endorse the engagement of students in their learning by means of practise.

From an interview done to certain HOD mathematics in a school, he mentioned that depending on the lesson plan, different combination of teaching method is used to deliver content. This is an indication that all mathematics teachers use different methods to deliver mathematics lessons in class. In another interview conducted by different HOD mathematics revealed that the strategies used by the mathematics teacher depend on the lesson plan that

a teacher prepare since different topics in mathematics require different approaches. Form interview conduct to the HODs mathematics, the researcher also realized some schools had direct teaching strategies on learning mathematics and indirect strategies that help the school to perform well. Form HOD mathematics in a certain school in answer to the question of teaching strategies used said:

> "The teaching is normally the same but in this school we have allocated a lot of time to practice. Like on Monday and Friday between 6:30 am to 7:30 am the whole school does mathematics and we also come to assist learners either in discussion or sometimes teach. Between Tuesday and Friday, we have created 40 minutes during lunch for practicing mathematics. Another one said, "We ensure we complete the syllabus in time". (Personal communication, March 9, 2021).

It was also evident that some other schools just followed the normal school routine timetable had no extra teaching strategies put in place apart from what the teacher used in schools. For instance, one of the principals pointed out that, "apart from teaching normal classes, there is no any other arrangement".

From the research findings, the researcher concluded that how the mathematics department is organized by the school administration contribute a lot on teaching strategies used by the teachers. For instance where there is more time created, strategies that favour student-teacher engagement are used while where school follows hours allocated by ministry of education teacher-centred strategies are mostly used.

4.4 Teaching Strategies and Students' Mathematics Performance

The students were asked for reason why the felt that teaching methodology affected their performance in mathematics. Table 20 summarizes their responses on how teaching methodology affected students' mathematics performance.

Table 20

Teaching Methodology

Reason	Frequency	Percentages
A better understanding of concepts	1	1%
Builds learner's confidence	2	2%
Enhances students understanding of concepts	2	2%
Fosters positive learners' attitude	37	44%
inadequate materials affect performance	4	5%
The method used can affect the coverage of the syllabus	2	2%
Poor classroom observation results in a negative attitude towards the subject or teacher	3	4%
Resources are needed for continuous practice	1	1%
Unfavorable teaching method affects understanding of concepts	32	38%
Total	84	100%

Source: SPSS Out-Put, 2021

The results in table 20 shows that 84 students indicated that teaching methodology affected their performance in the following ways. The reasons given were as summarized as follows; a better understanding of concepts 1 (1%), builds learner's confidence 2 (2%), enhances students' understanding of concepts 2 (2%), fosters positive learners' attitude 37 (44%), inadequate materials affect performance 4 (5%), omission of some concepts 2 (2%), poor classroom observation results in a negative attitude towards subject or teacher 3 (4%), resources are needed for continuous practice 1 (1%), unfavorable teaching method affects the understanding of concepts 32 (38%).

On the reason that teaching methodology fosters positive learners' attitude, students indicated that good teaching methodology enhance socialization between the teachers and the students making learning easier. In addition some students felt that their teachers taught in a way they can understand while others indicated that their teachers test them by giving

questions or CAT on specific math day and revises all the questions in a friendly way. The findings of this study were in agreement with Pagtulon-an and Tan (2018) who in their findings observed that students exposed to rich assessment tasks environment marked high performance than those who are not exposed. From these findings, good teaching strategies fostered good relationship, which was an important recipe for good performance.

From the students' response on unfavorable teaching methods that affect the understanding of concepts, attracted comments from students such as: some teachers were too fast, lack of consideration of slow learners, use of few examples by the teacher, discouragement from teachers, and comparing of learners. This brought a poor attitude towards mathematics and the teacher. The study findings of the current research agreed with the findings of Mbugua, Kibet, Muthaa and Nkonke (2014) who observed that poor performance was a feature of poor attitude between teacher and students, and degenerative practices.

On the reason suggesting that teaching methodology enhances better understanding of concepts, students indicated;

> "The choice of teaching methodology - one may find it difficult to understand mathematics." Another one said, "The teacher's teaching methodology makes most students in my class understand better." While another one said, "I understand better when a teacher uses student-centered methodology than teacher-centered." (Personal communication, March 8, 2021)

From the research finding students associated their understanding depending on how teachers taught and the methods used. This finding agrees with Wekesa (2013) who pointed out that there is a positive association between teacher level of instructional strategies, classroom preparedness, and practices with students' mathematics performance.

In regard to enhancing students' understanding of concepts one of the students stated:

> "Because a way of teaching applied by the teacher should favor and accommodate everyone. Those who do not do well, understand fast and those who are not very good in mathematics should be accommodated. A good methodology ensures everyone gets a good chance to understand and excel method used can affect the coverage of the syllabus." (Personal communication, March 8, 2021)

From the research findings, a good teaching strategy is one that has ability to accommodate slow learners and ensure good performance for all students in the class. The findings of this study showed that simulation teaching strategy was beneficial to all ability level irrespective of the academic standards of whether students were weak or not as observed by Akanmu, Abinde and Fajemigadba (2014).

On the how the method used can affect the coverage of the syllabus one of the students suggested that, "The teacher methodology and effective work plan greatly affect the timely coverage of the syllabus and revision on various challenging topics with the students."

The findings of this research are in line with research done by Gichuru and Ongus (2016) which established that effective practice registered a higher students' performance because the teacher uses relevant resources, prepares well before going to teach, and engages pupils through evaluation and assessment.

4.5 What Affects Teachers Choice of a Teaching Strategy for a Mathematics Teacher

This section presents the findings related to the second research question which sought to find out what affects the choice of a teaching strategy for a mathematics teacher in secondary schools of Bahati Sub-County, Kenya.

4.5.1 Effect of Number of Lessons taught on choice of Teaching Strategies

The teachers were asked to indicate if the number of lessons they taught affected their choice of teaching strategies, and the response was as provided in Table 21.

Table 21

Effect of Number of Lessons taught on Choice of Teaching Strategies

Response	Frequency	Percentage
Yes	23	57.5
No	17	42.5
Total	40	100

Source: SPSS Out-Put, 2021

The results in Table 21 show that most of the teachers 23 (57.5%) indicated that the number of lessons they taught affected their choice of teaching strategies, while 17 (42.5%) indicated that number of lessons did not affect their choice teaching strategies. From the research findings, it is evident that the number of lesson affected teacher's choice of teaching strategy.

Qualitative results reveal that number of lessons affected teacher's choice of teaching strategy because of the associated workload. Some of the responses are as follows:

> With minimum workload, there is enough time to prepare for the lesson and hence I will use a strategy that ensures a good standard regarding students' performance. On the other hand, many lessons lower my quality on delivery due to limited time of preparation, fatigue among others. I will prefer to go for a simple and less time consuming strategy." Another teacher said "too much workload leads to less time for preparation and student individual consultation" while another one said, "too much workload makes it difficult to attend the interest of all students that you are handling." (Personal communication March 7, 2021)

From these research findings the researcher concluded that teachers who had more number of lesson ended up not using interactive methods such as group work, random assessment test, and timed testing since they required more time for preparation and used less interactive methods that required less time for preparation. The findings study concur with what Adhikar (2017) who found out that total number of teaching hours assigned to teacher, examination, and number of students in a class were the major factors that affected the choice of teaching strategy.

