AN ANALYSIS OF THE FACTORS INFLUENCING ACHIEVEMENT IN MATHEMATICS GEOMETRY AMONG SECONDARY SCHOOL STUDENTS IN MAKADARA SUB-COUNTY, NAIROBI COUNTY

MUSYIMI DORCAS NDINDA

E55/CE/13187/09

RESEARCH THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF EDUCATION(MATHEMATICS EDUCATION) IN THE SCHOOL OF EDUCATION KENYATTA UNIVERSITY.

JUNE 2016
DECLARATION

I confirm that this thesis is my original work and has not been presented for a degree in any other university/institution for certification. This thesis has been complemented by referenced works duly acknowledged. Where text, data, graphs, pictures or tables have been borrowed from other works – including the internet, the sources are specifically accredited through referencing in accordance with anti-plagiarism regulations.

Signature .................................................. Date..........................

Dorcas NdindaMusyimi-E55/CE/13187/09
Department of Educational Communication & Technology

SUPERVISORS

We confirm that the work reported in this thesis was carried out by the candidate under our supervision as University supervisors.

Signature .................................................. Date..........................

Dr. Marguerite Mihevo O’Connor
Department of Educational Communication & Technology
Kenyatta University

Signature .................................................. Date..........................

Dr. Simon Rukangu
Department of Educational Communication & Technology
Kenyatta University
DEDICATION
I dedicate this work to my mother AnnahMuthike, my loving husband Jonathan Nzomo and my children Loice, Gabriel and Debora, so that it may be a source of inspiration in their pursuit for knowledge.
ACKNOWLEDGEMENT

I am grateful to the Almighty God for his protection, provision of good health, guidance and for enabling me to start and finish this work. My sincere gratitude goes to my supervisors; Dr. Miheso O’Connor and Dr. Simon Rukangu for their tireless support, encouragement, guidance and constructive criticism which yielded ideas that enabled me complete my work. Special thanks go to all lecturers in the Department of Educational Communication and Technology for their academic support throughout the course.

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### ACRONYMS AND ABBREVIATIONS

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<tr>
<td>GOK</td>
<td>Government of Kenya</td>
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<tr>
<td>INSET</td>
<td>In-Service Education Training</td>
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<tr>
<td>K.C.S.E</td>
<td>Kenya Certificate of Secondary Education</td>
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<td>K.I.E</td>
<td>Kenya Institute of Education</td>
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<td>K.I.C.D</td>
<td>Kenya Institute of Curriculum Development</td>
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<tr>
<td>KNEC</td>
<td>Kenya National Examination Council</td>
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<tr>
<td>M.G.A.T</td>
<td>Mathematics Geometric Achievement Test</td>
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<td>M.S.Q</td>
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<td>M.T.Q</td>
<td>Mathematics Teachers Questionnaire</td>
</tr>
<tr>
<td>PDSI</td>
<td>Plan, Do, See and Improve</td>
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<tr>
<td>SMASSE</td>
<td>Strengthening of Mathematics and Science Education</td>
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<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
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ABSTRACT

This study investigated the factors influencing achievement in mathematics geometry among secondary schools student in Makadara sub-county, Nairobi county. The aim of the study was to find out the factors contributing to poor performance in Mathematics and provide a way of improving the students performance specifically in geometry. The study was guided by the following objectives: effects of teaching strategies on the students level of achievement in geometry in secondary schools, to examine the effect of student study habits on the level of achievement in geometry, to assess the effect of curriculum implementation on the students level of achievement in geometry, to examine the effects of evaluation on the students level of achievement on geometry and to determine some of the problems students encounter in learning of geometry. Two hundred and forty students selected randomly from six schools in the district participated in the study. Student level of geometrical achievement was tested using mathematics geometric achievement test (M.G.A.T), and different teaching and learning strategies explored. The key issues postulated in the study revolved around teaching strategies, student study habit, curriculum implementation, assessment and evaluation criteria on the level of achievement geometry. Data were collected using a questionnaire and the M.G.A.T. Descriptive and inferential statistics were used to establish the relationship between the aforementioned factors and the understanding of geometry among the students. The findings of this study showed that teaching strategies, students study habits, curriculum implementation and evaluation had positive and significant relationship with the level of achievement in geometry. The finding showed that 79% of the students and teachers in this study indicated poor attitude toward geometry among students was the major problem among students while 65.9% indicated lack of adequate learning resources, 62.7% indicated lack of practical sessions, 55.5% of the respondents indicated poor learning strategies used by teachers. Only 38.6% of the respondents indicated lack of enough trained and experienced teacher. The study concluded that strategies used by teachers in learning/teaching geometry contribute to the level of performance in geometry test. Teachers used strategies that don’t motivate students to excel in geometry. This study further concluded that the performance of students within the study region in geometry tests was still very poor. This can be attributed to poor attitude among students, lack of adequate learning resources and poor learning strategies used by teachers, lack of practical sessions. Lack of enough trained and experienced teacher was the least problem that affected the learning/teaching of geometry.
CHAPTER ONE
INTRODUCTION

1.1 Overview
This chapter chronologically presents the background, problem statement, purpose, objectives, research questions, assumptions, significance, delimitation, limitation, theoretical framework, conceptual framework, and operational definition of terms. Therefore, the chapter builds on the study.

1.2 Background to the Study
The main objective of teaching Mathematics at all levels is to enable the learner develop clear and logical thinking needed for analysis of both academic and everyday life situation (Scopes, 1973). Thus Mathematics aids in understanding other subjects, especially sciences subjects. Mathematics is necessary for the development of scientific, technical, monetary and commercial activities around the life of an individual and the community (Ayot & Patel, 1992).

Education is an element in stimulation of social economic development as advanced by several government policy documents and various scholars (Selina, 2012). According to Todaro (2004) a country which is unable to invest in education to develop knowledge and skills of her people and utilize them effectively in national economy will be unable to develop anything else. Hallack (1990) states that education has been identified Worldwide as an important component that determines character and social economic development of any nation.
Developed countries like USA and Japan have a large pool of highly skilled human resources. This has enabled them to not only exploit local natural resources but also to identify and negotiate for other countries resources. Education is fundamental ingredient for creating economic development. In the United States it has been more important than increased capital in accounting for worker productivity and US economic growth (Smith, 2003).

The performance of education is evaluated based on examinations given and attainments of students in such examinations. Examinations have been accepted by educationists and other stakeholders as an important aspect of any education system (Musau, 2015). The importance placed on examination has seen stakeholders come up with strategies aimed at improving learner’s performance in examinations (Juma, 2011).

Eze, Ezenwafor and Molokwu (2015) noted that to facilitate the process of knowledge transmission, teachers should apply appropriate teaching methods that best suit specific objectives and level exit outcomes. In the traditional epoch, many teaching practitioners widely applied teaching methods to impart knowledge to learners comparative. Adunola (2011) also maintained that teachers need to be conversant with numerous teaching strategies that take recognition of the magnitude of complexity of the concepts to be covered.

Secondary school Mathematics in Kenya is designed to help students in working out solutions to problems with accuracy, precision and speed both academic and functional life situation. According to Kinyua, Maina & Odera (2003), Mathematics helps the students to improve their skills in measurement, approximation and estimating. Such skills are necessary for any quest be it academic or business. It also aids students in collecting, representing and interpreting data, which they can manipulate and add meaning to Mathematics, therefore
helps the learner to develop investigative and problem solving skills, thus enabling them to understand better and manage their personal and collective life (Costello, 1991). Despite the importance of Mathematics in daily life, the student’s achievement in Mathematics is very low. Un-attainment of the objectives set for Mathematics is a global issue. Several countries question the Mathematics low attainment of the students in school.

Britain as a country has its share in the great debate that led to Cockcroft inquiry (Costello, 1991). He observed that ‘anxiety’ about standards of achievement in school Mathematics appeared to be a permanent feature of British life with complaints of declining standards made regularly in the press and by government organs for well over hundred years. In Kenya the baseline survey of 1998, revealed that performance in Mathematics and sciences by both boys and girls was generally poor (Maweu, 2005).

In 1998, the Government of Kenya (GoK) launched a project for strengthening of Mathematics and Sciences in Secondary Schools (SMASSE) INSET. SMASSE launch was against a background of poor performance in Kenyan schools in Mathematics and Science subjects. Kenyan Mathematics and Science teachers were to undergo four cycles meant to induct them to active teaching methods with SMASSE strategy of Activity, Students Experimentation, and Improvisation (ASEI) and Plan, Do, See and Improve (PDSI) movement skills in teaching learning process. Despite the training undertaken by teachers, the attainment in Mathematics is persistently low. Figure 1.1 shows the national mathematics mean score for the period 2006 to 2009.
Figure 1.1: National Mathematics Mean Score for 2006 to 2009
Source: KNEC (2011)

Figure 1.1 shows a slight improvement in attainment in Mathematics. Thirteen years after the introduction of SMASSE, the mean score is still low in Nairobi County. The performance in Mathematics was fluctuating as shown in the figure 1.2.

Figure 1.2: Mathematics Results Analysis for Nairobi County
Over the years, Makadara District performance stagnated at grade D Plain this trend of the performance indices is alarming. Figure 1.3 shows the performance in Mathematics of Makadara district for the last five consecutive years.

![Mathematics Performance Index Graph](image)

Figure 1.3: Mathematics Results Analysis for Makadara district Nairobi County

From Figure 1.3, it is clear that majority of the students had not attained grade D+ (Plus) over the five years. The low student’s achievement in Mathematics has been a source of great concern for all Education stakeholders, that is, parents, teachers and government who have been investing heavily in the Education of the young people in Kenya and the whole world. The immediate expected output from the Education system is good performance in examination. However, the performance has continued to be poor.

This means that the problem is not been addressed. According to Cockcroft report (1982:454), the poor performance could be as a result of failure to understand Mathematical concept which can result from the fact that the Mathematical concept involved may be too
difficult for the stage of mathematical development which pupil has reached or it can also result from teaching which pays too little attention to practical experience or which moves ahead too rapidly so that understanding does not have time to develop. If students are following a syllabus, which is too large, or too demanding, both reasons can contribute to their poor performance. A close examination of the secondary Mathematics syllabus indicates that geometry covers a large portion of the content approximately 43.75%, (KNEC syllabus (2008-2009).

This geometrical content, according to Henderson (1982), can be classified into four areas i.e. Plane geometry; the geometry that deals with figures in two dimensional plane, Solid geometry which deals with figures in three dimensional space, Spherical geometry dealing with figures on the surface of the sphere, Euclidean geometry which deals with plane and solid based on Euclid’s postulates and Analytical geometry that deals with the relationship between algebra and geometry, using graphs and equations of lines, curves and surfaces to develop and prove relationships (Henderson, 1982).

The common topics in geometry, according to Kenyan Institute of curriculum development syllabus (KICD) includes: Plane geometry, Solid geometry covering the surface area and volumes of solids such as cubes, pyramids, cones and cylinders, Transformation geometry and Analytical geometry. Since large proportion of the content in the syllabus is geometry, these prompted the researcher to closely examine the content of this strand in the KCSE Examination of the year 2009 and 2010.

This implies that a student who does not understand Mathematics geometrical concept may not end up attaining high grades in Mathematics. The KNEC (2010) report indicated that candidates performed poorly in the construction question, which they were required to
inscribe a circle. According to the above report, there was misconception of the concept leading to wrong interpretation, hence the poor performance in the question.

A study by Amwayi (2002) on mastery of Euclidean plain geometry concept among standard seven primary school pupils in Kakamega showed that only 3.21% of the standard seven pupils had mastery of Euclidean plane geometry. This study was based on the basic Mathematics geometrical concepts that are the foundation of the further geometry studied in secondary school syllabus. Hence, this study was carried out to investigate the factors influencing achievement in mathematics geometry among secondary school students in Makadara Sub-County, Nairobi County.

1.3 Statement of the Problem

The national achievements in Mathematics are persistently low despite the efforts already in place to improve on it. Makadara-sub-county in Nairobi has consistently scored a mean grade of D plain in mathematics. Candidates persistently performed poorly in geometry questions KNEC (2010). Mathematics content in high school revolves around geometry e.g plane figures, coordinate geometry, trigonometry, transformation among others. A students whose spatial ability has not developed may not perform well in mathematics. Spatial ability to visualize figures is developed in geometry.

