

**IMPACT OF INSTRUCTIONAL MATERIALS ON ACADEMIC
ACHIEVEMENT IN MATHEMATICS IN PUBLIC PRIMARY SCHOOLS IN
SIAYA COUNTY, KENYA**

APONDI JENIPHER ADIPO

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**A Research Project Submitted to the University of Nairobi in Partial Fulfilment of
the Requirements for the Masters of Education Degree (M.Ed) in Measurement and
Evaluation.**

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DECLARATION

This research project is my original work and has not been submitted for any academic award at any other University.

Sign..... Date.....

APONDI JENIPHER ADIPO
E58/65590/2013

This research project has been submitted for examination with my approval as the university supervisor

Sign..... Date.....

DR. JAPHETH O.ORIGA
Department of Educational Communication and Technology
University of Nairobi.

DEDICATION

This work is dedicated to my parents, phoebe Agalo and the late father Lukas Apondi, my husband Charles Oduor, my sons Carey Francis, Fredrick Alvin, John Elton, and Hermans Onyango.

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ACRONYMS AND ABBREVIATIONS

ASEI Activity Student Experiment Improvisation

CEMASTEa Centre for Mathematics, Science and Technology Education in East Africa

ECE Early Childhood Education

EFA Education For All

FPE Free Primary Education

KCPE Kenya Certificate of Primary Education

KNEC Kenya National Examination Council

LD Learning Difficulty

MOEST Ministry of Education Science and Technology

NCTM National Council of Teachers of Mathematics

SMASE Strengthening Mathematics and Science Education

TIMSS Trends in Mathematics and Science Study

UNESCO United Nations Educational, Scientific and Cultural Organization

UPE Universal Primary Education

USAID United States Agency for International Development

ABSTRACT

The purpose of this research project is to determine the impact of instructional materials on academic achievement in Public Primary Schools in Siaya County when compared to only abstract mathematics symbols. The project was based on four objectives including; to establish the impact of concrete materials on achievement in measurement involving money, to establish the impact of Geo board on achievement in Geometry, to determine the impact of Algebra tiles on achievement in Algebra and to determine the impact of place value blocks on achievement in mathematics number operations. The study adopted experimental design involving pre test, post test of treatment and control groups. The study was conducted in public primary schools in Siaya County. The target population was 20564 Children and 696 standard four teachers and sample size comprised of 392 children and 8 teachers of mathematics. The findings from the research project indicated that teachers have undergone an education system that had enlightened them on need to know when, why and how to use manipulative effectively in the classroom as well as opportunities to observe; first-hand impact of allowing learning through exploration with concrete objects. According to findings, it can be seen that the control group of schools had mean and standard deviation of 52.70 and 13.57, respectively, while the experimental group of schools had a mean and standard deviation of 74.30 and 8.74, respectively. The difference in performance of children in control group of schools and those in experimental group of schools was found to be statistically significant ($t(8) = -5.482, p = .004$, two tailed). This suggests that children who are taught mathematics using instructional materials perform better than those who are only taught mathematics using abstract mathematics symbols only. The difference in performance is due to interventions (treatment) done to the experimental group of schools. Instructional material had more impact in achievement in measurement involving money. Further findings show that children in control group scored higher marks when they used place value blocks than children in experimental group where instructional materials were applied. Geo board as an instructional material had big impact on geometry achievement as compared to only mathematical symbols in learning mathematics. Algebra tiles on achievement in Algebra as a concept in mathematics had greatest impact compared to only mathematical symbols. These findings show that children in experimental group scored higher marks than children in control group where instructional materials were not applied. Study recommends that since children taught mathematics using instructional materials perform better than those who are taught mathematics using abstract mathematics symbols only, they should be taught by use of instructional materials for better performance in mathematics. In study where impact of place value blocks in achieving basic operations on numbers in mathematics, Children in control group scored higher marks than children in experimental group where instructional materials were applied. Study recommends that all stake holders involved in the management of mathematics performance to rethink the way forward. Government and ministry of education need to encourage elementary teachers to use manipulative to help teach mathematics thereby positively affecting student learning. Incorporating manipulative into mathematics lessons in meaningful ways helps students grasp concepts with greater ease, making teaching most effective.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The African people had developed their own systems of education even long before the coming of Europeans and Arabs. Although the systems varied from one community to the other, their goals were often strikingly similar (Sifuna & Otiende, 1980). At independence in 1963 education was viewed as the means to eradicating poverty, ignorance, and disease from Kenya (MOEST 2005). Kenya has had several Education commissions since independence, aimed at improving quality in Education. A lot of policies; EFA, UPE and the recent one, FPE have been formulated, aimed at addressing access, equity, relevance, external and internal efficiencies within education system.