During an interview one of HODs of the department of mathematics was asked how the number of lessons affects the teaching of mathematic and said that:

> "Majority of teachers have between 26 and 30 lessons per week. Having many lessons, you can't mark faster to give feedback. You are also tired such that you cannot spare sometimes after to have one on one with students. Sometimes you miss planning the lessons". (Personal communication, March 11, 2021)

In another interview with, the HOD mathematics pointed out: On average, we have 28 lessons per week which are roughly 7 lessons per day. Because of the huge workload, I don't have preparation time. Sometimes I lack time for checking assignments." (Personal communication, March 5, 2021).

From the interview done, it was evident that most of the mathematics teachers had much workload that hindered proper lesson preparation, consultation time with the students, marking assignments, and eventually, at the end of the day they are very tired. It is the view of the researcher that this compromised the choice of teaching strategy that a mathematics teacher uses in a mathematics lesson.

4.5.2 How Attending Seminars affect the Choice of Mathematics Teaching Strategies

Teachers were asked to indicate in which ways attending seminars affected the choice of teaching strategies in mathematics, and the results were as provided in Table 22.

Table 22

How Attending Seminars Helps Improve the Teaching Strategies in Mathematics

Seminars	Frequency	Percentage
Conducive learner environment	1	3%
Fosters positive attitude	2	5%
Improves ability to use modern methods in teaching	15	38%
Improves teacher mastery of concepts	1	3%
Teacher effectiveness	9	23%
Updated on modern trends in subject	1	3%

Source: SPSS Out-Put, 2021

The results in table 22 show that attending seminars affected the choice of teaching strategies in the following ways; conducive learner environment 1 (3%), fosters positive attitude 2 (5%), improves ability to use modern methods in teaching 15 (38%), improves teacher mastery of concepts 1 (3%), teacher effectiveness 9 (23%), and updated on modern trends in subject 1 (3%). Some of the teachers as indicated by the teachers:

> "The seminars have enabled me to be updated on current trends and changes in mathematics." Another teacher said, "it exposed me to many ideas and strategies on how I can handle different types of students." While another one said, "attending of seminar helps in improving skills in mathematics and helps in emerging issues." (Personal communication, March 8, 2021)

The research finding on how seminars affected the choice of teaching strategies among mathematics teachers agreed with a study conducted by Awour (2012) who pointed out that refresher courses and workshops for teachers are effective strategies that can improve the performance of mathematics and science subjects. From the research finding most of the teachers appreciate the fact that seminars and mathematics workshop have been organised to help them improve on their teaching strategies especially to handle topics that learners find them difficult. It was a point of concern from the researcher that some of the teachers teaching mathematics have not attended any workshop or seminar organized by the school.

From the interview done to find out whether the teachers attended the mathematics seminar; All the HODs mathematics, principals, and SCEO agreed that the mathematics teacher attends the seminar and workshop organized. These seminars included those organized by individual schools, Sub-County level, County level, Kenya Literature Bureau (KLB), Kenya institute of curriculum development (KICD), and mostly those organized by SMASSE. This seminar helps the teacher to demystify some of the concepts in mathematics, benchmark on how to improve mathematics performance, learn new strategies for handling difficult topics, and interact with mathematics teachers.

4.4.3 How Lesson Planning affects the Choice of a Teaching Strategy

The teachers were asked to indicate which ways their mathematics lesson planning affected the ability of students to grasp the mathematics content, and the response was as provided in Table 23.

Table 23

How Lesson Planning affects the Choice of a Teaching strategy

	Frequency	Percentage
Lesson planning	32	
Easy understanding by students	7	18%
Lesson organization	2	5%
Makes lesson convenient	2	5%
Students learn better	4	10%
Teacher effectiveness	13	33%
Time management	4	10%

Source: SPSS Out-Put, 2021

Table 23 shows the responses on how lesson planning affected the choice of a teaching strategy. The teachers indicated lesson planning has affected teachers on choice of a teaching strategy in the following ways: easy understanding by students 7 (18%), lesson organization 2 (5%), makes lesson convenient 2 (5%), students learn better 4 (10%), teacher effectiveness 13 (33%) and time management 4 (10%). It is evident from the response of the teachers that the use of a lesson plan helped the teacher in preparing the students psychologically, creates conducive learning environment, incorporate all the students in the learning process, staying focused, state objectives clearly, and much more avoid deviating most of the time while teaching. One of the teachers pointed out that “Well organized and planned sessions will have a good output since one has a work schedule of what to teach or cover. This makes the teacher achieve the set objectives of the lesson”.

From the research findings it the view of the researcher that a lesson plan provided a plan that would help the teachers adopted the most appropriate teaching strategies since it states the objective to be achieved and ways in which they could be achieved. It also shows the resources need for learning and how they are used.

4.5.4 Teachers' Responses on Factors Influencing the Choice of a Teaching Strategy

The respondents were asked to indicate whether they agree or disagree with select statements on factors influencing the choice of a teaching strategy in mathematics, and the responses were as provided in Table 24.

Table 24

Teachers' Responses on Factors Influencing the Choice of a Teaching Strategy

School-related factors	SD	D	U	A	SA	Mean	Std Dev
Students' entry behaviour affects the choice of teaching strategy	5.0%	32.5%	10.0%	37.5%	15.0%	3.25	1.214
I find it hard to use some of teaching strategies in mathematics	5.1%	46.2%	10.3%	25.6%	12.8%	2.95	1.213
The nature of the topic affects the choice of my teaching strategies	7.5%	0.0%	0.0%	20.0%	72.5%	4.50	1.086
The school management has influence upon my instructional strategies	5.0%	50.0	5.0%	7.5	32.5%	2.67	1.074
I choose the teaching learning activities considering available resources	5.1%	15.4%	5.1%	53.8%	20.5%	3.69	1.127
The examination system has impact upon my teaching strategy	0.0%	7.9%	7.9%	52.6%	31.6%	4.08	0.850
I consider students' interest and choose the teaching strategy	5.0%	42.5%	10.0%	27.5%	15.0%	2.56	1.214
My choice of teaching strategy is determined by the prescribed school curriculum	0.0%	43.56 %	15.50 %	23.5%	17.44	2.43	1.234

Source: SPSS Out-Put, 2021

The results to the statement implying that students' entry behaviour affects the choice of a teaching strategy recorded a mean score of 3.25 (52.5% agreeing). The value is higher than the 3.0 neutral mean score implying that the majority of the teachers agree. This suggests that the majority of the teachers agreed with the statement that student entry behaviour affect the choice of a teaching strategy. An interview with one of the HOD mathematics on how the entry behaviour affected teaching strategy in mathematics:

> "*Hapa ndio kuna kazi* (This is where there is work). Yesterday there was a student who over relied on a calculator on some simple mathematics operations. When I was seeing this, I was saying if this is a student at secondary level and they cannot do an operation of a two-digit number by themselves, they need a calculator! This is a big issue. That is just one and I know there are several. Their entry behaviour affects the teacher's choice of teaching strategy because the foundation was not strong". (Personal communication, March 5, 2021)

Form these research findings, the researcher views are that choice of teaching strategies should be tailor made such that students who have challenges on basic operations in mathematics are first taught at individual level and after they understand the operation is when a teacher should engage the whole class. These findings are in agreement with the research done by Preez (2018) who revealed that teachers should choose interactive methods that promote the achievement of the child in mathematics activities.