Several studies have been conducted in this field, forinstance, Odundo (2003) noted that students who experience a mismatch between instructional strategies used during teaching and their preferred styles often feel that their learning needs are being addressed using an unfamiliar language. The mismatch poses a difficulty for some students in internalizing the materials delivered, leading to lower grades (Odundo, 2003).
Similarly, Zeeb (2004) indicated that students whose styles are not matched with learning methods that are chosen by teachers are less likely to develop interest in learning. In the absence of learner interest in a subject, concentration level drops and learning achievement is greatly impaired.

Most of the studies in this field such as Odundo (2003) and Zeeb (2004) focused on mathematics as a subject whereas this study focused on geometry. This persistent poor performance in geometry raises a lot of concerns and little research has been carried in Kenya and more specifically in Makadara district Nairobi County to find out student’s status of achievement in geometry. This study aimed at investigating the factors influencing achievement of students in geometry among secondary school in Makadara Sub-County in Nairobi County.

1.4 General Objective

The study sought to investigate the factors influencing performance of students in geometry among secondary school in MakadaraSub-County in Nairobi County. The study was guided by the following specific objectives;

1.4.1 Specific Objectives

1. To establish the effects of teaching strategies on the students level of achievement in geometry in secondary schools in Makadara sub-county, Nairobi county

2. To examine the effects of students study habitson the level of achievement in geometry in secondary schools in Makadara sub-county, Nairobi county
3. To assess the effects of curriculum implementation on the students level of achievement in geometry in secondary schools in Makadara sub-county, Nairobi county

4. To examine the effects of evaluation on the students level of achievement in geometry in secondary schools in Makadara sub-county, Nairobi county

5. To determine some of the problems students encounter in learning of geometry among secondary schools students in Makadara Sub-County, Nairobi County

1.5 Research Questions

1. What are the effects of teaching strategies on the students level of achievement in geometry in secondary schools in Makadara sub-county, Nairobi county?

2. How does students study habits affect the level of achievement in geometry among students in secondary schools in Makadara sub-county, Nairobi county?

3. What are the effects of curriculum implementation on the students level of achievement in geometry in secondary schools in Makadara sub-county, Nairobi county?

4. What is the relationship between evaluation and the students level of achievement in geometry in secondary schools in Makadara sub-county, Nairobi county?

5. What are some of the problems that students encounter in learning of geometry among secondary schools students in Makadara Sub-County, Nairobi County?
1.6 Assumption of the Study

The study assumed that all Mathematics teachers are trained and are able to teach geometry. It also assumed that all students involved in the study undertake mathematics as a subject in their respective schools.

1.7 Significance of the Study

The findings of this study may provide information to the KICD and Ministry of Education about the students’ understanding of Mathematics geometry concept. It helps them understand the challenges faced by the students in understanding geometry concepts that makes them perform poorly. It also help them come up with ways and means of teaching techniques that will enhance correct understanding geometry concept and also produce materials that will aid geometric thinking. The findings of this study will add to the world of knowledge information about study habits that enhance understanding of geometry concepts.

1.8 Delimitation of the Study

This study focused on investigating the factors influencing performance of students in geometry among secondary school in Makadara Sub-County in Nairobi County. The study was carried out in Makadara district Nairobi County. The study focused on Nairobi county because of limited financial and time factors. The study focused on form one and two because basic geometry concepts are covered at this level and are expounded at advanced levels of secondary school. Therefore, this study generalized conclusion over the region using the sampled schools.
1.9 Limitations of the Study

The study confined to students and teachers in Makadara District, Nairobi County. The geometrical topic covered was Plane geometry in form one and two. The student respondents were form threes since it assumed that they have covered up to form two syllabuses. The data collection instruments were limited to questionnaires and Mathematics geometry achievements test (M.G.A.T) due to factor of time.

1.10 Theoretical Review

This study is anchored on system theory. Systems theory is a framework for elaborating increasingly complex systems across a continuum that encompasses the person-in-environment (Carter, 2011). Systems theory was proposed in the 1940’s by biologists Ludwig and Von Bertalanffy, who suggested that real systems are open to and interact with their environment, and that they can acquire qualitatively new properties through emergence, resulting in continual evolution. Rather than reducing an entity to the properties of its parts or elements, system theory focuses on the arrangement of and relations between the parts which connect them into a whole (Bertalanffy and Ludwig, 1973).

In this study the system theory explains that teaching/learning process is dynamic and has inputs and output. Input includes the characteristics of teachers and students that they bring to the teaching learning process. Process include the thinking, feeling, commitment and action of teachers and students within the classroom or learning situation as well as interaction patterns and description of the learning environment that results from this interaction (Mcllrath et al, 1995). Output includes specific measurement or measurement of learning.
It is argued that understanding of Mathematics geometry concepts leads to students’ achievement in Mathematics. The best results are achieved when the most suitable materials are used in the teaching/learning system in the best way possible. The study was based on teaching strategies that involve students that lead to worthwhile learning of geometry than expository teaching method. It was also based on the fact that some students study habits if employed can result to correct understanding of mathematical geometry concept. It looked into school curriculum implementation, teaching strategies, students study habits and evaluation effect on the level of achievement in geometry.

The study will further be guided by the social constructivist theory by Woo and Reeves (2007). Social constructivist theory suggests that knowledge is first constructed in a social context and then appropriated by individuals. It involves learners constructing knowledge which would not be possible alone. This theory emphasizes that individuals make meaning through the interactions with each other and with the environment that they live in.

In this theory Vygotsky observed that when children were tested on tasks on their own they rarely did as well as when they were working with others. Constructivism is a theory that gives teachers another perspective to rethink how learners learn and to focus on the process and provide ways of documenting change for transformation. It also reminds teachers to look for different ways to engage individual learners and to provide a rich environment for explorations. The teacher’s role is to prompt and facilitate learning (Vygotsky, 1978).
1.11 Conceptual Framework of the Study

Independent Variables

**Teaching Strategies**
- Discussion Methods
- Participatory Teaching Approach
- Demonstration
- Assignment Method
- Drawing and Modelling Method

**Students study Habits**
- Discussion
- Privately using textbooks
- Consultation
- Doing assignments

**Curriculum implementation**
- Remedial Lessons
- Motivation of Student
- Resources for Learning Geometry

**Evaluation**
- Assessment of geometrical concept
- Frequency of assessment
- Assessment Feedback
- Continuous Assessment Tests

Dependent Variable

**Student’s achievement in Geometry**
- Grasp of concepts
- Good performance
- Concept application

**Intervening Variables**
- Teaching/learning resources
- Teachers’ training/experience
- Students’ attitude

Figure 2.1: Conceptual Framework of Study
1.12 Operational Definition of Terms

**Achievement** in Mathematics could be all possible tasks successfully accomplished by students in and out of school.

**Analytical geometry** is the geometry that deals with relation between algebra and geometry, using graphs and equations of lines, curves and surfaces to develop and prove relationship.

**Euclidean geometry** is the geometry based on postulates.

**Geometry** is the branch of Mathematics that deals with space, figures in space and with properties of those figures such as size and shape. Bold all key terms see KU format

**Learning** a permanent change in behaviour as a result of sustained practice or experience.

**Plane geometry** is the geometry that deals with figures in a two dimensional plane.

**Postulates** or axioms are unproven but universally accepted assumptions such as ‘there is one and only one line that passes through two distinct points’.

**Solid geometry** is the geometry that deals with figures with three-dimensional space.

**Spherical geometry** is the geometry that deals with figures on the surface of the sphere.

**Strategy** is the overall way in which the process of instruction is organised and executed.

**Syllabus** is a document that shows the content to be covered in a given subject and time at a particular level.

**Theorems** are logically deduced postulates.
**Van Hiele Level** this are levels through which students geometrical understanding progresses

1.13 **Chapter Summary**

This chapter provides the background information, a statement of the problem, study objective and the scope of the study. Theseis also consist of the theoretical review and the conceptual framework. The study is anchored on systems theory and social constructivist theory. The conceptual framework shows the relationship between the dependent and independent variables to be tested in the study.
CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviewed literature related to the study. Since limited numbers of related studies are available to the researcher, most of the literature reviewed has been cited from foreign studies and from internet. This study in particular discussed issues on teaching strategies, students’ study habits, school curriculum implementation, and evaluation that enhance understanding of Mathematics geometry concept and summary of literature review.

2.2 Teaching Strategies

The learning of Mathematics is often viewed as an isolated, individualistic or competitive matter, one sits alone and struggles to understand the material or solve the assignment problems. This process can often be lonely and frustrating, Davidson Neil (1990). This can lead to “math avoidance” or “math anxiety”. Davidson observed that small group cooperative learning could solve this. Small group provide a forum in which students ask question, discuss ideas, demonstrate to others, learn to listen to others and offer constructive criticism and summarise their discoveries in writing.

According to Rukangu (2000) in his study on pupils ‘ development of spatial ability in Mathematics, he observed that one of the students’ study habits was discussion between students and students, between teachers and students and between students and parents. This method of teaching enhances psychomotor skills, helps students to discern mathematical relationship in objects and concretizes mathematical concepts. Learning by doing also raises learner’s level of recall and retention of mathematical content in long-term memory (Kluwe,
et al., 1990). Students do these practical tasks in either of the following environments: within the classroom and out of classroom environment. In both cases, Mathematics teachers are expected to provide materials and guidelines to the students on what to do. For instance, students can construct 3-dimensional models for teaching geometry or any other construction within the classroom. In out of class tasks, students calculate the dimensions of physical environment. They can be involved in measuring the dimensions of the school compound in tackling the topic: “scale drawing and survey.” The task given to the student should be relevant to the learners and have mathematical value. In a group, most students are usually active, cooperative and self-reliant in solving problems outside the normal Mathematics classroom. This method stimulates, motivates and improves students’ interest, retention and creativity. (Kluwe, et al., 1990; UNESCO, 1987). The current research aimed at investigating whether teaching strategies, students study habits, curriculum implementation and evaluation affect the level of achievement in geometry among secondary schools students.

According to Mondo (2001), games promote learning of Mathematics. Based on the students’ rate of mastering concepts, facts, skills and principles, it makes mathematical concepts interesting to the slow and average learners. These games have mathematical contents and rules of the game are based upon the solution of a mathematical problem. Winning a game motivates students to solve the mathematical problems (UNESCO, 1987). Charles and Lynwood (1990) attest that geometry has the characteristic of both game and a puzzle; an intellectual game to be played under accepted rules and a puzzle to challenge the ingenuity of the student. They argue that these two characteristics in effect constitute the spirit of demonstrative geometry and when students can be brought to approach the subject in this spirit the problem of boredom cease to be a problem at all.
Tangrams can also be used to teach students to measure areas without formulas, an approach that should help students develop an intuitive sense of geometry. Tangrams are Chinese consisting of seven shapes, two larger right triangles, one medium sized right triangle, two small right triangles, one small right triangles and a parallelogram. Shapes can be fitted together as a large square, rectangle or triangle. They can be arranged in a variety of complex shapes including fanciful words. The player is shown a target shape and then asked to recreate that shape using the seven pieces (NCTM 2003).

2.3 Students Achievements in Geometry

Every unit whether it is built around a particular kind of geometric property will aim at the understanding and mastery of several kinds of things (Charles et al 1990). This includes the mastery of an associated mathematical vocabulary, clarification of certain geometrical concepts, understanding of relationships within and among particular geometric figures under given conditions, the ability to make acceptable and helpful drawings and to use a suitable notation, the ability to understand certain geometric facts, (Charles et al 1990).

The role of the teacher is to provide a suitable learning situation and activities through which students will have optimal opportunity for attaining the desired understanding and abilities and to help the students in appropriate ways of mastery of the objectives towards which the instruction is aimed. The teacher may use numerous means at their disposal since the principle aim at this stage is knowledge and understanding rather than formal proofs.