The Kenya government is committed to the provision of quality education and training as a human right, Kenya Education Act of (2013). Kenya's greatest asset lies in its people. Its potential lies in their creativity, work ethics, education and entrepreneurial skills among others, Kenya vision 2030, (2009). The overall policy goal for the Government is to achieve EFA in order to give every Kenyan the right to education and training to better his socio-economic status (MOEST, 2005).

The Kenya vision 2030, the new country's development blue print aims at making Kenya a newly industrialized "Middle income country providing high quality life for all citizens by the year 2030". Kenya aims at providing a globally competitive quality education, training and research for development -Kenya Vision 2030 (2007). The provision of education and training to all Kenyans is fundamental to the success of the government's overall development strategy (MOEST, 2005). The vision 2030 further aims at creating adaptive human base to meet the requirement of a rapidly industrializing economy which can be achieved through development of high quality of pool of technical, industrial and skills which assist in developing entrepreneurial human resources (MOEST, 2005). One of the subjects which can be used to embrace this aim is mathematics whose main goal is to equip students with knowledge and skills which assist in developing logical thinking,

ability to apply the knowledge required to analyze situations and make rational decisions. The Kenya government has therefore made mathematics compulsory both at primary and secondary levels.

The Kenya government has over the years, demonstrated its commitment to the development of education and training through sustained allocation of resources to the sector (MOEST 2005, Sessional paper no. 1). However, despite the substantial allocation of resources and notable achievements attained, the sector still faces major challenges, some of which include, access, equity, quality, relevance, efficiency in management of educational resources. Eshiwani (1993) affirmed that the school based factors that influence the performance in pupils include availability of teaching and learning materials. However, in Kenya, most resources are not evenly distributed as Schools are located in different environment all over the country. The Kenya government since the year 2003 has come up with the measure to reduce variation of teaching and learning materials through the Kenya education Support Program and School Infrastructure and Material program. Each pupil in primary School is allocated with some amount of money each year for purchases of these materials.

Report by Bunyi, G.,et al.,(2012) in the studies by USAID-Kenya state that Within the FPE program, the government is responsible for providing all school materials including textbooks. However, studies continue to report serious shortages of textbooks in Kenyan classrooms. Policy issues related to the production of teaching-Learning materials and procurement of textbooks and other teaching- learning materials have been put in place to ensure availability of textbooks and other learning materials in schools, not effective though.

The Kenya government in collaboration with the government of Japan, began the project of strengthening mathematics and science project, (SMASSE), in 1998.This trickled down to Primary schools in the year 2003.The project was taxed with the provision of teaching and learning materials and training teachers on how to improvise them where necessary. The core of SMASE was to have the student at the centre, hence, the acronym;

ASEI (Activity, Student, Experiment, Improvisation). The learners are called to participate fully in the lesson, do experiment and where possible, improvise the learning materials from the locally available materials. An object well-handled practically impresses itself firmly in the mind than object merely seen from a distance, Yadar, (2007) and UNESCO,(2008). Seeing, touching and listening which are characteristics of instructional materials are gateway of human learning in this 21st century. Aramide and Bolarinwe (2010) opine that instructional materials have the potential for enhancing students learning. Its role in teaching and learning is one of the most important and widely discussed issues in contemporary education policy. Education in this age has become wide spread and as such, exclusively oral teaching cannot be the key to successful pedagogy. Using a multiple baseline design, researchers Cass, Cates and Smith (2003), in their study of three Secondary Schools with learning disabilities in mathematics, found that students acquired and retained problem solving skill when the concept of perimeter and area were taught using physical manipulative.

Manipulative materials are concrete materials such as geo boards, pattern blocks, chip-trading boards, counters, algebra tiles, attribute pieces, fraction bars and Cuisenaire rods that students arrange in some way to represent a variety of mathematical relationships (Maccini & Gagnon 2000). Common instructional materials include chalkboards, charts, graphs, diagrams, exhibits, flat pictures, photographs, maps, models objects motion pictures, textbooks, reference books, computers, etc.(Mundi and Alfred, 2006). Yet, teaching with instructional materials, especially with the newer technologies that suit today's information technological society is the trend in contemporary society. It is now a common knowledge that advances in technology have brought instructional materials – especially the projected and electronic materials to the forefront as the most radical tools of globalization and social development, which have affected the classroom teaching-learning situation positively.