The results of statement implying that teachers find hard to use some of teaching strategies had a mean score of 2.95 (49.16%). Although these mean score value is below 3.0 neutral mean it is quite evident a good number of teachers had difficulties in the use of some teaching strategies. The researcher view is that those teachers who have difficulties in use of a particular teaching strategy are more likely to avoid its use and this could be limiting them in a certain way. These research findings are similar to what Akani (2017) who found out that most of teachers struggle in selection of teaching strategies and even recommended that the school should engage subject specialist in assisting teacher on selection of teaching strategies.

The results of the statement implying that the nature of the topic affects the choice of teaching strategy had recorded a mean score of 4.5 (75%). This mean is above 3.0, which indicate that the nature of the topic affected the teaching strategy. During an interview with one of the HOD reported that different topics required different approach and thus different teaching methods should be used. An interview done with HOD revealed that:

> "If the teacher mastery of the concepts is poor, he or she will not be able to deliver the concepts to the students properly." While another HOD noted, "If the teacher understands the concept, it is easier for him or her to explain to the students in the easiest way possible." Agreeing with the result, another HOD pointed out, "If the teacher has mastered the concept, he can deliver it to the students without difficulties or problems." (Personal communication, March 8, 2021)

The researcher point of view is that the nature of the topic affected the choice of teaching strategies because it first assesses the teacher understanding of the concepts which further determines the most suitable teaching strategies employed. The research findings agrees with Akani (2017) who found out that the nature of topic taught was among the major factor that determine the choice of a teaching strategy in mathematics.

On the statement that the school management has influence upon teacher's instruction strategy registered a mean score of 2.67 (44.5%) that was below the neutral mean of 3.0. The results of this finding thus disagree to the fact that school management had influence on the teaching methodology used by the mathematics teachers. Although this means score if below, there is a good number of participants who feel that the school management had influence on the teaching strategy of the teachers. From the interview conducted it was opinion of some of some of HODs that school administration contributed indirectly to the teaching strategies used in teaching mathematics while other HODs felt that the school administration offered no contribution to the teaching strategies used. For instance one of the HOD reported that:

> "One thing the school does, it has supported the department very much. Because like creating mathematics program has to involve the whole school. At least they came to realize that when students do well in mathematics, the school mean rises. They

> have given us a lot of facilities like textbooks and physical facilities". While in another interview another HOD indicated that "there is no extra time the school provide. You have to stick to the scheduled time." (Personal communication March5, 2021)

The researcher opinion is that the school management influence the choice of teaching strategies by creating programmes that favour mathematics and also provide the resources required for mathematics teaching such as ICT, models, photocopying papers, printers among other resources.

The results show that the statement implying that teachers choose learning activities considering available resources recorded a mean score of 3.69 (61.5% agreeing). The value is higher than the 3.0 neutral mean score implying that majority of the teachers agree. This suggests that the majority of the teachers agreed with the statement that they choose teaching strategies considering the available resources. From interviews done to some of the HODs pointed out that schools lacked teaching and learning resources such as computer device, internet connection, printing papers, revision textbooks that hindered their choice of teaching strategies while other HOD admitted that the school had provided enough resources needed for teaching and learning mathematics. The findings of this study agree that presence or absence of resources contribute to the choice of teaching strategy (Adhikari, 2017).

On the result implying that examination system has impact upon teacher's teaching strategies score a mean of 4.08 (68% agreeing). This mean is higher compared to average mean of 3.0. This suggests that the majority of the teachers agreed with the statement that they choose teaching strategies considering the examination system. In an interview with HODs they pointed out the following:

> "As teachers, we have to be exam-oriented and prepare the students about what type of questions will be asked and how to solve them and all that", while another stated that "teachers are evaluated and rewarded or punished based on the grades the students achieve in their final examination". (Personal communication, March 8, 2021)

From the research finding, the researcher's opinion is that question and answer methods were used to familiarize students with the question but more elaborate methods that need to capture the mastery of contents seems to be avoided. This creates a situation where students are unable to handle a question if asked in a different manner. The research findings of this study are similar to what Njiru, Karuku and Nyanga (2020) said that teachers are using method that meet their desire to excel in their subject and achieve top rank to receive prizes rather than for understanding.

Another statement implying that teacher considers student interest to choose a teaching strategy reported a mean score of 2.56% (agreeing). This mean score value is lower than the 3.0 neutral mean score implying that students level of understanding affected the choice of the teaching strategy. In interviews done with some of the HOD revealed that:

> "Most of the teachers are unable to address students' interest due to constrains such as large class size, lack of technology, different level of learners, unavailability of authentic material and examination that compel them to apply teacher centered methods such as lecture and demonstration" while on contrary opinion another HOD "Teaching strategies should capture students' interest to avoid boredom and lack of concentration" and another one pointed out that " if students interest are not considered, students always find mathematics as a difficult subject." (Personal communication, March 11, 2021)

From the research findings the researcher came up with a conclusion that there is need to capture students interest regardless of constrains surrounding.

The statement implying that teachers' choice of teaching strategy is determined by the prescribed school curriculum reported a mean score of 2.43 (40.5%). Although this means score was below the neutral mean of 3.0, it is important to consider what the prescribed school curriculum recommend on a teaching methodology.

4.6 Challenges facing the Mathematics Teachers in choosing Teaching Strategies

This section presents the findings related to the fourth research question, which sought to find out challenges facing mathematics teachers in choosing a teaching strategy in secondary schools of Bahati Sub-County, Kenya.

4.6.1 Students' Response on Challenges Facing Teachers in Choosing Teaching Strategies

The students were asked about the challenge their mathematics teachers faced when choosing teaching strategies in mathematics. They responded to open-ended questions and the responses are summarised in Table 25. This is followed by an explanation and examples of responses in narrative form. The challenges are presented in the table in order of frequency strength.

Table 25

Students' Response on Challenges Facing Teachers in Choosing Teaching Strategies

Challenge	Frequency	Percentage
Difficulty in understanding mathematics concepts	95	32.5%
Inadequate teaching and learning resources	64	21.9%
Negative attitude towards mathematics	62	21.2%
Lack of practice and revision	47	16.1%
Not prepared well enough to answer questions accurately	47	16.1%
Poor teaching methods	30	10.3%
Time management challenge	29	9.9%
Student laziness (lack of commitment)	19	6.5%
Forgetfulness	18	6.2%
No motivation from teachers	15	5.1%
Teacher attitude towards students	14	4.8%
Negative attitude towards the subject teacher	13	4.5%
Distractions from other students	12	4.1%
Teacher shortage	10	3.4%
Teacher lack of commitment	10	3.4%
Poor teacher-student relationship	9	3.1%
Student confidence concerns (low or over)	8	2.7%
Discouragement from students	8	2.7%
Lack of concentration in class	8	2.7%
Teachers' rush to complete syllabus	7	2.4%
Not exposed to contests	5	1.7%
Poor classroom organization	5	1.7%
Teacher student relationship	5	1.7%
Uncooperative students	4	1.4%
Abrupt change of subject teachers	4	1.4%
Limited consultations with teachers	3	1.0%
Limited time for the subject	3	1.0%
Poor quality of teaching and learning materials	3	1.0%
Procrastination	3	1.0%
Problem with afternoon lessons	2	0.7%
Speed problem	2	0.7%
Teacher absenteeism	2	0.7%
Lack of support from school	1	0.3%
Student absenteeism	1	0.3%
Unhealthy student competition	1	0.3%