Direct measurement with measuring instruments including ruler & protractor, may be used to build clear understanding of the measuring and the approximate nature of measurements to provide numerical data for experimental study of geometric figures and their properties, chalkboard drawings accompanied by suitable explanatory comment serve to clarify many
ideas, experiment in paper folding can lead to discovery of principles about angles and lines, cross-section paper facilitates understanding of relationships through the construction and interpretation of graphs.

2.4 Intervening Factors

There are many studies that have explored the relationship between teaching materials and other related inputs and students’ learning and achievement in developing countries (Chepkurui 2004). Among the most important instructional material that has shown to have a significant influence in the teaching-learning process is text book. Their availability and use of such materials have a positive effect on students’ achievement in Mathematics and in particular in geometry, since the students can use it as a guide in geometric skill development and offers exercise for further practice of learnt concept.

Moreover, Greg et. al., (1992) assert that computers have had an enormous impact on the teaching of geometry. With the availability of good graphing programs and visualization software, teaching geometry has become more open-ended and exploratory than the traditional emphasis on memorizing theorems and proofs. This new approach is consistent with research findings that students pass through different levels of geometric thinking, visualization, analysis and deduction.

Clements and Batista (1989), argue that the computer language software has proved valuable in the teaching of geometry. It helps students move from empirical to logical thinking, encourages students to make and test conjectures, facilitate precision and exactness in geometric thinking, encourage the development of autonomy in learning. The fundamental characteristics of using logo in geometry classes is that students actively construct their own understanding of Mathematics, they use computers to create geometric shapes, change them,
move them around, and combine them into new shape. They discuss what they have done with each other and the teacher, in doing so they progress to higher levels of geometrical thinking, hence high achievement in Mathematics.

Many studies conducted have quite consistently shown that thoughtful use of calculators in mathematics classes’ improves student Mathematics achievement and attitude towards Mathematics. Research on the use of scientific calculators with graphing capabilities has shown positive effects on student achievement. Most studies have found positive effects on students graphing ability to relate graphical representation to other representation. Other content areas where improvement has been shown these calculators have been used in instruction include function concepts and spatial visualization. The graphing calculator is particularly useful in helping to illustrate and develop graphical concepts and in making connections between algebraic and geometrical ideas.

2.5 Empirical Review

2.5.1 Strategies used by Teachers in Teaching and Learning of Geometry

The methods used in teaching Mathematics are instrumental in determining ones performance Keith (1999). Farrant et al (1997) argues that instructional methods contribute towards success in subject teaching. Mathematics teaching at all levels should include opportunities for exposition by the teacher, discussion between the teacher and the pupils and between the pupils themselves and appropriate practical work consolidation. It also involves practice of fundamental skills and routines of problem solving (Morris 2001, Cockroft report 1982).

Kiminza et al (1999) in a study undertaken by K.I.E, found out that Mathematics teachers mainly use participatory teaching approach. In their analysis of mostly
frequently used methods, assignment method scored 50.6% followed by a class discussion 48.6%, demonstration 38.9%, drawing and modeling 34.4%. According to Kiminza et al (1999) participatory teaching method was prevalent despite the deteriorating performance over the years. This study wishes to establish teaching strategies that enhance achievement of geometry concept.

In his study, Edgar (1994) noted that many teachers forget the learner requires psychomotor and affective skills. He says that problems of motor learning are often overlooked by teachers. These can only be developed by certain teaching methods. This study was set to find out the strategies mostly used by teachers to teach geometry in Makadara district.

The learning of Mathematics is often viewed as an isolated, individualistic or competitive matter, one sits alone and struggles to understand the material or solve the assignment problems. This process can often be lonely and frustrating, Davidson Neil (1990). This can lead to “math avoidance” or “math anxiety”. Davidson observed that small group cooperative learning could solve this. Small group provide a forum in which students ask question, discuss ideas, demonstrate to others, learn to listen to others and offer constructive criticism and summarize their discoveries in writing.

According to Rukangu (2000) in his study on pupils ‘ development of spatial ability in Mathematics, he observed that one of the students’ study habits was discussion between students and students, between teachers and students and between students and parents.

Mathematics teachers in secondary schools provide students with worked examples of sample problems or use the ones provided in the textbook with the hope that students will determine the underlying principle or rule that govern the solution of the initial problem and
transfer the learning to a new problem. According to Mayer (1992) and Horn (1995), students face the obstacles of inability to understand why the underlying rule worked correctly in the given example and are unable to use the underlying rule on a new problem.

According to Horn (1995), teachers are advised to give adequate varied worked examples with various complexities; plan a series of worked examples and that students should work out similar examples immediately. This enhances students’ achievement and ability to transfer learnt concepts to new mathematical problems. Students can solve new problems by using what they already know from analogous problems.

2.5.2 Level of Understanding of Geometry Concepts

According to Charles and Lynwood (1990), mortality in high school geometry has traditionally been high and this has been ascribed to various causes such as the difficulty of the subject, others have to blame it to ineptitude or laziness on part of the student. While others have held that students lose interest in geometry because of its abstract nature which they regard as having no practical value. They argue that demonstrative geometry is not easiest subject to learn. It demands careful and sustained attention, perseverance and a measure of ingenuity; in order to attain a real mastery of its most, students do have to do some hard work. Charles and Lynwood argue that the real reason for much of the failure in geometry and apathy towards the subject lies mainly in poor motivation and failure to provide clear insights into the meaning and methods of the subject, they also assert that children will work hard at things that interest them and they delight in games and puzzles.

A study by Rukangu (2000) on pupils development of spatial ability on Mathematics found that 67% did not enjoy learning spatial concepts because they are confusing, abstractly demanding a lot of thinking and difficultly to understand. This is an attitude formed by the
students. To overcome this, he recommended that the teacher should understand, encourage and motivate their pupils. His study focussed on a wide content coverage on spatial ability while this study focuses on geometrical topics in form one and two syllabus.

A study by Njeru (2010) on relationship between students’ English language competence in solving word problems and Mathematics performance in secondary schools in Maara District observed that reading Mathematics textbooks provides students with opportunity to learn the language and vocabulary necessary to improve their language competence hence better performance in Mathematics. He argued that Mathematics required understanding of concepts and constant practice to internalize them.

Njeru (2010) also found out that there was a positive correlation (R=0.424) between students’ knowledge in translating English expression into mathematical symbols and mathematical symbols into English meaning. In his study, the teachers unanimously agreed that many English words can easily confuse students because they carry different meanings in the normal language usage from mathematical usage. For instance words like volume, normal line, bearing, elevation, deduce, perpendicular, among others were identified.

2.5.3 Effects of the Strategies Used in Teaching and Learning on Performance

The study attempted to review literature on factors influencing the level of students’ achievement geometry concept in secondary school in Makadara sub-county. Most of the scholars who carried out studies on teaching strategies focused on factors affecting the performance in Mathematics where, teaching methods were reviewed and also the techniques which enhance Mathematics achievement for instance studies by Miheso (2002), Wasiche (2001), Kiminza et al (1999) among others. The above scholars did not address the geometry
content part; hence this study was carried out to investigate the teaching strategies that enhanced understanding of geometry concept.

Other areas reviewed in this study include, school curriculum organization which may affect the student mathematics achievement. Such factors as remedial, provision of resources, motivation of the students’ study habits reviewed in this study did not focus on geometry concept but focused on Mathematics content in general. Therefore, this study was set to investigate the students study habits specifically in geometry. From the resources available to the researcher very little has been done particularly on geometrical evaluation and therefore this study was to investigate the mode of geometrical evaluation that enhanced geometry understanding.

2.5.4 Students Study Habits/Styles in Geometry

Study habits are those activities necessary to organize and complete schoolwork tasks and to prepare for and take tests. (Robbins et al., 2002). The learning of Mathematics is often viewed as an isolated, individualistic or competitive matter, one sits alone and struggles to understand the material or solve the assignment problems. This process can often be lonely and frustrating, Davidson Neil (1990). This can lead to “math avoidance” or “math anxiety”. Davidson observed that small group cooperative learning could solve this. Small group provide a forum in which students ask question, discuss ideas, demonstrate to others, learn to listen to others and offer constructive criticism and summarise their discoveries in writing. According to Rukangu (2000) in his study on pupils ‘ development of spatial ability in Mathematics, he observed that one of the students’ study habits was discussion between students and students, between teachers and students and between students and parents.
Mathematics textbooks act as a guide to the students since most of them have worked examples and exercise for practice (Kinyua et al., 2003), students can study privately to exercise further what they learnt in class following the given examples by the teacher and the worked examples in the textbooks. According to Horn (1995), teachers are advised to give adequate varied worked example with various complexities, plan a sense of worked examples each with a new concept that should work out immediately thus enhance student achievement and ability to transfer learnt concepts to new mathematical problems. In case of any difficulties, further consultation with the teacher for clarification can ensue.

2.5.5 School Curriculum Implementation

School curriculum implementation entails what the school does to enhance understanding of mathematic geometry concept. The following were explored under school curriculum implementation, that is; remedial lessons, motivation of students, availability of resources among others. Orodho (2003), in his study on remedial lessons indicated that at the national level 69.5% of teachers offered remedial lessons during evenings and over morning preps and over the school holidays basically to cope with the broad 8-4-4 curriculum. This study revealed that students and teachers perception towards remedial was positive with many indicating that it assisted both the weak and bright students especially in preparation of National Examinations. He also noted that regular teachers within the school premises and mainly in Mathematics and sciences carried out remedial lessons. From this study, remedial lessons were done particularly in Mathematics and science subjects, but did not indicate the specific topics in geometry, which poses difficult in teaching/leaning.

According to SMASSE base line survey (1998) and SMASSE curriculum review (2002) geometric concepts like vector geometry where midpoint of a vector and centroid of a
triangle are a challenge to students’ and three-dimensional geometry especially angle between a line and a plane and angle between two planes, all these among others require remediation. Therefore, this study was aimed at determining whether the school organises for remedial lessons to improve geometrical understanding in Mathematics.

There are many studies that have explored the relationship between teaching materials and other related inputs and students learning and achievement in developing countries (Chepkurui 2004). Among the most important instructional material that has shown to have a significant influence in the teaching-learning process is text book. Their availability and use of such materials have a positive effect on students’ achievement in Mathematics and in particular in geometry, since the students can use it as a guide in geometric skill development and offers exercise for further practice of learnt concept.

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what they have done with each other and the teacher, in doing so they progress to higher levels of geometrical thinking, hence high achievement in Mathematics.

2.5.6 Evaluation of Geometrical Concepts

Assessment of geometrical concept should be a continuous process rather than just at the end of lesson, topic or course (KIE 2006). In the class assessment that takes place is diagnostic. It reveals how much learners have understood various concepts for instance geometrical skills such as construction and therefore plan for remedial work accordingly. This assessment can be done by observation of pupils as they solve given problems. The teachers assess the students as well as themselves in the light of students work (Kinyua et al 2003). The teacher is also to correct misconception. Assessment is also carried out on assignment given on problem solving. This gives feedback to the teacher whether the learners have understood the concept. The learners too are encouraged when they get feedback on their understanding of concepts and skills. Mathematics is learnt by doing and not watching others do it. The learners are encouraged/ motivated to work out prudently when teachers mark their work (KIE 2006). Geometry requires that students should be assessed on practical such as modelling and the models should be awarded marks. This could be done in groups in order to promote collaborative learning.

According to Kinyua et al (2003), the common assessments in secondary schools are class test also called continuous assessment, end of term, end of year test and MOCK examinations. Most of the questions performed poorly by students include questions on three-dimensional geometry (SMASSE 2009, KNEC 2010), vector geometry (SMASSE 2009), among others. They argue that, when setting a test especially in Mathematics; a table of specification is necessary in order to ensure that the test is balanced and valid. In
geometry, the skills to be tested include cognitive skills such as knowledge, comprehension synthesis, and evaluation and should be few while the bulk of the questions should be at application and analysis. This study investigated the modes of assessment and how frequent assessment of geometrical concepts was done for enhancing their understanding.