The use of instructional materials in teaching and learning at the primary school level help the learners to explore experiment, create and interact with the environment intensively. Copious uses of instructional materials help to provide learners with an

enabling environment to learn Mathematics (Meremikwu, 2008). Instructional materials make teaching and learning more effective. They can be manipulated, seen, heard or talked about as instruments which facilitate such activity. Esu, Eukoha and Umoren (2004) stated that instructional materials are necessary ingredients in the development of any curriculum. Esu (1995) asserted that the main aim of instructional materials in the teaching of Mathematics is to increase the effectiveness of teaching mathematics as a means of preparing learners for future responsibilities as adults. Textbooks and other learning materials may influence teachers' beliefs about mathematics (Collopy, 2003). Mathematics is used as a basic entry requirement in any of the prestigious courses such as medicine, architecture and engineering among other degree programs. Despite the important role that mathematics plays in the society, there has been poor performance in Mathematics in Kenya National Examination (Aduda 2003). Several factors has been attributed to poor performance in mathematics among which are poor methods of teaching (Habour peters, 2001), poor interest in Mathematics (Badimas, 2002 & Bodo, 2004) and lack of appropriate instructional materials in teaching Mathematics at all levels of education(Gambari, 2010)

According to the analysis done by the Kenya's examination body (KNEC) between the years 2010 to 2014, general achievement in mathematics has been average. Siaya County Mathematics performance is equally average with raw scores ranging between 28 and 30 as stipulated below:

Table 1.1: General Performance in K.C.P.E for the Last 5 Years

Paper	2010	2011	2012	2013	2014
English	22.95	22.40	22.65	26.83	21.25
Kiswahili	25.76	24.03	25.34	21.98	21.82
Mathematics	26.90	26.09	28.15	26.43	28.14
Science	30.43	33.74	31.38	30.91	35.35
Social Studies	38.95	33.79	36.52	32.85	32.81
Religious Education	18.02	18.73	22.71	21.13	21.64

Source: Kneec Report 2014

Table 1.2: Siaya County Performance in Mathematics for the Last 5 Years

Year	2010	2011	2012	2013	2014
Raw scores	29.23	28.44	30.78	28.08	28.14

Source: Kneec K.C.P.E result analysis 2014

1.2 Statement of the Problem

The Kenya Vision 2030 aims at creating adaptive human base to meet the requirement of a rapidly industrializing economy which can be achieved through development of high quality of a pool of technical and industrial skills which assist in developing human resources. Poor town planning, lack of skilled manpower to construct roads and sewerage system in the county, scarcity of qualified surveyors, are some of the problems that need to be addressed by producing quality mathematicians in the county, since the main goal of mathematics is to equip students with knowledge and skills to assist them in developing logical thinking, innovativeness and creativity. In fact as we speak skilled engineers have been imported from China to construct roads and the sewerage system in the County. The natives of the land have been casually employed either to clear bushes or provide food for the Chinese who are working there.

Despite the importance attached to mathematics, the performance of the subject in Siaya County has been average and as a result the county cannot produce competitive workers who can match the global market demand. There is therefore need to improve performance in mathematics in order to produce highly qualified personnel in Siaya county who can address the above cited problems. One of the intervention measures to help improve mathematics achievement in the county can be the use of instructional materials during teaching and learning of mathematics. This study therefore sought to establish the impact of instructional materials on academic achievement in mathematics in public primary schools in Siaya County, Kenya. The study explored the impact of concrete materials on the concept of money, Geo board on achievement on geometry, Algebra tiles on the achievement on algebra and place value blocks on the achievement on place value operations.

1.3 Purpose of the Study

The purpose of this study was to determine the impact of using instructional materials to teach mathematics when compared with only abstract mathematics symbols in order to improve achievement in mathematics in primary school pupils in Siaya County.

1.4 Research objectives

1. To establish the impact of concrete materials on achievement in measurement involving money.
2. To establish the impact of Geo board on achievement in Geometry.
3. To determine the impact of Algebra tiles on learning in Algebra.
4. To determine the impact of place value blocks on achievement in mathematics basic operations

1.5 Research questions

1. What impact do concrete materials have on achievement in measurement involving money?
2. What is the impact of Geo board on geometry achievement?
3. What impact do algebra tiles have on achievement in Algebra as a concept in mathematics?
4. What is the impact of place value blocks in achieving basic operations on numbers in mathematics?