Source: SPSS Out-Put, 2021

From the summary of qualitative responses from students in Table 25, the main challenge mentioned by students was the difficulty in understanding mathematics concepts 95 (32.5%). Presented in order of frequency followed, inadequate teaching and learning resources 64 (21.9%), then negative attitude towards mathematics 62 (21.2%). The others that followed were: lack of practice and revision 47 (16.1%), not prepared well enough to answer questions accurately 47 (16.1%), poor teaching methods 30 (10.3%), time management challenge 29 (9.9%), student laziness (lack of commitment) 19 (6.5%), forgetfulness 18 (6.2%), no motivation from teachers 15 (5.1%), teacher attitude towards students 14 (4.8%), negative attitude towards the subject teacher 13 (4.5%), distractions from other students 12 (4.1%), teacher shortage 10 (3.4%), teacher commitment 10 (3.4%), and then poor teacher-student relationship 9 (3.1%).

The rest of the challenges, which had a frequency of between 1 and 8 (0.3% to 2.7%) included the following in order of frequency strength. Student confidence concerns (low or over), discouragement from students, lack of concentration in class, teachers' rush to complete syllabus, not being exposed to contests, poor classroom organization, teacher-student relationship, uncooperative students, abrupt change of subject teachers, limited consultations with teachers, limited time for the subject, poor quality of teaching and learning materials, procrastination, the problem with afternoon lessons, speed problem, teacher absenteeism, lack of support from the school, student absenteeism, and unhealthy student competition. From the researcher point of view this challenges affect the classroom environment and no matter the teaching strategy the teacher uses she is confronted with diversion of students' attention. Consequently, the students fail to perform well and thus blame on teacher's teaching strategies.

The aspect of difficulty in understanding mathematics concepts as viewed by the students revolved around complex concepts, complicated concepts, complicated

mathematical language, lack of understanding, confusion of related concepts, contradicting concepts, and difficulties in solving mathematical concepts. For example one of the students said, “complex concepts in mathematics such linear programming which is difficult to understand.” The researcher opinion is teachers fail to choose simplified teaching strategies that could break down some of difficult concepts to learners leading to lack of understanding on the topic taught. This could lead to students labelling some concepts as difficult.

Pertaining to inadequate teaching and learning resources as a challenge facing students included; few revision books for mathematics, lack of test materials (past papers), inadequate mathematics teachers, and lack of calculator. From these research findings, the researcher concluded that some teachers opted for less elaborative methods since they lack resources such as projectors to help students visualize on mathematics concepts.

The responses on a negative attitude towards mathematics subject as a challenge facing students included; the notion that mathematics is hard, negative attitude towards mathematics, timetabling of mathematics especially the afternoon lessons, lack of interest, nervousness during examination, fear of doing mathematics, and lack of practice of mathematics as indicated one of the students who said, “I skip it in my personal timetable”. From these research findings negative attitude towards mathematics could hinder use of student-centered methods such as self-discovery since the student lack self-motivation towards mathematics.

Relating to the challenge of teacher attitude towards students, examples included: teacher harassment during learning, assumption by teachers that some areas are simple to understand, favours of some students in class, assumption that the students are quick learners, and negative vibes from the teachers. From these research findings teachers choice of teaching strategies has been compromised by their behaviour and no matter the best strategy they chooses, students will still find mathematics as a hard subject. The finding of

this study agrees with a study conducted by Rameli and Kosnin (2016), which pointed out that students' performance in mathematics is affected by teachers' negative talks and actions.

The responses on lack of practice and revision as a challenge facing students included; little practice, not doing practice, poor revision skills, lack of enough time for revision, inconsistency in practice, and unpredictable questions in exams.

Concerning the aspect of not being prepared well enough to answer questions accurately, examples of responses included: difficulties in handling questions, lack of understanding of what the question is asking, lack of prior knowledge, silly mistakes, calculation errors, misinterpretation of questions, and challenges of how to choose an optional question in section B of mathematics paper. The finding of this study agrees with a study conducted by Rameli and Kosnin (2016) which revealed that students with low self-regulation suffered poor time management, lack of motivation, carelessness, lack of understanding, and experienced difficulties in doing mathematics. The poor performance of students had a direct relationship with low self-regulation practices.

Regarding to the aspect of not being prepared well enough to answer questions accurately, examples of responses included; poor explanation by the teachers, lack of emphasis, using methods that favour good performing students, discriminating between weak and good performers, poor explanation, having no group work, lack of regular test, poor marking and poor teaching skills. To emphasize this point one of the students stated: "Poor teaching skills i.e. teacher reading notes directly from the textbooks without further explanation." Another student said: "Some teaching methodologies used by some teachers do not allow students to grasp the concepts." The finding of this study agrees with a study conducted by Barker and Townsend (2006) that highlighted the complex such as input value, mathematical structure, prior strategies, visual imagination, and social interactions that influenced students' performance.

The challenges of forgetfulness revolved around; students forgetting crucial concepts, forgetting formulas, and sometimes apply them wrongly. On student commitment they pointed out students are not committed fully to learn mathematics, and finally on laziness, the students pointed out that some of them lack seriousness and are lazy to go the extra mile. The finding of this research is in line with research done by Isack (2015) that pointed at inadequate self-practice and students' poor mathematics background as one of the challenges facing mathematics performance.

4.6.2 Challenges Facing Teachers in Choosing Teaching Strategies (Teachers' Response)

Teachers were asked to indicate the challenges facing them in choosing teaching strategies and their responses were as provided in Table 26.

Table 26

Challenges Facing Teachers in Teaching Mathematics - Teachers' Responses

Challenge	Frequency	Percentage
Heavy workload	1	1.2%
Inadequate teaching resources	20	24.4%
Lack of Commitment from students	6	7.3%
Lack of support from school	4	4.9%
Large population in class	1	1.2%
Limited expertise	1	1.2%
Limited time for the subject	6	7.3%
Negative attitude towards the subject by students	33	40.2%
Slow learners challenge	1	1.2%
Teachers not motivated enough	4	4.9%
Unfavorable entry behavior	5	6.1%
Grand Total	82	100.0%

Source: SPSS Out-Put, 2021

The results in Table 26 show that there were 33 (40.2%) responses citing negative attitudes towards the subject by students as a challenge facing mathematics teachers in teaching mathematics. The examples of responses as indicated by the teachers included,

"Negative attitude towards mathematics by the students," and also "Existence of the word, mathematics is hard". Form an interview conducted to one of the HOD indicated that: "School culture on mathematics performance demotivates students. Perennial failure in K.C.S.E. level has made learners demotivated in the subject". From this research findings it is the opinion of the researcher that mathematics teachers are confronted with difficult in choosing teaching strategies considering the already implanted culture." (Personal communication, March 8, 2021)

The results show that 20 (24.4%) responses cited inadequate teaching resources as a challenge facing mathematics teachers in teaching mathematics. The examples of such responses included, "Lack of adequate models to teach some abstract topics." While another teacher said, "ICT integration resources are not enough" while another one said "Lack of teaching course books."