2.5.4 Problems Student Encounter in Learning of Geometry

Chappell (2003) claimed that high school students’ less than desirable background in geometry was due to middle school mathematics teachers’ superficial geometry knowledge. Other studies by Duatepe (2000) and Halat, (2008) charged that, pre-service elementary school mathematics teachers’ reasoning stages were below level - (III) (ordering).

In support of this Knight, (2006) stated that the pre-service elementary school teachers involved in her study were not at a suitable van Hiele level to understand formal geometry and that their previous instructions had not helped them to attain knowledge of geometry consistent with level – IV. Although these results were for pre-service teachers, they will be useful in the investigation and understanding of in-service mathematics student teachers’ challenges in transformational geometry.

Masaiti and Manchishi (2011) established that, there were gaps between what the University of Zambia programme was offering and what was obtaining in secondary schools. The study observed that, university trainee teachers were exposed to a broad content material which, in some cases, did not take into consideration what was obtaining in the Zambian secondary schools. In addition, the study revealed that UNZA prepared or trained teachers were weak in the delivery of subject matter (methodology).

The Examination Council (2006) examiners’ report showed that questions on geometry topics such as transformational geometry were very poorly answered. The same report
concluded that teachers did not get adequate support in the area of geometry (transformation) in their teacher preparation programme. Thus, they went into the field with the same challenges that they had when they were pupils themselves in schools.

2.6 Research Gaps

The study attempts to review literature on teaching strategies that can enhance understanding of Mathematics geometry concept. Most of the scholars who carried out studies on teaching strategies focused on factors affecting the performance in Mathematics where, teaching methods were reviewed and also the techniques which enhance Mathematics achievement for instance studies by Mihezo (2002), Wasiche (2001), Kiminza et al (1999) among others. The above scholars did not address the geometry content part; hence this study was carried out to investigate the teaching strategies than enhanced understanding of geometry concept.

Other areas reviewed in this study include, school curriculum organization which may affect the student geometrical concept understanding. Such factors as remedial, provision of resources, motivation of the students’ study habits reviewed in this study did not focus on geometry concept but focused on Mathematics content in general. Therefore, this study was set to investigate the students study habits specifically in geometry.

2.7 Chapter Summary

The chapter contains a review of previous literature related to this study. The review of the literature revealed that the strategies adopted by teachers contribute to the level of achievement of students in geometry. the attitude of the students was also established to be related with the level of achievement in Geometry. the review of the literature further revealed that curriculum organisation was among the challenges the hinder students
excellence in geometry. This chapter also provided some of the research gaps the study identified from the previous literature.
CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter provides details of methodology that were used to investigate the research problem, the research design, location of the study, target population, sampling techniques, sample size, research instruments, data collection procedures, data analysis techniques and ethical consideration.

3.2 Research Design

Orodho (2003) defines research design as the scheme outline or plan that used to generate answers to research problems. It is an arrangement of condition and analysis of data in a manner that aims to combine relevance and research purpose. This study employed descriptive survey design. Ogula (1998) asserts that surveys are used to gather systematic information necessary for decision-making. The descriptive survey was suitable for this study because the purpose of the study was to gather data on factors influencing achievement in mathematics geometry among secondary school students. In addition to the above, Kothari (1978) says that descriptive survey proceeds through well-defined stages, which include; Formulating the purpose of the study, Designing the method of data collection, Selecting the sample, Collecting the data, Processing and analyzing and, Reporting the findings.

3.3 Location of the Study

This study was done in Makadara District, Nairobi County-Kenya. MakadaraSub-County was chosen for this study because the students’ achievement in Mathematics has been continuously is low. Over the years, MakadaraSub-County performance stagnated at grade D
Plain. The low student’s achievement in Mathematics has been a source of great concern for all Education stakeholders, that is, parents, teachers and government who have been investing heavily in the Education of the young people in Kenya.

3.4 Target Population

Population is the complete set of individual cases or objects with some common observable characteristics. In this study, the accessible population comprised two hundred and forty (240) form three students and twelve (12) Mathematics teachers. This was because the students have covered most of the topics in form two geometry syllabuses. The form three Mathematics teachers were included in the study because by the virtue of their experience, they are knowledgeable and informative about phenomenon under study. The estimated number of form three students taking Mathematics in the district is 1200 and 40 teachers. The study excluded form four students because they were preparing for their final examinations therefore they were unavailable for the survey.

3.5 Sampling Techniques and Sample Size

3.5.1 Sampling Techniques

There are twenty schools in Makadara district. The schools were stratified by the school categories, out of which nine are boys six are girls and the rest are mixed schools .Stratified random sampling was suitable because there were three types of school categories whose characteristics were non homogenous (Kathuri& Pail 1993).Therefore simple random sampling was used to select two boy schools, two girls schools, and two mixed schools these totaled to six schools which is thirty per cent of secondary schools in the district as recommended by Mugenda and Mugenda (2003).
3.5.2 Sample Size

A sample is a finite part of a statistical population whose properties are studied to gain information about the whole (Webster, 1985). The sample for the study constituted 12 Mathematics teachers and 240 students. Some schools had more than one stream therefore simple random sampling was used to select only one class for the study. This was done by writing the name of each stream on a piece of paper folded them keenly, put in a box then shuffled and one was picked from the box. The name of the stream picked from the box was the one which was involved in the study. The researcher met Mathematics teacher of the entire form three classes and used simple random sampling to select only two teachers in each category.

Table 3.1 Total Population and Sample Size

<table>
<thead>
<tr>
<th>Category Of School</th>
<th>Population Of Schools</th>
<th>Sample Population Of Schools</th>
<th>Number Of Students Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>9</td>
<td>2</td>
<td>80</td>
</tr>
<tr>
<td>Girls</td>
<td>6</td>
<td>2</td>
<td>80</td>
</tr>
<tr>
<td>Mixed</td>
<td>5</td>
<td>2</td>
<td>80</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>6</td>
<td>240</td>
</tr>
</tbody>
</table>

The samples were taken from three categories so that boys, girls and mixed schools were represented. By so doing, a true representative of the total population was obtained. The study used 30% of the population of the schools in the region for the survey (Mugenda and Mugenda, 2003). The school selected in this study had a total population of about 2400 students, therefore the study used 10% of the population as the sample.
3.6 Research Instruments

Three instruments used for this study were; Mathematics Students Questionnaire (M.S.Q) - Intended for collecting data related to students learning experiences in Mathematics geometry. Mathematics Teachers Questionnaire (M.T.Q.) - Intended for collecting data related to the teaching and learning of Mathematics as a follow up of the students’ responses. The questionnaires was in sections A to F. Section A contains questions on demographics characteristics of the respondents while sections B to F contains question based on the research objectives. The M.S.Q and M.T.Q. were based on a 5-point Likert scale having the following options; Strongly Agree = S.A, Agree = A, Undecided= U, Disagree = D Strongly Disagree = S.D.

Mathematics Geometric Achievement Test (M.G.A.T) was adopted from Muturi (2007). The items in the text were based on form one and two geometry syllabus which constitute content on circles and polygons. The test had four questions which tested students on knowledge comprehension, application and analysis categories on the cognitive levels as required by the Ministry of Education regulation KIE (1992).

3.7 Pilot study

This section provides the methods of pre-testing the research instrument in this case the questionnaire. It includes pilot study, validity testing and reliability testing of the data collection instrument. In order to minimize the possible instrumentation error and hence increase the reliability of the data collected, pilot study was conducted to measure the research instruments reliability and validity (Mathiyazhagan and Nandan, 2010). A pilot study was undertaken on 10% of the sample population which was not included in the final
research. Pilot study, therefore, was conducted to detect the weakness in design and instrumentation, and to provide accurate data for sample selection (Sutrisna, 2009).

### 3.7.1 Validity of the Research Instruments

Validity is the accuracy and meaningfulness of inferences, which are based on the research results. In other words validity is the degree to which results obtained from the analysis of the data actually represent the phenomenon under study. The purpose of validity is to measure the accuracy with which the questions measure the factors under study (Mugenda and Mugenda 2003). The questionnaire were given to two mathematics teachers to review and their comments were reviewed and incorporated to enhance the validity of the questionnaire.

### 3.7.2 Reliability of the Research Instrument

According to Adejimi, Oyediran and Ogunsanmi (2010), reliability refers to the consistency of measurement and is frequently assessed using the test–retest reliability method. Reliability was enhanced by including many similar items on a measure, by testing a diverse sample of individuals and by using uniform testing procedures. The research instruments was subjected to overall reliability analysis of internal consistency. This was measured using Cronbach’s alpha as a coefficient of internal consistency.

Internal consistency measures the correlations between different items on the same test (or the same subscale on a larger test) and whether several items that propose to measure the same general construct produce similar scores. Castillio (2009) provide the following rules of thumb: that a cronbach alpha of $\alpha>0.9 = \text{Excellent}$, $\alpha>0.8 = \text{Good}$, $\alpha>0.7 = \text{Acceptable}$, $\alpha>0.6 = \text{Questionable}$, $\alpha>0.5 = \text{Poor}$ and $\alpha<0.5 = \text{Unacceptable}$. The acceptable value of $\alpha=0.7$ was used as a cut–off of reliability for this study.
3.8 Data Collection Procedure

Sample schools were visited three times by the researcher to familiarize herself with teachers and students. Both the head teachers and Mathematics teachers were notified of the study. The researcher administered the questionnaire and the MGAT on the same day, however, the questionnaire results were collected on the following day. The researcher administered the test with the help of their Mathematic teachers and the students were informed in advance in order to have time to look for geometrical instrument if they did not have any.

The questionnaires were administered to form three students from six randomly selected schools in Madaraka district. Both the geometrical assessment test and the questionnaires were attached together and administered to each of the candidate. The administration of the test followed standard examination regulations and the students were given an hour to the test.

3.9 Data Analysis Techniques

After the data was collected, the researcher turned to the task of analyzing. The analysis required a number of closely related operations such as establishment of categories, the application of those categories to raw data through coding, tabulation and drawing statistical inferences. The researcher classified raw data into purposeful and usable categories. Descriptive statistics and inferential statistics were used for data analysis. Quantitative data was analysed to obtain frequencies, percentages and averages. The frequency table was constructed to show the understanding of geometry concept. Items difficult and discrimination techniques were also used analyse the understanding the content of the text. Data collected on both questionnaires were used to answer the question of whether teaching learning strategies, student study habit, resources, their availability and the school curriculum
implementation enhance the understanding of the Mathematics geometry concept, and to what extent they do so. The analysis was done using SPSS program. Correlation and regression analysis were conducted to ascertain the relationship between the study variables.

The regression model to be tested is:

\[ Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon \]

Where: - \( Y \) = Level of Achievement/performance in Geometry test

Explained Variations of the Model=\( \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \)

\( X_1 \) = Teaching Strategies
\( X_2 \) = Student Study Habits
\( X_3 \) = Curriculum Implementation
\( X_4 \) = Evaluation

\( \epsilon \) = Unexplained Variation i.e. error term, it represents all the factors that affect the dependent variable but are not included in the model either because they are not known or difficult to measure.

\( \beta_0 \) = Constant. It defines the level of achievement in Geometry without inclusion of predictor variables.

\( \beta_1, \beta_2, \beta_3 \) = Regression Co-efficient. Define the amount by which \( Y \) is changed for every unit change of predictor variables. The significance of each of the co-efficient was tested at 95 percent level of confidence to explain the variable that will explain the most of the problem.

3.10 Ethical Consideration

A formal letter was obtained from the graduate school, Kenyatta University. The letter was used to obtain a research permit from NACOSTI. Copies of the research permit were sent to the District Education officer and District Commissioner, Makadara District. The letter of
introduction and research permit were taken to the station in the first visit and given to the principals of the schools. Confidentiality was assured to all respondents.
CHAPTER FOUR

FINDINGS, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter provides the presentation of the study findings. The result presentation was done in line with the study objectives. Charts and table were used to present the findings. The study was conducted on 240 students and 12 teachers. The total number of students who completed the study was 220 which represent a response rate of 91.7%. All the teachers duly filled their questionnaire and returned. According to Mugenda and Mugenda (2003) a response rate of above 50% is adequate for a descriptive study.