1.6 Significance of the Study

The result of this study helped to provide evidence for teachers to incorporate instructional materials in teaching and learning in order to improve the standard of Mathematics in the schools. The study provided an insight to teachers and learners so that they may not rely on the Government for production of instructional materials but find a way of producing the materials locally. It helped to improve on careful usage of the existing materials and even their maintenance and sustainability. The study changed children's attitude in Mathematics since the use of instructional materials during teaching and learning made the lessons very interesting. It would help the government to improve

on the production of instructional materials not only in Mathematics but other subjects as well. The study would also provide empirical evidence on how the use of concrete materials to teach the concept of money, geo board on geometry, algebra tiles in Algebra and place value blocks on place value are related in the achievement in Mathematics. Siaya County education department would be able to address the challenges of instructional materials.

1.7 Limitations of the Study

The study focused on a small area in the curriculum ignoring others. The study did not take care of all learners. It left out learners with disabilities, especially the visually and hearing impaired learners. It would only benefit the low achieving students since high achievers must have already mastered the concepts.

1.8 Delimitations of the Study

The study was concentrated in Siaya county Schools. The schools that were sampled for the study were closed to each other and helped ease the transportation challenges, for example, fare. The administration of pre test confirmed that there was a problem in the four topics, namely money, geometry, algebra and place value of numbers. The standard four teachers of mathematics used instructional materials willingly. They willingly responded to the questions asked during interview. Assurance of confidentiality was given to the teachers to minimize limitation of not responding to the questions.

1.9 Assumptions of the study

The assumptions of the study were that:

The weather would be fine to favor the movement by the researcher.

The instructional materials would be available during teaching and learning.

Standard four teacher of mathematics would use the instructional materials to teach mathematics.

Standard four teachers of mathematics in the county have undergone uniform training

Children learn under the same classroom environment and their level of understanding is the same.

1.10 Definitions of Significant terms

Achievement refers an accomplishment which is shown by scores

Algebra refers to a concept in mathematics where symbols are used to represent numbers

Algebra Tiles refer to learning materials that are either in square or rectangle form that can be used to teach the concept of algebra

Concrete Materials refer to physical materials that can be used to facilitate learning

Geo board refers to an instructional material used to facilitate teaching and learning of geometry

Geometry refer to a concept in mathematics which deals with shapes, sizes and patterns

Instructional Materials refer to teaching and learning aids or resources that can be used to facilitate learning

Manipulative refer to physical, concrete or virtual materials that can enhance learning

Mathematics achievement refers to performance according to set criteria

Mathematics refer to a subject in the curriculum which involves the use of numeracy skills

Place value blocks refers to the physical blocks used to teach place value of numbers

Primary School refers to an institution of learning which just before secondary school where children receive elementary education

1.11 Organization of the Study

The report comprises five chapters. Chapter one contains the background information to the study, the statement of the problem, purpose of the study, limitations of the study, assumptions of the study, Organization of the study and definitions of significant terms used in the study. Chapter two contains review of related Literature, summary of the literature review, theoretical framework and conceptual framework. Chapter three highlights methodology of the study. This includes research design, target population, sample size and sampling techniques, research instruments, data collection procedures and data analysis techniques. Chapter four consists of data analysis and interpretation. Chapter five comprises summary of the study, conclusions recommendations and suggestions for further research.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter explores the concept of instructional materials in relation to mathematics achievement in Geometry, Algebra, money as a concept in measurement and Numbers in class Four, also referred to as a junior or elementary class.

2.2 The concept of instructional materials

Teaching at any level requires that students be exposed to some form of simulation. Ikerionwu, (2000), refers to instructional materials as objects or devices that help the teacher to make learning meaningful to the learners. Instructional materials, which are educational inputs, are of vital importance to the teaching of any subject in the school curriculum. Wales (1975), opined that the use of instructional materials would make discovered facts glued firmly to the memory of students. A teacher who makes use of appropriate instructional materials to supplement his teaching will help enhance student's innovative and creative thinking as well as help them become enthusiastic, Ekwueme and Igwe (2001).

Instructional materials refer to objects or devices which help the teacher to make learning meaningful to the learners, (Ikenionwu, 2000). Ezegbe, (1994), classified them into two; visual materials made up of reading and non reading materials, and audio visual materials comprising electrically operated and none electrically operated materials. According to Aduwa Et Al, (2005), these materials and resources include, audio tapes recorders, video tape recorders, slide projectors, still pictures, programmed instructional film strips, maps, chart, graphs and many more; offer a variety of learning experience individually or in combination to meet different teaching and learning experiences. Ngaroga, (2007), talks of teaching and learning materials as those that are accessed in the School environment, collected and brought. They can be three dimensional, two dimensional real objects and others are electronic. The "term mathematical instructional resource" is defined as any form of specific mathematical apparatus (Structured or unstructured), image, ICT game,

tool, paper, or everyday material which could be utilized to provide a mathematical teaching or learning (Dorine, Et. Al, 2007).