The biggest challenge facing the teaching of mathematics in the school as pointed by the principal was inadequate mathematics teachers. One of the principals pointed out;

> The main challenge is staffing. You realize that teachers who are employed by the Teacher Service Commission (T-S-C) are not enough. We are forced to hire teachers for mathematics and other subjects on B-O-M terms and then after a term or so, there is mass recruitment where these teachers are absorbed by T-S-C in another new station. This means we have to bring in new teachers. This breaks down the chain of continuity in learning mathematics by the students. (Personal communication, March 5, 2021).

The finding of this research is in agreement with research conducted by Majo (2016) that indicated that scarcity of qualified subject teachers and inadequate availability of teaching and learning resources are the major factors influencing poor performance.

Another challenge pointed by the principal was the poor attitude towards mathematics as a subject by the students. One of the principals pointed out

> This is also an element of attitude as much as mathematics is done well in this school. We still have some students who have that maths '*ni chuma*' (it is metal) math is

difficult, maths is iron, maths is this or that. That kind of out-dated attitude that math is difficult… (Personal communication, March 11, 2021).

An interview with SCEO pointed out that "One of the challenges facing mathematics was poor performance because of the attitude from students. Not all the school but especially from day schools" (Personal communication, March 26, 2021).

The finding of this study agrees with research conducted by Rameli and Kosnin (2016), which revealed that students' poor performance is greatly contributed by students' attitudes and behaviours, and lack of support.

Other challenges pointed out include lack of support 4 (4.9%), lack of commitment 6 (7.3%), lack of time for the subject 6 (7.3%), unfavourable entry behaviour 5 (6.1%), heavy workload 1 (1.2%), large population in class 1 (1.2%), limited time for the subject 1 (1.2%) and slow learner challenges 1 (1.2%). Other challenges pointed out by HODs during interview included, balancing diverse learning needs, performance pressure from school administration, lack of time for planning, too large classes, different rates of learning for students, and inadequate teaching resource for mathematics. These challenges hindered the teachers in choosing the most appropriate teaching strategies for the learners.

4.7 Interventions for Improving Teaching Strategies in Mathematics

This section presents the results for the fourth objective which sought to determine the intervention that can be put in place to improve teaching strategies in mathematics for school in Bahati Sub-County, Kenya.

4.7.1 Students' Response on Interventions of Improving Teaching Strategies

In addressing the fourth research question of the study, the students were asked to indicate the intervention that can be put in place to improve teaching strategies in

mathematics for secondary schools in Bahati Sub-County Kenya. The results of the findings were summarized on Table 27.

Table 27

Students - Measures to Improve Mathematics Performance

Measure	Frequency	Percentage
Frequent Use of RATs and CATs	75	25.7%
Encouraging group work	63	21.6%
Mobilize adequate mathematics resources	63	21.6%
Motivating students	46	15.8%
Revise and practice regularly	44	15.1%
Build good teacher-student relationship	35	12.0%
Improving teaching methods	34	11.6%
Positive attitude cultivation	33	11.3%
Organizing mathematics contests	31	10.6%
Allocation of more time for mathematics	29	9.9%
Teacher factors such as age and attitude need to be checked	22	7.5%
More Consultations with teachers	18	6.2%
Teachers to try and employ individualized learning	15	5.1%
Employ more teachers	14	4.8%
Learners' attentiveness and concentration	12	4.1%
Use of math games to make mathematics interesting	11	3.8%
Increase frequency of math speed test	10	3.4%
Peer consultations	7	2.4%
Interclass joint exams	3	1.0%
Regular teacher-student consultation	3	1.0%
Avoid after lunch lessons	2	0.7%
Recognition of outstanding performance in mathematics	2	0.7%
Avoid changing mathematics teachers	1	0.3%
Improve on individual discipline	1	0.3%
Pray for God's intervention	1	0.3%
Use modern technology	1	0.3%
Use of flexible teaching methods that accommodate all learners	1	0.3%
Use of modern technology	1	0.3%
Use of rewards for performance	1	0.3%
Utilize mathematics materials available	1	0.3%

Source: SPSS Out-Put, 2021

From the summary of qualitative responses from students in Table 27, the most popular intervention suggested by students was the frequent use of RATs and CATs 75 (25.7%). The main measures presented in order of frequency included; encouraging group work 63 (21.6%), mobilizing adequate mathematics resources 63 (21.6%), motivating students 46 (15.8%), revising and practice regularly 44 (15.1%), building good teacher-

student relationship 35 (12.0%), improving teaching methods 34 (11.6%), positive attitude cultivation 33 (11.3%), organizing mathematics contests 31 (10.6%), allocation of more time for mathematics 29 (9.9%), teacher factors such as age and attitude need to be checked 22 (7.5%), and more consultations with teachers 18 (6.2%).

The rest of the measures which had a frequency of between 1 and 15 (0.3% to 5.1%) included the following in order of frequency strength; teachers to try and employ individualized learning, employ more teachers, learners' attentiveness and concentration, use of math games to make mathematics interesting, increase the frequency of math speed test, peer consultations, interclass joint exams, regular teacher-student consultation, avoid after lunch lessons, recognition of outstanding performance in mathematics, avoid changing mathematics teachers, improve on individual discipline, pray for God's intervention, use modern technology, use of flexible teaching methods that accommodate all learners, use of modern technology, use of rewards for performance, and utilize mathematics materials available.

Examples of responses on frequent use of RATs and CATs included: "Regular mathematics exams that make students familiarize with questions." Another student mentioned, "Performing frequent assessment tests to gauge the level of student's understanding of concepts". While another one said, "Exposing students to many papers that may help them in keeping time".

The findings of this study on the use of the frequent test, agree with the findings of Halton Catholic Board (2017) that suggested that engagement in responsible mathematics programs such as assessment practices would lead to confidence and ability to use and apply mathematics knowledge, skills, and processes in a meaningful way.

On the suggestion of encouraging group work, examples of responses include:

> "Setting up group discussions for maths which should be done on Saturday from 8:00 am to 1:00 pm. This group discussion should be led by students who performs

> well in mathematics and monitored by the teacher". Another student said "setting time for group discussion in maths". While another one said, "Advocating for group works as early as possible". (Personal communication, March 8, 2021)

On the suggestion to mobilize adequate mathematics resources, examples of responses to include: "Increasing most recent learning materials and improved the existing ones." While another student said "ensuring that there are more mathematics revision books". While another one said, "Students should be provided with mathematical instruments e.g. calculator" (Personal communication, March 5, 2021).

The study findings agree with research conducted by Majo (2016) who recommended the ministry of education should ensure adequate teaching and learning resources such as books, teaching aid, with a conducive learning environment.

4.7.2 Teacher's Response on Intervention to Improve Teaching Strategies

The teachers were asked to indicate the intervention that can be put in place to improve the teaching and learning of mathematics in their schools, and the results were as captured in Table 28.