4.2 Demographic Characteristics of the Respondents

This section contains the demographic characteristics of the respondents. The study sought to find the Gender of the students, type of school, age group of teachers among other characteristics.

4.2.1 Gender of the Students

The proportion of male students that participated in this study was 55% while the female students were 45% of the sample. These proportions were good for the study since finding can be used to generalize the findings for both male and female students.
4.2.2 Type of School

Makadara sub-county has both boy’s schools, girl’s school and mixed schools. The findings show that 38% of the students were from girl’s schools while 33% of the students in this study were from boy’s school. Students from mixed schools were 29% of the total sample. These results imply the study sought opinion from all the three type of school in Makadara sub-county.
4.2.3 Teachers’ Age group

The findings show that 40% of the teachers who participated in the study were between 36 and 40 years old. Teachers between 46 and 50 years old were 30% while those below 35 years were 20% of the total sample. Only 10% of the teachers were 51 years and above. These findings indicate that most of the teachers who participated in the study were above 36 years old. This was an indication that teachers who participated in this study had taught long enough to understand factor underlying the bad performance of students in Geometry.
The study also assessed the highest academic qualification of the teachers. The results in figure 4.4 show that majority of the teacher (70%) were Bachelor’s degree holders. Teachers with master’s degree were 20% while 10% of the teachers had diploma qualification. This finding implies that majority of the teachers in the study region were qualified enough to teach. This finding further implies that students in the study region were taught by properly trained teachers.
4.2.5 Teachers Experience

The study further sought to find out the experience of the teachers in Makadara subcounty. The results show that 40% of the teachers had taught for between 6 and 10 years while 30% had taught for 16 years and above.
4.2.6 In service Training

The study also sought to find how teachers attended in-service training to further their professionalism. The result revealed that 70% of the teachers indicated that they have attended any in-service training. Only 30% indicated to have not attended in-service training. The finding implies that teachers in Makadara subcounty attend in-service training. In-service training is an essential component where teachers are retrained and also discuss their work with colleagues.

![Pie chart showing 70% Yes and 30% No for in-service training attendance.]

Figure 4.6 In service Training

4.3 Level of Understanding of Geometry Concepts Covered In Syllabus

The study used mathematics geometry achievement test to assess the students’ level of achievement in geometry. The performance was categorized into 6 categories which include less than 10%, 11-20%, 21-30%, 31-40%, 41-50% and finally above 50%. The results of the test indicate that 19 students scored less than 10% in the test, 53 students scored between 11
and 20% while 41 students scored between 21 and 30%. The results further showed that only 17 students scored above average marks of 50%.

Using cutoff marks of 50%, these findings imply that over 90% of the students who undertook the test failed. The finding implies that the performance of students in geometry in Makadara sub-county was still very low. These findings concurs with Charles and Lynwood (1990), who argued that poor performance in high school geometry has traditionally been high and this has been ascribed to various causes such as the difficulty of the subject, others have to blame it to ineptitude or laziness on part of the student. While others have held that students lose interest in geometry because of its abstract nature which they regard as having no practical value. They argue that demonstrative geometry is not easiest subject to learn.

Similarly, Rukangu (2000) conducted a study on pupils development of spatial ability on Mathematics and found out that 67% did not enjoy learning spatial concepts because they are confusing, abstractly demanding a lot of thinking and difficultly to understand.

<table>
<thead>
<tr>
<th>Number of students</th>
<th>Percent Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 students</td>
<td>less than 10%</td>
</tr>
<tr>
<td>53 students</td>
<td>11-20%</td>
</tr>
<tr>
<td>41 students</td>
<td>21-30%</td>
</tr>
<tr>
<td>37 students</td>
<td>31-40%</td>
</tr>
<tr>
<td>53 students</td>
<td>41-50%</td>
</tr>
<tr>
<td>17 students</td>
<td>above 50%</td>
</tr>
<tr>
<td><strong>Total 220</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td><strong>Mean Score</strong></td>
<td><strong>29.29545</strong></td>
</tr>
</tbody>
</table>
The study further sought to find the relationship between strategies used for teaching geometry and the level of achievement/performance of the students. The strategies assessed include instructional methods, discussion methods, participatory method, assignment method and finally drawing and modeling method.

Figure 4.8  Student Performance in Mathematics Geometry Achievement Test

4.4  Strategies Used in Teaching/Learning and Performance in Geometry

The study further sought to find the relationship between strategies used for teaching geometry and the level of achievement/performance of the students. The strategies assessed include instructional methods, discussion methods, participatory method, assignment method and finally drawing and modeling method.
4.4.1 Instructional Methods

The study required students to indicate whether instructional strategy enabled them to excel in geometry examination, whether the strategy enabled them to grasp geometry concepts among other measure of performance. The finding indicated that 35% of the students agreed that instructional methods enable them to excel in geometry examinations while 44.1% of the students disagreed with this statement.

Similarly 39.1% agreed that instructional methods enabled them to grasp geometry concepts while 40% disagreed. This findings imply that majority of the students did not prefer instructional method as a strategy in learning geometry.
Table 4.2  Instructional Methods

<table>
<thead>
<tr>
<th>Using instructional methods in teaching geometry leads to excellence in mathematics</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17.3%</td>
<td>26.8%</td>
<td>20.9%</td>
<td>19.1%</td>
<td>15.9%</td>
<td>2.90</td>
<td>1.34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Using instructional methods in teaching geometry ensures students grasp geometry concepts</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21.4%</td>
<td>18.6%</td>
<td>20.9%</td>
<td>14.1%</td>
<td>25.0%</td>
<td>3.03</td>
<td>1.48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Using instructional methods in teaching geometry enables students to apply the geometry concepts in problem solving</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19.5%</td>
<td>18.2%</td>
<td>16.8%</td>
<td>23.6%</td>
<td>21.8%</td>
<td>3.10</td>
<td>1.44</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Using instructional methods in teaching geometry enables students to do their assignments with easy</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>22.7%</td>
<td>17.7%</td>
<td>20.0%</td>
<td>22.7%</td>
<td>16.8%</td>
<td>2.93</td>
<td>1.41</td>
</tr>
</tbody>
</table>

### 4.4.2 Discussion Methods

The study sought to find out the effectiveness of discussion methods on the students achievement in geometry. The results show that students had varying opinions on the discussion methods. The finding indicates that 39.5% of the students disagreed that using discussion methods in teaching geometry leads to excellence in mathematics. On the other hand 49.5% of the respondents agreed with the discussion methods lead to better performance. The finding also revealed that over 50% of the students agreed that discussion methods enabled students to grasp geometry concepts. Majority of the students (50.5%) also agreed that using discussion methods in teaching geometry enables students to apply the geometry concepts in problem solving.

These findings imply that majority of the students preferred their teachers to use discussion method because they associated it with high performance in geometry. These findings agree
with Rukang (2000) in his study on pupils ‘development of spatial ability in Mathematics, he observed that one of the students’ study habits was discussion between students and students, between teachers and students and between students and parents.

<table>
<thead>
<tr>
<th>Table 4.3 Discussion Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>Using discussion methods in teaching geometry leads to excellence in mathematics</td>
</tr>
<tr>
<td>Using discussion methods in teaching geometry ensures students grasp geometry concepts</td>
</tr>
<tr>
<td>Using discussion methods in teaching geometry enables students to apply the geometry concepts in problem solving</td>
</tr>
<tr>
<td>Using discussion methods in teaching geometry enables students to do their assignments with easy</td>
</tr>
</tbody>
</table>

4.4.3 Participatory Teaching Approach

The study assessed the effects of using participatory approach on student’s achievements. The study findings show that 60.4% of the students agreed and strongly agreed that using participatory teaching approach methods in teaching geometry leads to excellence in mathematics while 28.2% of the respondent disagreed with this statement. The results further show majority of the students agreed and strongly agreed that this method enabled them to grasp concept, apply the concepts in problem solving and aided them to do their assignments. These findings simply the use of this method led to high performance among students.
Table 4.4  Participatory Approach Methods

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using participatory teaching approach methods in teaching geometry leads to excellence in mathematics</td>
<td>16.4%</td>
<td>11.8%</td>
<td>11.4%</td>
<td>32.7%</td>
<td>27.7%</td>
<td>3.04</td>
<td>1.35</td>
</tr>
<tr>
<td>Using participatory teaching approach in teaching geometry ensures students grasp geometry concepts</td>
<td>17.7%</td>
<td>15.0%</td>
<td>13.6%</td>
<td>27.7%</td>
<td>25.9%</td>
<td>3.14</td>
<td>1.42</td>
</tr>
<tr>
<td>Using participatory teaching approach in teaching geometry enables students to apply the geometry concepts in problem solving</td>
<td>16.4%</td>
<td>19.5%</td>
<td>13.2%</td>
<td>20.9%</td>
<td>30.0%</td>
<td>3.92</td>
<td>1.38</td>
</tr>
<tr>
<td>Using participatory teaching approach in teaching geometry enables students to do their assignments with easy</td>
<td>14.0%</td>
<td>17.7%</td>
<td>16.8%</td>
<td>21.8%</td>
<td>30.6%</td>
<td>2.88</td>
<td>1.36</td>
</tr>
</tbody>
</table>

4.4.4 Assignment Methods

The study also investigated if the use of assignment methods in teaching/learning of geometry influenced the achievement of students. The results show that respondents agreed and strongly agreed with the statements in the table below. The results indicate that 59.6% of the students in this study agreed and strongly agreed that assignment methods helped them to excel in mathematics examinations. The result further show that 57.3% of the students in this study agreed and strongly agreed that using assignment method in learning geometry had great influence in assisting them to grasp geometry concepts. The findings imply that students associated the use of assignment method with better performance in geometry.

According to Horn (1995), teachers are advised to give adequate varied worked examples with various complexities; plan a series of worked examples and that students should work
out similar examples immediately. This enhances students’ achievement and ability to transfer learnt concepts to new mathematical problems. Students can solve new problems by using what they already know from analogous problems.

Table 4.5  Assignment Method

<table>
<thead>
<tr>
<th>Using assignment methods in teaching geometry leads to excellence in mathematics</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.7%</td>
<td>15.0%</td>
<td>17.7%</td>
<td>33.2%</td>
<td>26.4%</td>
<td>3.95</td>
<td>1.36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Using assignment methods in teaching geometry ensures students grasp geometry concepts</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8.6%</td>
<td>13.6%</td>
<td>20.5%</td>
<td>30.0%</td>
<td>27.3%</td>
<td>3.94</td>
<td>1.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Using assignment methods in teaching geometry ensures students grasp geometry concepts</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19.1%</td>
<td>15.0%</td>
<td>20.5%</td>
<td>22.3%</td>
<td>23.2%</td>
<td>3.15</td>
<td>1.43</td>
</tr>
</tbody>
</table>

4.4.5 Drawing and Modeling Method

Geometry learning requires the use of drawing and modeling for illustration purposes. Therefore the study sought to find out if students that are taught using drawing and modeling method performed better than those that don’t use this method. The findings in the table below indicate that above 50% agreed and strong agreed with the statements in table below. The findings show that 54.6% of the respondents agreed and strong agreed that drawing ad modeling in geometry learning led to better performance. The findings further, show that 59% of the students agreed and strongly agreed that use of drawing and modeling significantly improved the grasping of geometry concepts among students. The findings also show that 64% of the students indicated that using drawing and modeling in geometry enabled them to apply the concepts acquired in problem solving. These findings imply that
the use of drawing and modeling improved the students’ performance. Kluwe, *et al.*, 1990 indicate that this method stimulates, motivates and improves students’ interest, retention and creativity.