Instructional materials can be improvised,(SMASE Project, 2010). Onasanya et al: (2008), Adebimpe (1997) and Aguisiobo (1998) noted that improvisation demands adventure, creativity, curiosity and perseverance on the part of teachers. Such skills are only realized through well-planned training program on improvisation. Odi F, (1990) asserts that improvised instructional materials may be used as practice devices with which the students build accuracy, understanding and efficiency. According to Dada (2006), improvised instructional materials involve the fact of producing and using alternative resources aimed at facilitating instruction. Again, Ikwuas and Onwiodiket (2006) state that improvised materials involve selection and deployment of relevant instructional elements of teaching and learning processes in absence or shortage of standard teaching and learning materials, for meaningful realization of specified educational goals and objectives. Abimbade (2004) had earlier noted that the approach of using improvised materials in mathematics classroom assist in proper introduction of new skills, develop understanding as well as show the appropriate way of doing things.

Instructional strategies need to be identified where the use of manipulative are often suggested as some of the effective approaches to improve student mathematics achievement (Gurbuz, 2010; Sherman & Bisanz, 2009). Mathematics manipulative-based instructional techniques are approaches that include opportunities for students to physically interact with the objects to learn target information (Carbonneau & Marley, 2012). For example, at the elementary level, teachers use play money to help students learn basic arithmetic functions. The use of manipulative in mathematics instruction has been cited as a strategy to allow students draw on their practical knowledge (Burns, 1996). Concrete objects that resemble everyday items should assist students in making connections between abstract mathematical concepts and the real world (Brown, Neil, & Glernberg, 2009).

Brudett and Smith, (2003) in their study based on 57 schools in England and Wales concluded that those learning institutions with abundant learning and teaching resources, favorable student-teacher ratio, commendable workload and good reward and incentives for teachers perform better than the institutions that do not provide the same. However in a clear departure from the above views, Orji (2012) and Ekpe (2010) in their independent studies agreed that instructional materials are not necessarily important if the learners are intelligent and the teacher has good mastery of the subject matter. Egbu (2012) argued that involving learners in classroom activities is what matters most as it makes teaching learner centered.

Eke (2010) carried out a survey study on the various roles of using instructional materials in teaching Social Studies in primary schools in the Isukwata local government. The finding showed that instructional materials make abstract ideas concrete and easier to understand. Arisi (1998) carried out a study on the usage of instructional materials by social studies teachers in junior secondary schools in Oredo local government area of Edo state. In this study female teachers were found to use instructional materials more than the male social study teachers. The finding equally showed that female teachers are more predisposed than the male teachers in terms of improvisation of instructional materials Williams (2004) conducted a study on the extent of utilization of instructional facilities in secondary schools in the Gboko Education zone of benue state, which found that instructional facilities appear to be inadequate. Nwafor (2012) carried out a study on the availability and utilization of Social Studies Instructional materials in secondary schools on Onueke Education zone of Ebony, State. According to this study, instructional mat were available underutilized. Ifeaka (2005) studied the influence on the production and utilization of instructional materials on students' attitude to chemistry in Anambra state. The results revealed that chemistry teachers tend to show a poor attitude towards the production of instructional materials.

The above reviewed works have a relationship with the present study as they all focused on some aspects of instructional materials; however they differed significantly from the present study in content and geographical scope, hence, creating a gap in knowledge in

terms of achievement. The interest to fill this existing gap in knowledge is the premise on which this study stands, which is to determine impact of instructional materials on academic achievement in mathematics in public primary schools.

2.3 Mathematics achievement

Mathematics is one of the formal disciplines that help man lay a solid foundation for future survival. Scientific and technological developments are dependent on mathematics. Ginsburg, (2002), defines mathematics as a fundamental human activity-a way of making sense of the world. Fapohunda, (2002), sees mathematics as essential tool in the formation of the educated man. Because of its importance, Kenya has made mathematics compulsory in both primary and secondary School curriculum (Mutunga and Breakel, 1992; Republic of Kenya 1992) in order to give a sound basis for scientific and reflective thinking, and prepare students for the next level of education. Its application in other disciplines, mostly in sciences, is appreciative and without it, knowledge of the sciences remains superficial. However a considerable number of students have inadequate understanding of mathematics and mathematical concepts and skills (KNEC, 2000, MOEST, 2001.