Table 28

Teachers Response on Intervention to Improve Teaching Strategies

Measure	Frequency	Percentage
Cultivate a positive attitude among learners	13	33%

Adequate teaching and learning resources	13	33%
Motivate learners	12	30%
Frequent use of RATs and CATs	10	25%
Encourage more student participation in maths contests	6	15%
Allocate more time for the subject	6	15%
Integrate ICT in mathematics teaching and learning	5	13%
Use of group work	3	8%
Students to do more practice and revision	3	8%
Peer teaching approach	3	8%
Lesson observation	2	5%
Use of creative and elaborative methods	2	5%
Restrict number of students per class	2	5%
Mathematics lessons to be done in the morning	1	3%

Source: SPSS Out-Put, 2021

In the summary of qualitative responses from students in Table 25, the most popular intervention suggested by teachers included cultivation of positive attitude among learners 13 (33%), and ensuring adequate teaching and learning resources 13 (33%). The following main measures, in order of their frequencies, were also suggested. These include a suggestion to: motivate learners 12 (30%), arrange frequent use of RATs and CATs 10 (25%), encourage more student participation in maths contests 6 (15%), allocate more time for the subject 6 (15%), and integrate ICT in mathematics teaching and learning 5 (13%).

The rest of the measures which had a frequency of between 1 and 3 (3% to 8%), presented in the order of frequency included: the use of group work, students to do more practice and revision, peer teaching approach, lesson observation, use of creative and elaborative methods, restrict the number of students per class, and mathematics lessons to be done in the morning.

Although constrained by issues such as a large number of students, under- resourced classrooms, and examination pressure, the teachers in this study still have been trying their

best to improve teaching strategies in mathematics so students can perform well in mathematics.

On the suggestions to cultivate a positive attitude among learners, examples included: “Inviting carrier/professional in the subject to address the students e.g. doctors, auditors, accountants, etc. to talk to students on the importance of mathematics”. Another teacher said, “Hold talks on advantages of having a positive attitude towards mathematics”. While another one said, “Offer guidance and counselling to learners to change attitude”.

This study’s finding on cultivating a positive attitude agrees with a study conducted by Mundiaa and Metussin (2019) that revealed information campaigns could encourage the students to perform well in mathematics.

On the suggestions to ensure there are adequate teaching and learning resources, examples include: “Provision of mathematics teaching resources e.g. dioramas, charts, tables, etc.” Another teacher said, “Administration to ensure that all students have the required facilities/materials while learning mathematics”. While another one said, “provide revision material to students”.

On the suggestions to motivate learners, examples include: “Provide better ways of recognizing and motivating both the teacher and the students”. Another teacher said, “School to introduce token for better performance”, while another teacher said “motivating the top performers”.

On the suggestions to organize frequent use of RATs and CATs for the learners, examples include: “Weekly continuous assessment test to improve the ability of the students to tackle a lot of diverse question”. Another teacher said, “Having as many quiz tests as possible”. While another one mentioned, “CATs or RATs done by the whole school”.

On the suggestions to encourage more student participation in maths contests, examples include: “Build confidence among learners e.g. through maths club and contest.”

Another one said, “Ensuring every student get a chance to participate in both internal and external contests to encourage them to continue great work”. Another one said, “Organizing test and giving them prices as a way of motivation”.

The study done is in line with a study conducted by Demisse and demise (2017) that revealed that appropriate and relevant small-group learning and whole-class discussion activities with clear classroom demonstration, equitable activities followed with classroom evaluation can improve student achievements.

Pertaining the interviews done to the HOD mathematics suggested that the schools should embrace mathematical programs from the mathematics department, allocate more time for mathematics, popularize the subject because to win students’ attitudes, some teachers to major in mathematics, provide revision books, and enhance ICT in the school.

Responding to the intervention put in place to improve teaching strategies in mathematics the SCEO suggested; “Firstly, provision of a variety of textbooks. Secondly, more time should be dedicated to the teaching of mathematics. Thirdly, change of attitude from learners. Finally, more time and practice almost on daily basis” (Personal communication, March 26, 2021).

4.8 Hypothesis Testing

4.8.1 Teaching Strategies and Mathematics Performance of Students during the years 2015-2019

The results for Pearson product moment correlations between teaching strategies for mathematics and mathematics performance of students during 2015-2019 that were obtained in the document analysis guide were as presented in Table 29.

Table 29

Pearson Product Moment Correlation between Teaching Strategies and Students Mathematics Performance of Students during 2015-2019

		2015	2016	2017	2018	2019
Teaching strategies for mathematics	Pearson Correlation	.284	.296	-.114	.305	.315
	Sig. (2-tailed)	.076	.064	.483	.056	.048
	N	40	40	40	40	40

Source: SPSS Out-Put, 2021

The findings in Table 29 show that there was a positive correlation between teaching strategies for mathematics and mathematical performance of students at r = 0.284; p = 0.076 in the year 2015, r = 0.296; p = 0.064 in the year 2016, r = -0.114; p = 0.483 in the year 2017, r = 0.315; p = 0.056 in the year 2018, and r = 0.315; p = 0.04 in 2019. Given that the p-value was less than the test significant value at 0.05, the correlation value in the year 2019 is interpreted to be statistically significant. This therefore means that in the year 2015 -2018 where the p-values were greater than 0.05, the teaching strategies had no significant difference in the students' academic performance in mathematics. However, in the year 2019 where the p-value was less than 0.05 there was an indication that there was a statically significance difference in the extent to which the selected teaching strategies contributed to the academic performance of mathematics. For this reason therefore the null hypothesis was rejected at 5% significance level for the years 2015-2018 while for 2019 it was accepted.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary, conclusions, and recommendations for the study.

5.2 Summary of the Findings

This section will looked at the summary of research findings on strategies used by mathematics teachers in teaching mathematics, what affect the choice of a teaching, challenges facing mathematics teachers in choosing a teaching strategy, and what intervention can be put in place to improve teaching strategies in secondary schools of Bahati Sub-County.

5.2.1 Teaching Strategies used by Mathematics Teachers in Teaching Mathematics

The main teaching strategies employed in most of the schools were question and answer, demonstration, timed testing, group work, self-discovery, teacher explanation, math games, and random assessment tests. The teaching strategies used by the majority of the teachers were teacher explanation, question and answer, group work, and demonstration strategies.

5.2.2 Teaching Strategies and Students Mathematics performance

The results of the research findings indicated that teaching strategies affected students understanding of concepts, learners' confidence, and students' attitude towards mathematics. This affects their performance in mathematics positively or negatively.

5.2.3 What Affects the Choice of a Teaching Strategy

The results show that the number of lessons affected the choice of teaching strategy because it was associated with workload. The more the number of lesson the less the time

allocated for lesson preparation, students' consultation, marking of assignment, and integration of resources. Consequently teacher opted for less collaborative and interactive methods. Attending of seminars helped to improve ICT integration, updated teaching strategy, handling of difficult concepts as well as identify students' challenges. Attending of the seminar thus provided an opportunity of learning new methods that the teacher can choose from.

Lesson planning provided a schedule of what to be done and most appropriate method to be used. The objective stated in the lesson plan acted as guide on which strategy to use and the most appropriate teaching aid required. Other factors that affected the choice of a teaching strategy included entry behaviour of the learners, ease of use, school management, availability of resources, examination system, students' interest, and prescribed school curriculum.

5.2.4 Challenges Facing Mathematics Teachers in Choosing a Teaching Strategy

According to students the challenges facing mathematics teachers in choosing teaching strategies emanate from students' difficulty in understanding mathematics concepts, inadequate teaching, and learning resources, then negative attitude towards mathematics by students, lack of practice and revision by learners, not being prepared well enough to answer questions accurately, poor teaching methods, time management challenges, and student laziness (lack of commitment).