**Table 4.6 Drawing and Modeling method**

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using drawing and modeling in teaching geometry leads to excellence in mathematics</td>
<td>7.7%</td>
<td>15.5%</td>
<td>22.3%</td>
<td>25.5%</td>
<td>29.1%</td>
<td>3.23</td>
<td>1.46</td>
</tr>
<tr>
<td>Using drawing and modeling in teaching geometry ensures students grasp geometry concepts</td>
<td>10.0%</td>
<td>14.5%</td>
<td>16.4%</td>
<td>29.5%</td>
<td>29.5%</td>
<td>3.88</td>
<td>1.39</td>
</tr>
<tr>
<td>Using drawing and modeling in teaching geometry enables students to apply the geometry concepts in problem solving</td>
<td>5.9%</td>
<td>11.4%</td>
<td>18.6%</td>
<td>29.5%</td>
<td>34.5%</td>
<td>3.89</td>
<td>1.42</td>
</tr>
<tr>
<td>Using drawing and modeling in teaching geometry enables students to do their assignments with easy</td>
<td>9.5%</td>
<td>10.5%</td>
<td>20.9%</td>
<td>25.0%</td>
<td>34.1%</td>
<td>3.04</td>
<td>1.45</td>
</tr>
</tbody>
</table>

**4.5 Student’s Study Habits**

The study also sought to find out some of the study habit used by student when studying geometry. The results revealed that privately studying using textbooks was the common study habits used by majority (58) of the students. The results show that the second most common habits used by the study were discussion among themselves which was indicated by 48 students. Discussion with teachers and consultation was indicated by 40 students each and finally least students indicated they preferred doing assignment/practice on their own.

According to Horn (1995), teachers are advised to give adequate varied worked example with various complexities, plan a sense of worked examples each with a new concept that should
work out immediately thus enhance student achievement and ability to transfer learnt concepts to new mathematical problems. In case of any difficulties, further consultation with the teacher for clarification can ensue.

Figure 4.7 Students Study Habits

4.6 Curriculum Implementation

Mathematics curriculum in Kenya requires that students and teachers should have materials necessary in learning geometry. The study sought to find out whether students adhered to the curriculum requirements when learning geometry. The findings show that a significant number of students in the schools surveyed did not have the necessary materials when learning geometry. Some of the materials include geometry set, textbooks, and calculators among others. Geometry requires a lot of demonstration therefore lack of necessary materials could lead to poor performance. Chepkurui (2004) argues that availability and use of such
materials have a positive effect on students’ achievement in Mathematics and in particular in geometry, since the students can use it as a guide in geometric skill development and offers exercise for further practice of learnt concept.

<table>
<thead>
<tr>
<th>Table 4.7 Curriculum Implementation</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>There enough textbooks for students in the ratio 1:1</td>
<td>20.5%</td>
<td>27.3%</td>
<td>20.9%</td>
<td>22.7%</td>
<td>8.6%</td>
<td>3.02</td>
<td>1.40</td>
</tr>
<tr>
<td>Each students has a geometrical set</td>
<td>32.3%</td>
<td>17.7%</td>
<td>21.4%</td>
<td>18.6%</td>
<td>10.0%</td>
<td>2.96</td>
<td>1.44</td>
</tr>
<tr>
<td>The school should have mathematical lab/library</td>
<td>29.5%</td>
<td>30.9%</td>
<td>19.5%</td>
<td>13.6%</td>
<td>6.4%</td>
<td>2.96</td>
<td>1.37</td>
</tr>
<tr>
<td>The school should provide computers</td>
<td>25.5%</td>
<td>25.9%</td>
<td>23.6%</td>
<td>10.9%</td>
<td>14.1%</td>
<td>3.12</td>
<td>1.39</td>
</tr>
<tr>
<td>The school should provide programmable calculators</td>
<td>23.2%</td>
<td>24.5%</td>
<td>22.3%</td>
<td>19.1%</td>
<td>10.9%</td>
<td>2.97</td>
<td>1.35</td>
</tr>
<tr>
<td>The school should organize for remedial lessons for weak students in geometrical concepts</td>
<td>30.9%</td>
<td>24.1%</td>
<td>16.4%</td>
<td>10.5%</td>
<td>18.2%</td>
<td>2.91</td>
<td>1.42</td>
</tr>
<tr>
<td>Mathematics teachers should give a lot of assignments in geometry and mark frequently</td>
<td>20.5%</td>
<td>22.7%</td>
<td>22.3%</td>
<td>24.5%</td>
<td>10.0%</td>
<td>3.11</td>
<td>1.41</td>
</tr>
<tr>
<td>Mathematics teachers should always motivate students</td>
<td>20.5%</td>
<td>22.7%</td>
<td>14.5%</td>
<td>19.5%</td>
<td>22.7%</td>
<td>3.01</td>
<td>1.47</td>
</tr>
</tbody>
</table>

4.7 Evaluation and Geometry Achievement

The study sought to establish the effects of evaluation on the students’ achievement in geometry. The study sought to find out whether assessment of geometrical concept is a continuous process, whether after assessment feedback should be given immediately to the student, whether feedback given to the learner after assessment is motivating to the student among other measures of evaluation.
The finding revealed show that 46.4% and 38.2% of the respondents agreed and strongly agreed that assessment of geometrical concept was a continuous process among the schools in madaraka sub-county. The results also show that 82.8% of the respondents agreed that after assessment feedback should be given immediately to the student. Majority of the respondents also agreed that geometry concepts are tested in both continuous assessment and main examinations.

The findings of this study imply that there was continuous evaluation on geometry concepts among secondary schools in Madaraka sub-county. The study established that evaluation was conducted in terms of continuous assessment of geometry concept, giving feedback immediately after assessment and testing geometrical concepts in continuous assessment tests main end of term examinations.

<table>
<thead>
<tr>
<th>Table 4.8 Evaluation</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of geometrical concept is a continuous process</td>
<td>2.3%</td>
<td>5.0%</td>
<td>8.2%</td>
<td>46.4%</td>
<td>38.2%</td>
<td>4.13</td>
<td>0.92</td>
</tr>
<tr>
<td>After assessment feedback should be given immediately to the student</td>
<td>5.5%</td>
<td>7.7%</td>
<td>4.1%</td>
<td>42.3%</td>
<td>40.5%</td>
<td>4.05</td>
<td>1.12</td>
</tr>
<tr>
<td>Feedback given to the learner after assessment is motivating to the student</td>
<td>7.3%</td>
<td>5.5%</td>
<td>4.1%</td>
<td>42.3%</td>
<td>40.9%</td>
<td>4.04</td>
<td>1.15</td>
</tr>
<tr>
<td>Assessment is an important process of teaching and learning of geometry</td>
<td>4.5%</td>
<td>4.1%</td>
<td>8.6%</td>
<td>42.3%</td>
<td>40.5%</td>
<td>4.1</td>
<td>1.03</td>
</tr>
<tr>
<td>When setting a test a table of specification is</td>
<td>5.9%</td>
<td>6.8%</td>
<td>4.1%</td>
<td>45.0%</td>
<td>38.2%</td>
<td>4.03</td>
<td>1.11</td>
</tr>
</tbody>
</table>
important for evaluation
Geometrical concepts are always tested in assignments

<table>
<thead>
<tr>
<th></th>
<th>4.5%</th>
<th>6.8%</th>
<th>6.8%</th>
<th>38.6%</th>
<th>43.2%</th>
<th>4.09</th>
<th>1.09</th>
</tr>
</thead>
</table>
Geometrical concepts are always tested in continuous assessment tests (C.A.T’s)

<table>
<thead>
<tr>
<th></th>
<th>6.8%</th>
<th>5.5%</th>
<th>2.7%</th>
<th>45.9%</th>
<th>39.1%</th>
<th>4.05</th>
<th>1.12</th>
</tr>
</thead>
</table>
Geometrical concepts are always tested in main exams.

|                | 4.5% | 7.3% | 5.9% | 40.0% | 42.3% | 4.08 | 1.09 |

4.8 Correlation Results

The study conducted a correlation analysis to show the nature of association between various method of learning/teaching geometry and students’ level of achievements in geometry. The results show that teaching strategies had a negative and significant association with level of achievement in geometry test (r=-0.366, p=0.000). The findings further show that study habits had positive association with the level of achievement in geometry test (r=0.425, p=0.000). Similarly, the findings further showed that curriculum implementation had positive association with the level of achievement in geometry test (r=0.194, p=0.004). The findings also showed that evaluation also had a positive and significant association (r=0.242, p=0.000) with level of achievement in geometry tests as shown in table 4.8 below.
### Table 4.9 Correlation Results

<table>
<thead>
<tr>
<th></th>
<th>study habits</th>
<th>teaching strategies</th>
<th>curriculum implementation</th>
<th>Evaluation</th>
<th>Level of understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>study habits</td>
<td>Pearson Correlation</td>
<td>1.00</td>
<td>-0.07</td>
<td>0.312**</td>
<td>0.176**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.301</td>
<td>0.009</td>
<td>0.004</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>220</td>
<td>220</td>
<td>220</td>
<td>220</td>
</tr>
<tr>
<td>teaching strategies</td>
<td>Pearson Correlation</td>
<td>-0.07</td>
<td>1.00</td>
<td>-0.253**</td>
<td>-0.122</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.301</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>220</td>
<td>220</td>
<td>220</td>
<td>220</td>
</tr>
<tr>
<td>curriculum implementation</td>
<td>Pearson Correlation</td>
<td>0.312**</td>
<td>-0.253**</td>
<td>1.00</td>
<td>0.490**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.009</td>
<td>0.009</td>
<td>0.009</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>220</td>
<td>220</td>
<td>220</td>
<td>220</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Pearson Correlation</td>
<td>0.176**</td>
<td>-0.122</td>
<td>0.490**</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.009</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>220</td>
<td>220</td>
<td>220</td>
<td>220</td>
</tr>
<tr>
<td>Level achievement</td>
<td>Pearson Correlation</td>
<td>0.194**</td>
<td>-0.366**</td>
<td>0.402**</td>
<td>0.242**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.004</td>
<td>0.004</td>
<td>0.004</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>220</td>
<td>220</td>
<td>220</td>
<td>220</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).

These findings agree with Rukangu (2000) in his study on pupils’ development of spatial ability in Mathematics, he observed that one of the students’ study habits was discussion between students and students, between teachers and students and between students and parents.

Similarly, Horn (1995), posit that teachers should give adequate varied worked examples with various complexities; plan a series of worked examples and that students should work
out similar examples immediately. This enhances students’ achievement and ability to transfer learnt concepts to new mathematical problems. Students can solve new problems by using what they already know from analogous problems. The findings are consistent with Kluwe, et al., (1990) who indicate that method used in teaching geometry stimulates, motivates and improves students’ interest, retention and creativity.

The findings of this study also concurs with Orodho (2003), who indicated that at the national level 69.5% of teachers offered remedial lessons during evenings and over morning preps and over the school holidays basically to cope with the broad 8-4-4 curriculum. This study revealed that students and teachers perception towards remedial was positive with many indicating that it assisted both the weak and bright students especially in preparation of National Examinations.

Charles and Lynwood (2009) also argued that the real reason for much of the failure in geometry and apathy towards the subject lies mainly in poor motivation and failure to provide clear insights into the meaning and methods of the subject, they also assert that children will work hard at things that interest them and they delight in games and puzzles.

4.9 Regression Analysis

To ascertain the relationship between different factors influencing achievement in mathematics geometry among secondary school students in Makadara Sub-County, Nairobi County, the study conducted a linear regression analysis. The results of the model summary revealed that the factors/variables in this study accounted for 24.5% of the variation in the level of achievement of students in geometry tests. The F-statistics in the ANOVA test revealed that the model was statistically significant.
Table 4.10  Model Summary

<table>
<thead>
<tr>
<th>Model</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>.495a</td>
</tr>
<tr>
<td>R Square</td>
<td>0.245</td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.23</td>
</tr>
<tr>
<td>Std. Error of the Estimate</td>
<td>0.5753</td>
</tr>
</tbody>
</table>

Table 4.11  ANOVA

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>23.034</td>
<td>4</td>
<td>5.758</td>
<td>17.399</td>
<td>.000</td>
</tr>
<tr>
<td>Residual</td>
<td>71.157</td>
<td>215</td>
<td>.331</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>94.191</td>
<td>219</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: Level achievement  
b. Predictors: (Constant), Evaluation, teaching strategies, study habits, curriculum implementation

Table 4.12  Regression Coefficients

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Std. Error</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>2.648</td>
<td>0.276</td>
<td>9.591</td>
<td>0.</td>
</tr>
<tr>
<td>study habits</td>
<td>0.057</td>
<td>0.046</td>
<td>1.237</td>
<td>0.217</td>
</tr>
<tr>
<td>Teaching strategies</td>
<td>0.231</td>
<td>0.05</td>
<td>4.621</td>
<td>0</td>
</tr>
<tr>
<td>Curriculum implementation</td>
<td>0.254</td>
<td>0.066</td>
<td>3.845</td>
<td>0</td>
</tr>
<tr>
<td>Evaluation</td>
<td>0.045</td>
<td>0.053</td>
<td>0.857</td>
<td>0.393</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Level of achievement

The findings revealed that students study habits had a positive and insignificant relationship (B=0.057, p=0.217) with the level of achievement in geometry test. These findings imply that the use of students study habits will lead to an increase in the level of achievement by 0.057 units.