According to data released by the Ministry Of Education Science and Technology on December 31st, 2014 of the 839,759 of standard eight pupils took the 2013 KCPE, which serves as the form one entrance examination, 467,353 scored below the average, receiving scores 250 out of possible 500 marks. Uwezo Kenya's report findings of 2012 showed little progress on children's learning capabilities.

Mathematics is used as a basic entry requirement into any of the prestigious courses such as medicine, architecture and engineering among other degree programs. Despite the important role that mathematics plays in the society, there has been poor performance in Mathematics in Kenyan national examinations (Aduda 2003). Several factors have been attributed to poor performance in mathematics among which are poor methods of teaching (Harbour-peters, 2001), poor interest in mathematics (Badimus, 2002&Bodo,

2004), Lack of appropriate instructional materials for teaching mathematics at all levels of education (Gambari, 2010).

Several studies have shown other indices that could affect pupils' mathematics achievement. Stringfield and Teddie(1991). In their study of rural education in the U.S showed that classes and Schools differ in terms of their learning environment and School resources. Okoyeocha (2005) in a comparative study of public and private Schools were better equipped than their private counterparts.

TIMSS report of 2011 on mathematics result analysis showed that Mathematics achievement is improving over the years in some member Countries, Kenya is not one though. The percentage of high level and low level students increased in both 4th and 8th grades. The Governments of many countries are struggling in considering how to provide best mathematics education for their students. According to the report, students' ability in mathematics is deteriorating over their school years, as a student grows older, math competencies decrease. A country such as Chinese Taipei showed bimodal distribution on mathematic achievement with 2 peaks of high performance and high peak of low performance. This signifies that educational opportunities or resources are not equally distributed to all students (Ker W.2013)

The current education system in Kenya consists of early Childhood education (ECE), Primary and secondary education. At the end of primary education, pupils sit for the Kenya Certificate of Primary Education (KCPE) prepared by Kenya National Examinations Council (KNEC). Performance in KCPE determines who is admitted to secondary schools. A candidate is required to sit for five subjects-English, Mathematics, Kiswahili, Social Studies and Science.

Identifying difficulties at an early age can prevent children from developing inappropriate strategies and misconceptions that can become long term obstacles to learning, (Williams, 2008). Early intervention can also combat the development of anxiety which can become a significant factor among older students,(Dowker,2004).It can be assumed

in most cases that if intervention start early and specific weaknesses are concentrated upon, they might not need to be very long or intensive,(Dowker,2009). Zan & Martino, 2007), reported in TIMSS that 4th grade students have much more positive attitude towards mathematics and this plays a crucial role in learning the subject, hence high achievement.

Gathier et al. (2004) in their report assert that junior years are an important time of transition and growth in student's mathematical thinking. According to the report, during this time, the curriculum is changing in its content, sophistication, abstraction and expectations of student proficiency. There is also move to abstract reasoning. Junior students begin to investigate increasingly complex ideas, building on their capacity to deal with more formal concepts.

2.3.1 Concrete materials and mathematics achievement

Concepts are constructed from a series of experience. Piaget's Stages of intellectual development are useful guides to the teaching in which he emphasizes concrete operational materials that facilitate internalization of concepts presented to them. There is therefore a need to determine the adequacy of teaching and learning resources for mathematics as this would affect achievement in the subject.

Onasanya, (2004) gave various kinds of models used in educational instructional materials namely; mental models, theoretical models etc. These types of models are of special pedagogic significance in science and technology instruction due to the nature of knowledge and knowledge getting process in various disciplines. Concrete models are material objects which are likenesses of natural or man-made structures or systems and which are intended to highlight and explain or describe structures, functional processes and relationships in the original. Concrete models are constructed in the effort to understand the behavior of the physical world and the causes of such behavior (Onasanya and Adegbija, 2007). Huang, L. E and Chang (2012) mentioned that assessment of student's mathematical understanding should not be solely based on their writing of the problems but also on their demonstration and oral interpretation.

Concrete manipulative are concrete objects used as tools that allow students to experiment and explore mathematical concepts (Burns & Hamm, 2011). Boggan, Harper, and Whitmire, (2010) state that manipulative have been used for many years and from several different civilizations to solve mathematical problems that they have encountered every day.

When students employ concrete manipulative in long-term use during early elementary level, they have greater mathematical achievement than students who have not used concrete manipulative (Burns & Hamm, 2011). Concrete materials that resemble everyday day items should assist students in making connecting between abstract mathematical concepts and real world.