The main challenges facing teachers in teaching mathematics are too many lessons, inadequate teaching resources, lack of commitment from students, lack of support from school administration, the large class population in class, limited extra time outside normal school timetable allocated for mathematics, negative attitude towards the subject by students, slow learners challenge, teachers not motivated enough, and unfavourable students' entry behaviour.

5.2.5 Intervention for Improving Teaching Strategies in Mathematics

The main intervention suggested by students included: Encouraging group work, mobilize adequate mathematics resources, motivating students, revise and practice regularly, build good teacher-student relationships, improving teaching methods, positive attitude cultivation, organizing mathematics contests, allocation of more time for mathematics, student attitude needs to be checked, and students need to consult with teachers concepts that are difficult to understand and apply them in mathematics.

The most popular measures suggested by teachers included cultivation of positive attitude among learners, and ensuring adequate teaching and learning resources, motivate learners, arrange frequent use of RATs and CATs, encourage more student participation in mathematics contests, allocate more time for the subject, integrate ICT in mathematics teaching and learning, restrict the number of students per class, use creative and elaborative methods, popularize mathematics, and teachers to major in mathematics.

5.3 Conclusions

The study concludes that there are some of the teaching strategies preferred by students, yet not preferred by teachers. Teachers preferred using group work, teacher explanation, and demonstration. Students mostly preferred teacher explanation, random assessment tests, and question and answer. From the research done between the teaching strategies used and the mathematics performance, it was indicated that the methods used in teaching mathematics did not enable the students to perform well as expected.

The teaching methods to be more affect good performance on students need to promote understanding of concept, good relationship between teachers and students, and improve students' confidence in mathematics.

The number of lessons affected the choice of the teaching strategy where teachers with more lessons preferred teacher centered methods as opposed to students centered

methods. This reduced teacher-students interaction and consequently affected students' performance. Attending of seminars helped to improve teacher choice of teaching strategy for it provided opportunity of ICT integration, updated teaching methods and methods of handling difficult concepts. This eventually helped to improve students' performance. Lesson planning helped the teacher to visualize the most appropriate teaching method for delivering content so that there can be improvement of performance.

The challenges that affected the choice of teaching strategy were entry behaviour of students, inadequate mathematics model, lack of revision books and materials, inadequate staffing, frequent change of mathematics teachers, large class population, diverse learning needs, pressure from school administration, and students' attitude towards mathematics. These hinder and limit the teachers in choosing mathematics strategies that would favour good performance of mathematics.

The use of RAT and CAT, Group work, increase of mathematics teachers, more resources, ICT integration, more time allocation, individualised learning, peer teaching and peer consultation, interclass joint examinations, building good teacher relationship, and reducing class sizes would be some of the intervention are that were needed to improve teaching strategies in mathematics.

5.4 Recommendations

1. The teaching strategies should be tailored toward student-centered as opposed to teacher-centered methods.
2. The school should support the mathematics programs such as creating extra time in the morning, lunchtime or evening so that learners can practice mathematics using students-centered approaches on their own or with the aid of the teacher.
3. The ministry of education should urgently employ mathematics teachers to curb the shortage of mathematics teachers. This will help teachers to be able to use students' centered strategies since they will have adequate time for lesson preparation and individualised student follow up.
4. The class sizes should be reduce to 40 so that individualised teaching methods can be achieved.

The study further recommends that a study should be carried out in other areas such as

1. Effects of early syllabus coverage on students' mathematics performance.
2. Monitoring and evaluation of teachers teaching strategies on mathematics performance.
3. School support on mathematics performance of students.
4. Teacher motivation verses performance.

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APPENDIXES

Appendix I: Students' Questionnaire

I am a post-graduate student from the Catholic University of Eastern Africa, Nairobi. I am carrying out a study on the teaching strategies in enhancing students mathematics performance in public secondary schools of Bahati Sub-County, Kenya.

It is hoped that the result of this study will be useful in improving mathematics performance for students in National exams.

Your participation in this research study is completely voluntary. If you agree to participate in this study, please answer the questions on the questionnaire as best as you can. Your responses will be treated as confidential and will only be used for this research study. Kindly do not indicate your name on the questionnaire.

Thank you in advance for your cooperation and assistance in this important endeavour.

Sincerely,

Hellen Nyaikamba Kamau

Section A: Demographic Information

1. Gender
   a) Male [ ]
   b) Female [ ]
2. What is your age ……..
3. School category: National [ ] Extra-County [ ] County [ ] Sub-County [ ]
4. School type: Boys school [ ] Girls school [ ] Mixed school [ ]

Section B: Strategies Used in Teaching Mathematics

5. The following are mathematics teaching strategies, which applies in your school?
   a) Question and answer [ ]
   b) Demonstration [ ]
   c) Timed testing [ ]
   d) Group work [ ]
   e) Self-discovery [ ]
   f) Teacher explanation [ ]
   g) Math games [ ]
   h) Random assessment test [ ]

i) Others (specify)

……

……

6. From the list in question (5) which one do you prefer your mathematics teacher to use in teaching mathematics?

……

……

……

……

7. What are the reasons why you prefer the choice you made in (6) for learning mathematics?

……

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……

Section C: Teaching Strategies and Students' Mathematics Performance

8. In which way does teacher's teaching strategies affected your performance in mathematics

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Section D: Factor Affecting Teachers' Choice of Teaching Strategies

9. What are the factors affecting teacher's choice of teaching strategy?

……

……

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Section E: Challenges facing Mathematics in Choosing a Teaching Strategies

12. Name (3) major challenges you experience in learning mathematics.

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……

Section F: Measures in Improving Teaching Strategies in mathematics

12. What measures should be put in place to enhance mathematics performance in your school?

    ……
    ……
    ……
    ……
    ……

Appendix II: Questionnaire for Mathematics Teachers

I am a post-graduate student from the Catholic University of Eastern Africa, Nairobi. I am carrying out a study on teaching strategies in enhancing students' mathematics performance in public secondary schools of Bahati Sub-County, Kenya.

It is hoped that the result of this study will be useful in improving students' mathematics performance.

Your participation in this research study is completely voluntary. If you agree to participate in this study, please answer the questions on the questionnaire as best as you can. Your responses will be treated as confidential and will only be used for this research study. Kindly do not indicate your name on the questionnaire.

Thank you in advance for your cooperation and assistance in this important endeavour.

Sincerely,

Hellen Nyaikamba Kamau

Section A: Demographic Information

1. Gender
a) Male [ ]
b) Female [ ]
2. Age bracket below 25 [ ] 25-30 [ ] 30-35 [ ] 35-40 [ ] 40-45 [ ] 45-50 [ ] 50-55 [ ] 55-60 [ ]
3. For how long have you taught mathematics 0-5 [ ] 5-10 [ ] 10-15 [ ] 15-20 [ ] above 20 [ ]
4. School category: National [ ] Extra-County [ ] County [ ] Sub-County [ ]
5. School type: Boys school [ ] Girls school [ ] Mixed school [ ]

Section B: Strategies Used in Teaching Mathematics

6. Which strategies do you use in teaching mathematics?
   j) Question and answer [ ]
   k) Demonstration [ ]
   l) Timed testing [ ]
   m) Group work [ ]
   n) Self-discovery [ ]
   o) Teacher explanation [ ]
   p) Math games [ ]

q) Others (specify)

…….