The findings of this study showed that teaching strategies had positive and significant relationship with the level of achievement in geometry (B=0.231, p=0.000). These findings imply that teaching strategies accounted for 0.231 units variation in the level of achievement in geometry.
The study further sought to find out the effect of curriculum implementation on the students’ level of achievement in geometry. The results of the regression model revealed that curriculum implementation had a positive and significant relationship (B=0.254, p=0.000) with the students’ level of achievement in geometry. The result imply that curriculum implementation accounted for 0.254 units variation in students’ level of achievement in geometry.

Finally this study sought to find out the effect of evaluation on the students’ level of achievement in geometry. The results of the regression model revealed that evaluation had a positive and insignificant relationship (B=0.045, p=0.393) with the students’ level of achievement in geometry. The result imply that evaluation accounted for 0.045 units variation in students’ level of achievement in geometry.

The findings of this study are consistence with those of Zakaria, Chin and Daud (2010) who specified that teaching should not merely focus on dispensing rules, definitions and procedures for learners to memorize, but should also actively engage learners as primary participants. According to Awiti (2010), discussion method can be effective and successful when the following preparations are made by the teacher and the learners: the learners given adequate time to search for information on the topic; the teacher avails the documents or assists the learners by suggesting sources of information; and the learners to be organized in appropriate groups and choose group leaders to record the points raised during discussion.

Ngaroga (2008) emphasized that the teachers role during discussion should be that of a guide. The learners are therefore given time to express their ideas and participate actively in the lesson. Discussion method is therefore appropriate for teaching when the topic requires flow of information and ideas from the teacher to learners, from learners to teacher or learner
to learner. Waka and Ngigi (2009) suggested that learners need to be taught using those teaching methods that will build confidence in them so that when they get to exam rooms, they can perform well.

4.10 Problems Encountered in Learning Geometry

The study sought to find out some of the problems that the students encountered in learning geometry. The finding show that 79% of the students and teachers in this study indicated poor attitude toward geometry among students was the major problem among students while 65.9% indicated lack of adequate learning resources, 62.7% indicated lack of practical sessions, 55.5% of the respondents indicated poor learning strategies used by teachers. Only 38.6% of the respondents indicated lack of enough trained and experienced teacher.

<table>
<thead>
<tr>
<th>Problems encountered in learning geometry</th>
<th>Percent(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor attitude toward geometry among students</td>
<td>79.10%</td>
</tr>
<tr>
<td>lack of adequate learning resources</td>
<td>65.90%</td>
</tr>
<tr>
<td>lack of adequate practical session</td>
<td>62.70%</td>
</tr>
<tr>
<td>Poor learning Strategies used by teachers</td>
<td>55.50%</td>
</tr>
<tr>
<td>Lack of enough trained and experienced teacher</td>
<td>38.60%</td>
</tr>
</tbody>
</table>
CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter presents summary, conclusion and discussion of findings presented in chapter four. Conclusions based on the discussions of findings of the study are offered. The interpretation and discussion revolves around the objectives.

5.1 Summary of the key findings

The purpose of this study was to analyse the factors influencing achievement in geometry among secondary schools student in Makadara Sub-County, Nairobi County. Specifically the study sought to establish the effects of teaching strategies, students study habits, curriculum implementation and evaluation on the students level of achievement in geometry in secondary schools in Makadara sub-county, Nairobi county. Finally the study sought to determine the problems students encounter in learning of geometry among secondary schools students in Makadara Sub-County, Nairobi County.

5.1.1 Effect of the Teaching Strategies on Geometry Achievement

The study sought to establish the strategies used by teachers in teaching and learning of geometry in secondary schools in Makadara sub-county, Nairobi County. The results revealed that most of the teachers in Makadara used assignment which was indicated by 89% of the students. The second most common method used by students was instructional methods indicated by 72.3% of the students. Drawing and modeling method, participatory approach and discussion methods were indicated by 55%, 52% and 46.8% respectively. Both
instructional method and assignment method are teacher centered methods which had been 
attributed to poor performance of students.

The findings of this study showed that teaching strategies had positive and significant 
relationship with the level of achievement in geometry (B=0.231, p=0.000). These findings 
imply that teaching strategies accounted for 0.231 units variation in the level of achievement 
in geometry. Zakaria, Chin and Daud (2010) specified that teaching should not merely focus 
on dispensing rules, definitions and procedures for learners to memorize, but should also 
actively engage learners as primary participants.

The methods used in teaching Mathematics are instrumental in determining ones 
performance Keith (1999). This finding concurs with Kiminza et al (1999) who found out 
that Mathematics teachers mainly use participatory teaching approach. In their analysis of 
mostly frequently used methods, assignment method scored 50.6% followed by a class 
discussion 48.6%, demonstration 38.9%, drawing and modeling 34.4%.

Discussion method, assignment method and drawing methods were found to have positive 
relation with the level of achievement in geometry test. Discussion method, assignment and 
drawing are example of learner centered approach that most literature shows that they 
positively affect the level of achievement in geometry tests.

According to Awiti (2010), discussion method can be effective and successful when the 
following preparations are made by the teacher and the learners: the learners given adequate 
time to search for information on the topic; the teacher avails the documents or assists the 
learners by suggesting sources of information; and the learners to be organized in appropriate 
groups and choose group leaders to record the points raised during discussion.
5.1.2 Effects of the students study habits on Geometry Achievement

The findings revealed that students study habits had a positive and insignificant relationship (B=0.057, p=0.217) with the level of achievement in geometry test. These findings imply that the use of students study habits will lead to an increase in the level of achievement by 0.057 units. These findings concurs with Charles and Lynwood (1990), who argued that poor performance in high school geometry has traditionally been high and this has been ascribed to various causes such as the difficulty of the subject, others have to blame it to ineptitude or laziness on part of the student. While others have held that students lose interest in geometry because of its abstract nature which they regard as having no practical value. They argue that demonstrative geometry is not easiest subject to learn. Similarly, Rukangu (2000) conducted a study on pupils development of spatial ability on Mathematics and found out that 67% did not enjoy learning spatial concepts because they are confusing, abstractly demanding a lot of thinking and difficultly to understand.

5.1.3 Effects of the curriculum implementation on Geometry Achievement

The study further sought to find out the effect of curriculum implementation on the students’ level of achievement in geometry. The results of the regression model revealed that curriculum implementation had a positive and significant relationship (B=0.254, p=0.000) with the students’ level of achievement in geometry. The result imply that curriculum implementation accounted for 0.254 units variation in students’ level of achievement in geometry.

The findings concurs with those of Orodho (2003) who revealed that students and teachers perception towards remedial was positive with many indicating that it assisted both the weak and bright students especially in preparation of National Examinations. He also noted that
regular teachers within the school premises and mainly in Mathematics and sciences carried out remedial lessons.

5.1.4 Effects of the Evaluation on Geometry Achievement

Finally this study sought to find out the effect of evaluation on the students’ level of achievement in geometry. The results of the regression model revealed that evaluation had a positive and insignificant relationship \((B=0.045, \ p=0.393)\) with the students’ level of achievement in geometry. The result imply that evaluation accounted for 0.045 units variation in students’ level of achievement in geometry.

According to Kinyua et al. (2003) in the class, assessment that takes place is diagnostic. It reveals how much learners have understood various concepts for instance geometrical skills such as construction and therefore plan for remedial work accordingly. This assessment can be done by observation of pupils as they solve given problems. The teachers assess the students as well as themselves in the light of students work.

5.1.5 Problems Students Encounter in Learning of Geometry

The study sought to find out some of the problems that the students encountered in learning geometry. The finding show that 79% of the students and teachers in this study indicated poor attitude toward geometry among students was the major problem among students while 65.9% indicated lack of adequate learning resources, 62.7% indicated lack of practical sessions, 55.5% of the respondents indicated poor teaching strategies used by teachers. Only 38.6% of the respondents indicated lack of enough trained and experienced teacher.

5.2 Conclusions

The strategies used by teachers in learning/teaching geometry contribute to the level of performance in geometry test. Teachers used strategies that don’t motivate students to excel
in geometry. Methods that are teacher centered where teachers are at the center of classroom activities, including explanations and discussions are associated with low performance. Teachers should adopt methods that allow students to be at the centre of the learning process while they remain as reference point to aid the learning process.

This study concludes that the performance of students within the study region in geometry tests was still very poor. This can be attributed to poor attitude among students, lack of adequate learning resources and poor learning strategies used by teachers, poor study habits, lack of practical sessions. Lack of enough trained and experienced teacher was the least problem that affected the learning/teaching of geometry. The study region was found to have experienced and well trained teachers.

5.3 Recommendations

Based on the study findings the study recommends;

1. Teachers should revisit the strategies they use in teaching/learning of geometry

2. Teachers need to encourage students to form small discussion groups so that each individual student can have a platform to express their ideas and learn from each other. This will encourage consultations among students and with the teachers and eventually boost mastery of the geometry concepts.

3. Teachers should demonstrate enough geometry examples from different texts to the students before giving them assignments.

4. Teachers should also guide students to practice more on items on the comprehension and application levels of the cognitive domains.
5. The Ministry of Education through the relevant departments should carry out regular inspections to schools and organize in-service courses for teachers in order to alleviate some of the probable causes of poor achievement of geometry content.

6. Teachers and parents should avail the necessary material used for learning geometry.

5.4 Recommendations for further Research

The study recommends that a similar study should be conducted in a different geographical region for comparison purposes. In addition, the teaching strategies identified by the learners as the mostly used by teachers and the most effective in enhancing achievement in geometry are not in agreement with the conventional methods of learning and teaching geometry. It is therefore prudent that a study be carried out to identify effective methods involving the emerging technologies that can be used to improve achievement in geometry. Further studies should also focus on the effects of mathematical language on students’ performance in geometry.
REFERENCES


APPENDIXES

Appendix A: Mathematics Students Questionnaire (M.S.Q)

This questionnaire aims at getting your opinion pertaining to the teaching and learning of Mathematics geometrical concepts.

The information you give is for research purpose only and will be treated with confidentiality

Part A: General Information

1. The response to the following interview items will be indicated by ticking [ √ ] the appropriate option or by filling in the missing information.