Hunt Nipper and Nash (2011) in their study found many perceived benefits on the use of concrete manipulative. The benefits included trial and error, view mathematic information visually and kinesthetically break down mathematical concepts and actively engage in the math lesson (Hunt et al, 2011). “A good manipulative bridges the gap between informal mathematics and formal mathematics.” (Boggan et al., 2010, p.2).

Over the past few decades, researchers have studied the use of manipulative in several different grade levels and in several countries (Boggan, Harper & Whitmire, 2010 ,Cain Caston 1996, Castro, 2006, Kelly 2006). Manipulative can also be referred to as virtual or concrete (hands on) materials.

The majority of the studies indicate that math achievement increases when manipulative are put to good use. Teachers need to know when, why and how to use manipulative effectively in the classroom as well as opportunities to observe, first-hand impact of allowing learning through exploration with concrete objects. Students who use manipulative during mathematics instruction outperform students who do not (Driscoll, 1981, Sowell, 1989). Mathematics manipulative can both be commercial and teacher-made. The ultimate goal of using manipulative is to help children handle abstract concepts and symbols that are used to represent these concepts. Heddens (1986) claims

that since all mathematics come from the real world, the real situation must be translated into symbolism of mathematics for calculating. In order to help students to construct geometric ideas, concrete educational materials such as geometric rods, geo board, among others are to be utilized. This utilization also provides an opportunity for the teacher to assess and meet the needs of primary school students as they construct personal mathematical knowledge.

2.3.2 Concrete materials and achievement on money activities

Studies by Mcneil, Uttal, Jarvin and Sternberg (2009) investigated whether highly realistic physical manipulative were more helpful to fourth through sixth grade students in problem solving than simple. The study had two groups, experimental group where highly realistic bills and coins were used to help student in solving word problems involving money and a control group where the objects were not used. Data showed that students from the control group solved more problems correctly than the experimental group where concrete materials were used. The data suggested that different types of manipulative may offer distinct advantages to student learning.

The study found that some manipulative actually had a negative effect on student problem solving ability, they also pointed out that the type of manipulative employed during instruction appeared to be a relevant factor with respect to student learning. Concrete manipulative as modeling tool appeals to all types of learners (Durmus & Karakirk, 2006)

According to a publication by Noyce Foundation, 2008, one of the easiest ways to teach about monetary values is to use coins or paper money. Working with money is an application of number and operations. Student need to understand about the notations and conventions of coins and money in order to work successfully, but the basic strategies of operations and the basic ideas such as decomposition and multiple representation still apply. Students need experiences to be able to name and identify coins and also to understand value of each coin and note. Further they need many experiences on counting and spending money. In addition to operations and concepts of money students must

learn problem solving nature. Plastic or actual coins are often used a manipulative in the elementary classroom (Randall, D. & Wesley, P. (1999). The authors suggest that the models used to represent money should be proportional to their values.

2.4 Geo board and achievement in Geometry

The belief that concrete objects aid children in development of abstract concepts have been widely accepted in academic communities (Mc Neil & Jarvin, 2007) and a number of studies have corroborated this idea by showing that use of physical manipulative does positively affect student performance (Cass & Smith, 2003; Martin & Schwartz, 2005, Raphael & Wahlstrom, 1989). Using data collected through educators participation in the second international mathematics study (1981-1982), Raphael and Wahlstrom found that students' achievement improved when experienced teachers employed physical manipulative in geometry instruction.

Geometry is an important part of mathematics curriculum. Geometry thinking includes a strong focus on the development of careful reasoning and proof, using definitions and established facts (NCTM, 2000). Geometry helps students gain basic skills such as analysis, comparison, and generalization and is useful in representing and solving problems in other areas of mathematics in real world situations. However many students develop misconceptions and fail to go beyond simple visualization of geometric figures (Mistretta, 2000).

A study of the impact of manipulative instruction on student with LD in the area of geometry is warranted for several reasons. No studies were found that investigated the impact of manipulative instruction on the area and perimeter problem solving skills of adolescents with LD: in addition, only one group of researchers examined the effect of employing just the concrete phase of instruction acquisition maintenance and generalization of skills to an abstract level. (March & Cooke, 1996). Also there is a need to assess long term maintenance of skills acquired. Moreover a study in this area is justified because effective means to address NCTM standards in the area of geometry as well as measurement are needed. Specifically the geometry standard (NCTM, 2000) calls

for ‘‘geometry to be learned using concrete models, drawings and dynamics software.’’ The measurement standard requires students to apply appropriate techniques, tools and formulae to determine measurements. Further mastery of skills noted in this standard is considered crucial because measurement is employed in many aspects of everyday life.