…….

7. From the list of (6) above which one do you prefer for teaching mathematics?

……

……

8. What are the reasons why you prefer the choice you made in (7) for learning mathematics?

……

……

……

……

Section C: Factors Affecting Teachers Choice of A Teaching Strategy

9. (a) Do the number of lessons you teach affect your teaching strategies?
   Yes [ ] No [ ]
   (b) If your answer is (yes) in which ways does it affect your teaching strategies?

……

……

……

10. In which ways does your mathematics lesson planning affect the ability of students to grasp the mathematics content?

……

……

……

……

11. Have you ever attended for the last five years seminars that are organized to enhance teaching mathematics in your Sub-County? Yes [ ] No [ ]
12. In which ways is it helpful in improving your teaching of mathematics?

……

……

……

……

13. Please indicate to what extent you agree/disagree with school-related characteristics in mathematic performance. (Tick appropriately).

School-related factors	SD	D	U	A	SA
Students' entry behaviour affects the choice of teaching strategy					
I find it hard to use some of teaching strategies in mathematics					
The nature of the topic affects the choice of my teaching strategies					
The school management has influence upon my instructional strategies					
I choose the teaching learning activities considering available resources					
The examination system has impact upon my teaching strategy					
I consider students' interest and choose the teaching strategy					
My choice of teaching strategy is determined by the prescribed school curriculum					

Section D: Challenges Facing Teachers in Choosing a Teaching Strategy

14. Name three challenges you face when choosing a teaching strategy?

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……

Section E: Measures in Improving Teaching Strategies in Mathematics

15. What intervention that can be put in place to improve teaching strategies in mathematics?

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Appendix III: Interview Schedule for HODs

1. What are some of the teaching strategies used by mathematics teachers in teaching and learning mathematics?
2. How does the choice of teaching strategies affect students' mathematics performance?
3. What kind of workshops and seminar teachers have mathematics teachers attended in the last five years?
4. In what ways do those seminars affect the choice of teaching strategies in mathematics?
5. In what ways does teachers' workload affect the strategies used by mathematics teachers?
6. How does the curriculum affect the choice of teaching strategies in mathematics
7. What are the challenges facing teaching and learning mathematics in your school?
8. Suggest possible solutions that can be put in place to enhance mathematics performance in your school?

Appendix IV: Interview Schedule For the Principal

1. What are the teaching strategies used by mathematics teachers in your school?
2. What is the current teacher-student ratio in your school?
3. What are the teaching and learning resources available for mathematics teachers in your school?
4. How does the entry behaviour affect the choice of teaching strategies in mathematics?
5. What kinds of workshops have your mathematics teachers participated in the last five years?
6. What are the challenges facing teachers in choosing teaching strategies in your school?
7. Suggest intervention that can be put in place to improve teaching strategies in your school?

Appendix V: Interview Guide for Sub-County Education Officers

1. Does the sub-county official conduct monitoring of teacher's strategies in teaching mathematics?
2. What kind of seminars and workshops organized by the Sub-County office to enhance teaching strategies for mathematics teachers?
3. What is the teacher-student ratio in your sub-county?
4. What are challenges facing the choice of teaching strategies in your Sub-County
5. In your opinion what can be to improve teaching strategies in your school?

Appendix VI: Document Analysis Guide

1. What is the mathematics performance of students in K.C.S.E. for the last five years?
2. What is the workload of mathematics teachers?
3. What is the number of students currently present in each class?

Appendix VII: Research Budget

Item	Amount in Ksh
Stationary/ Binding	10000
Printing/Photocopy	5000
Typing/Software (SPSS) use	10000
Travel expenses	10000
Research Assistant	10000
Contingencies	3000
Total	**480000**

Appendix VII1: Introductory Letter

THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

Faculty of Education

Department of Postgraduate Studies in Education

Our Ref: CUEA/DVC-ACAD/FOE/PGSE/NACOSTI/01/ FEBRUARY, 2021

24 February 2021

THE DIRECTOR,

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION (NACOSTI) NAIROBI, KENYA

RE: HELLEN NYAIKAMBA KAMAU, RE**G. NO. MED 1035156**

I wish to introduce to you Kamau Hellen Nyaikamba a final year Master of Education of Education student at The Catholic University of Eastern Africa, Nairobi – Kenya; and request you to assist her accomplish her academic research requirements.

Nyaikamba's area of specialization is in Educational Research and Evaluation. Every student in the programme is required to conduct research, write a report/dissertation and submit it for examination in the final years of study. Accordingly, **Nyaikamba's** research proposal has been approved and she will conduct research on the following topic:

"Teaching Strategies in Enhancing Students' Mathematics Performance in Public Secondary Schools of Nakuru North Sub-County, Nakuru County, Kenya".

Thanking you in advance for according Hellen Nyaikamba, the assistance she may require to conduct her research successfully.

Sincerely,

SR. DR. ELIZBETH NDUKU
HEAD OF DEPARTMENT - POSTGRADUATE STUDIES IN EDUCATION

Appendix IX: NACOSTI Research License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **653704**

Date of Issue: **08/March/2021**

RESEARCH LICENSE



This is to Certify that Sr.. Hellen kamau Nyaikamba of Catholic University of Eastern Africa, has been licensed to conduct research in Nakuru on the topic: TEACHING STRATEGIES IN ENHANCING STUDENTS' MATHEMATICS PERFORMANCE IN PUBLIC SECONDARY SCHOOLS OF NAKURU NORTH SUB-COUNTY, NAKURU COUNTY, KENYA for the period ending : 08/March/2022.

License No: **NACOSTI/P/21/9350**

653704

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix X: Permission Letter from County

MINISTRY OF EDUCATION

STATE DEPARTMENT OF EARLY LEARNING OF BASIC EDUCATION

Telegrams: "EDUCATION",
Telephone: 051-2216917
When replying please quote
Email:cdenakurucounty@gmail.com

COUNTY DIRECTOR OF EDUCATION
NAKURU COUNTY
P. O. BOX 259,
NAKURU.

Ref. CDE/NKU/GEN/4/1/21 VOL.II/77

8th February, 2021

Approved and allowed to Proceed with the Study.
SUB-COUNTY DIRECTOR OF EDUCATION
NAKURU NORTH
P. O. Box 50-20113, BAHATI
Date: 9/3/21 Sign:

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION – SR. HELLEN KAMAU NYAIKAMBA
PERMIT NO. NACOSTI/P/21/9350

Reference is made to letter NACOSTI/ P/21/9350 dated 9th March, 2021.

Authority is hereby granted to the above named to carry out research in Nakuru County, Kenya on the topic: "***TEACHING STRATEGIES ENHANCING STUDENTS' MATHEMATICS PERFORMANCE IN PUBLIC SECONDARY SCHOOLS OF NAKURU NORTH SUB-COUNTY*** "for the period ending ***09/03/22.***

Kindly accord her the necessary assistance.

For COUNTY DIRECTOR OF EDUCATION
NAKURU COUNTY
P. O. Box 259 NAKURU

Ruth Kamau
For: COUNTY DIRECTOR OF EDUCATION
NAKURU

Copy to:

- Catholic University of Eastern Africa

Appendix XI: Map of Kenya



Appendix XII: Map of Nakuru County