(a) Gender

Male [ ]

Female [ ]

Part B: Strategies Used By Teachers in Teaching and Learning of Geometry

What are the teaching methods mostly used when teaching geometry? Tick all that apply

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional Methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion Methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participatory Teaching Approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assignment Method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drawing and Modelling (Use of games and puzzles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other(s) specify</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Indicate by putting a tick [ √ ] in the box what you feel about curriculum implementation that can enhance Mathematics geometrical concept interpretation. Show your extent of agreement using the words;

1. Strongly disagree -------------------------- SA
2. disagree ------------------------------------ A
<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. There are enough textbooks for students in the ratio 1:1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Each students has a geometrical set</td>
<td></td>
<td></td>
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<tr>
<td>3. The school should have mathematical lab/library</td>
<td></td>
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<tr>
<td>4. The school should provide computers</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5. The school should provide programmable calculators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The school should organise for remedial lessons for weak students in geometrical concepts</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>7. Mathematics teachers should give a lot of assignments in geometry and mark frequently</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Mathematics teachers should always motivate students</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Part C: Level of Understanding of Geometry Concepts Covered In Syllabus among Secondary Schools
<table>
<thead>
<tr>
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<th>D</th>
<th>U</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>I score highly in geometry examinations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can apply geometry concepts in problem solving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geometry concepts are easily understood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students enjoy learning geometry topics in class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grasping geometry concepts help students pass their mathematics examinations</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Part D: Effects of the Strategies Used In Teaching and Learning on Performance in Geometry among Secondary Schools**

**Part D1: Instructional Methods**

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<th>A</th>
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</thead>
<tbody>
<tr>
<td>Using instructional methods in teaching geometry leads to excellence in mathematics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using instructional methods in teaching geometry ensures students grasp geometry concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using instructional methods in teaching geometry enables students to apply the geometry concepts in problem solving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using instructional methods in teaching geometry enables students to do their assignments with easy</td>
<td></td>
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<td></td>
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</tbody>
</table>

**Part D2: Discussion Methods**

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<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using discussion methods in teaching geometry leads to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
excellence in mathematics
Using discussion methods in teaching geometry ensures students grasp geometry concepts
Using discussion methods in teaching geometry enables students to apply the geometry concepts in problem solving
Using discussion methods in teaching geometry enables students to do their assignments with easy

Part D3: Participatory Teaching Approach

<table>
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<th>D</th>
<th>U</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using participatory teaching approach methods in teaching geometry leads to excellence in mathematics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using participatory teaching approach in teaching geometry ensures students grasp geometry concepts</td>
<td></td>
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<tr>
<td>Using participatory teaching approach in teaching geometry enables students to apply the geometry concepts in problem solving</td>
<td></td>
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</tr>
<tr>
<td>Using participatory teaching approach in teaching geometry enables students to do their assignments with easy</td>
<td></td>
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</table>

Part D4: Assignment Method

<table>
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<th>D</th>
<th>U</th>
<th>A</th>
<th>SA</th>
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</thead>
<tbody>
<tr>
<td>Using assignment methods in teaching geometry leads to excellence in mathematics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using assignment methods in teaching geometry ensures students grasp geometry concepts</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Using assignment methods in teaching geometry enables students to apply the geometry concepts in problem solving

Using assignment methods in teaching geometry enables students to do their assignments with easy

Part D5: Drawing and Modeling (Use of games and puzzles)

<table>
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<tbody>
<tr>
<td>Using drawing and modeling in teaching geometry leads to excellence in mathematics</td>
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<tr>
<td>Using drawing and modeling in teaching geometry ensures students grasp geometry concepts</td>
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<tr>
<td>Using drawing and modeling in teaching geometry enables students to apply the geometry concepts in problem solving</td>
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</tr>
<tr>
<td>Using drawing and modeling in teaching geometry enables students to do their assignments with easy</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Part E: Problems Students Encounter in Learning of Geometry among Secondary Schools Students

Kindly indicate some of the challenges students encounter in learning of geometry in secondary school. (Tick as many as possible)

a) Lack of enough trained and experienced teacher (  )

b) lack of adequate learning resources (  )

c) Poor attitude toward geometry among students (  )

d) Poor learning Strategies used by teachers (  )

e) lack of adequate practical sessions (  )
Appendix B: Mathematics Teachers Questionnaire (M.T.Q.)

This questionnaire aims at getting your opinion pertaining to the teaching and learning of Mathematics geometrical concepts.

The information you give is for research purpose only and will be treated with confidentiality

Part 1: General Information

1. The response to the following interview items will be indicated by ticking $[\sqrt{\,}]$ the appropriate option or by filling in the missing information.

(a) **Gender**  
   Male [ ]  Female [ ]

(b) Kindly indicate your age bracket  
   Below 35 years [ ]  
   36 -45 years [ ]  
   46 – 50 years [ ]
(c) What is your highest academic qualification?
   Diploma [ ]
   Bachelor’s degree [ ]
   Master’s degree [ ]
   Other(s) specify ________________________________

(d) How long have you been teaching?
   5 years and below [ ]
   6 – 10 years [ ]
   11 – 15 years [ ]
   16 years and above [ ]

(e) Have you ever attended any in-service training (INSET)?
   Yes [ ] No [ ]

(f) If your answer above is yes, which INSET have you attended?
   ___________________________________________________________________

Part Two: Teaching Strategies

The answer to this part is done by ticking [✓] in the appropriate box or filling in the space provided.
What are the teaching methods mostly used when teaching geometry?

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional Methods</td>
<td></td>
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<tr>
<td>Discussion Methods</td>
<td></td>
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<tr>
<td>Participatory Teaching Approach</td>
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<tr>
<td>Assignment Method</td>
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<tr>
<td>Drawing and Modelling (Use of games and puzzles)</td>
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<tr>
<td>Other(s) specify</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   Strongly agree ------------------------- SA
   Agree ------------------------------- A
Uncertain -------------------------- U
Disagree -------------------------- D
Strongly Disagree ----------------- SD

<table>
<thead>
<tr>
<th>Teachers opinion</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. There enough textbooks for students in the ratio 1:1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. Each student has a geometrical set</td>
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<tr>
<td>3. The school should have mathematical lab/library</td>
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<tr>
<td>4. The school should provide computers</td>
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<tr>
<td>5. The school should provide programmable calculators</td>
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<tr>
<td>6. The school should organise for remedial lessons for weak students in geometrical concepts</td>
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<tr>
<td>7. Mathematics teachers should give a lot of assignments in geometry and mark frequently</td>
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<tr>
<td>8. Mathematics teachers should always motivate students</td>
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</tbody>
</table>

**Part three: Curriculum Implementation**

Indicate by putting a tick [✓] in the box what you feel about curriculum implementation that can enhance Mathematics geometrical concept interpretation. Show your extent of agreement using the words:

Strongly agree ----------------- SA
Agree --------------------------- A
Uncertain ------------------------ U
Disagree ------------------------ D
Strongly Disagree ---------------- SD

<table>
<thead>
<tr>
<th>Teachers opinion</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. There enough textbooks for students in the ratio 1:1</td>
<td></td>
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</tr>
<tr>
<td>2. Each student has a geometrical set</td>
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</tbody>
</table>
Part Four: Students Study Habits/Styles

1. What frequent study habits are often used by students in studying geometry? (Tick the appropriate option)

(a) Discussion between student and other student
(b) Discussion between students and teachers
(c) Studying privately using textbooks
(d) Doing assignments /practice
(e) Consultation

Part Six: Evaluation
1. Please indicate by ticking in the appropriate box to show the extent of agreement using the words;

<table>
<thead>
<tr>
<th>Teacher’s opinion on assessment</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assessment of geometrical concept is a continuous process</td>
<td></td>
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<tr>
<td>2. After assessment feedback should be given immediately to the student</td>
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<tr>
<td>3. Feedback given to the learner after assessment is motivating to the student</td>
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<tr>
<td>4. Assessment is an important process of teaching and learning of geometry</td>
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<tr>
<td>5. When setting a test a table of specification is important for evaluation</td>
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<tr>
<td>6. Geometrical concepts are always tested in assignments</td>
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</tr>
<tr>
<td>7. Geometrical concepts are always tested in continuous assessment tests (C.A.T’s)</td>
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</tr>
<tr>
<td>8. Geometrical concepts are always tested in main exams.</td>
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</tbody>
</table>

Appendix C: Mathematics Geometry Achievement Test (M.G.A.T)

TIME: 1 HOUR
NAME: ________________________________
SCHOOL: ________________________________
TYPE OF SCHOOL: BOYS [ ] GIRLS [ ] MIXED [ ] (Tick appropriate option)
GENDER: MALE [ ] FEMALE [ ]

Instructions
Answer all the questions given you may or may not write your name.
The test is for the purpose of research and the marks obtained will be confidential.

1. Using a ruler and a pair of compass only construct triangle ABC in which BC = 6cm, AB = 8.8 cm and \( \angle ABC = 22.5^\circ \) (4marks)
   a. Measure AC and \( \angle ACB \) (2marks)
   c. Circumscribe a circle through AB and C. (3marks)
   d. What is the radius of this circle (1mark?)

2. In the figure below use a pair of compass and ruler only to locate the centre of the circle and measure its radius (4marks)

3. The diagram below shows a regular hexagon ABCDEF inscribed in a circle centre 0. The hexagon consists of congruent triangles. Answer the following questions without using a protractor

Questions:
- i) How many triangles does the hexagon contain? (1 Mark)
- ii) What kind of triangle is the hexagon made up of? (1 Mark)
- iii) Find the measure of \( \angle ABC \) (3 Marks)
- iv) Find the sum of the interior angle of the hexagon (1 Mark)
- v) Find the sum of the six exterior angles of the hexagon. (1 Mark)
- vi) How many pairs of parallel lines does the hexagon contain? (1 Mark)
- vii) If the radius of the circle is 6cm what is the perimeter of the hexagon (2 Marks)
4. (a) Using a pair of compass and ruler only, construct a regular hexagon of size 6cm (4Marks)
    (b) Use letter X to mark all interior angles in the figure constructed in part (a) (1 Mark)
    (c) Use letter Y to mark all your exterior angles constructed in part (a) (1 Mark)
Appendix D: MGAT Marking Scheme

3. \( 360^\circ \) A1

VI) 3 pairs A1

VII) 6x6 m1

= 36 A1

Total 10 marks.

4. a) Drawing circle of radius 6cm B1
- Marking arcs on the circumference of circle B2
- Joining the arcs to form the hexagon A7

b) Correct marked interior angles A7

C) Correct marked exterior angle A1

Total 6 marks.
Appendix E: Sampling Frame - List of Schools in Makadara District

1. Aquinas High School
2. Buru Buru Girls
3. Highway Secondary
4. Huduma Girls
5. Makongeni Secondary
6. Nile Road Girls
7. Ofafa Jericho Boys
8. St. Anne’s Girls Jogoo Rd
9. St. Patrick’s Secondary
10. Our Lady of Mercy Secondary
11. Apostolic Carmel Girls
12. Bright Star Secondary
13. Crescent Girls Secondary
14. New Jogoo Boys Secondary
15. New Jogoo Girls Secondary
16. N.P.C Academy
17. St. Mary’s High School
18. St Micheal Secondary
19. Three in One Secondary
20. Wamy High School
Appendix F: Makadara District Maps
Appendix G: Research Permit

THIS IS TO CERTIFY THAT

Ms. DORCAS NDINDA MUSYINI
OF KENYATTA UNIVERSITY, 35496-100
NAIROBI, HAS BEEN PERMITTED TO CONDUCT RESEARCH IN NAIROBI COUNTY
ON THE TOPIC: UNDERSTANDING OF GEOMETRY CONCEPTS AND ITS IMPACT ON SECONDARY SCHOOL STUDENTS’ ACHIEVEMENT IN MATHEMATICS: THE CASE OF KANDARA DISTRICT, NAIROBI COUNTY
FOR THE PERIOD UNTIL 31ST DECEMBER, 2014

APPLICANT'S SIGNATURE:

Secretary
National Commission for Science, Technology and Innovation

CONNECTIONS:
1. You must report to the County Commissioner and the County Education Officer of the area before commencing your research. Failure to do so may lead to the cancellation of your permit.
2. Government officers will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.

This condition on the gathering, filming and collection of data is vital to ensure that you have the permission from the relevant Government Ministries.

You are required to submit at least two (2) hard copies of your final report to the Government. The Government reserves the right to modify the conditions of this permit including its cancellation without notice.

RESEARCH CLEARANCE PERMIT

Serial No. A911

REPUBLIC OF KENYA

National Commission for Science, Technology, and Innovation
Appendix H: Research Letter

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Ref: No.

NACOSTI/P/14/5999/796

Dorcas Ndinda Musyimi
Kenyatta University
P.O.Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on
"Understanding of Geometry concepts and its effect on secondary school
students’ achievement in mathematics – the case of Makadara District,
Nairobi County," I am pleased to inform you that you have been authorized to
undertake research in Nairobi County for a period ending 31st December
2014.

You are advised to report to the County Commissioner and the County
Director of Education, Makadara County before embarking on the research
project.

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

DR. M. K. RUGUTU, PhD, HSc.
FOR: SECRETARY/CEO

Copy to:

The County Commissioner
The County Director of Education
Makadara County.

Date: 24th March, 2014