Board of studies New South Wales (2002) classifies space and geometry as the study of spatial forms and is organized into three sub-strands: three dimensional space, two dimensional space and position. It considers recognizing, visualizing and drawing shapes and describing the features and properties of three and two-dimensional objects, as important and critical skills for students to acquire.

Geo boards were invented by an English mathematician and pedagogues, Caleb Gattegno (1911 – 1988). The geo board was designed a manipulative tool for teaching primary geometric in schools (Williams, 1999). As a learning tool, it provides a means to act upon the world and can be used as cognitive scaffold that facilitates the extension of knowledge (Salomon & Perkins, 1998, in McInerney & McInerney, 2002).

Through using geo boards, students cannot only work towards space and geometry outcomes but also be engaged in working mathematically (board of studies New South Wales, 2002). Geo board is versatile and can be used at all levels for teaching and learning about different areas of mathematics. It has been found to be a particularly useful aid for investigational and problem solving approaches (Carol, 1992).

A multiple baseline studies on the effect of geo board as a manipulative by Cass M. Cates, D. Smith, M. & Jackson, C (2003) in conjunction with studies by Cambray-Nunez R. Cruz-Oliva, V. and the Veega- Ramirez E. (2007), revealed that learners who were learning difficulties in the area of mathematics rapidly acquired the problem solving skills, maintained these skills over a two-month period and transferred the skills to a paper and pencil problem solving format.

2.5 Algebra Tiles and achievement in Algebra

Formal teaching has always been a complex process involving diverse knowledge and instructional decisions. Teacher's knowledge seems to be vital element for understanding the teacher's role (Elbaz, 1983). Teaching approaches have evolved and shown clear digression from teacher-centered to learner centered tendency and of course, the teaching could not be said to be complete without having mathematics and algebra as its integral part.

Algebra is a language where groups of symbols have specific meanings. Gatley (1991) claimed that a pilot project in an algebra by some Vancouver schools, showed that students learned concepts more quickly and remembered them better when the manipulative. "Algebra tiles" was used. The Vancouver study also indicated that students are required to follow a certain process to ensure that the learning are abstracted so that dependence on the tiles is eliminated Gatley (1991, p. 7).

Algebra can be difficult to learn because it is often taught with no recognizable meaning. Edge and Kant (1992) provide an interesting analogy. They claim that learning a language is easy because it means something as words generally represent something touched or experienced. 'If you look at a word like "mango" or "computer" you will obviously visualize an object' mathematics on the hand can be difficult because, it is often taught with no recognizable meaning $2x$: or x^2 cannot be visualized to stand for anything. Algebra is taught as an integral part of mathematics which involves: set theory, number of its operations, algebra geometry and measurement, matrices and trigonometry to develop reasoning and logical thinking among learners (Government of Pakistan, 2006).

The National Council of teachers of mathematics (NCTM, 2000) recommended introducing algebra and algebraic reasoning in elementary and middle grades throughout the courses of mathematics. Studies reveal that students don't understand algebraic concepts properly because the teachers mostly deal with algebraic variables mechanically without explaining real meaning in social context. This obviously results in poor learning

(Demby, 1997; Kieran, 1992, Lee and Wheeler, 1989; Mason, 1996). A number of things contribute toward effective teaching thus must have proper subject knowledge for teaching (Hill and Ball, 2004), pedagogical knowledge (Wilson, et al., 1987), practical knowledge (Connelly & Clandinin, 1986), knowledge of student thinking (Franke & Kazemi, 2001) etc.

Larbi (2011) conducted a study to investigate the effect of algebra tiles on students' performance in algebra. Two intact classes from two Schools were selected for the study and were assigned experimental and control group. The experimental group was taught using algebra tile manipulative while the control group received instruction using the traditional method, a treatment which lasted for three weeks. It was concluded that the use of manipulative promote students understanding in the learning of mathematics. Findings from the study showed that there was significant difference between the two groups. The group that received instruction using algebra tile scored better than the group without the tiles. It was concluded that the use of manipulative promote student understanding in the learning of mathematics. In a similar study, al- Absi and Nofal (2010) found statistically significant differences between two groups in favor of the experimental group, those who were taught using the algebra tile.

2.6 Place value blocks and achievement in Place Value operations

Hope M, (2006) in his book opined that number theory, numeration and computation remain important components of the current school mathematics curriculum, while it is true that computational and basic number facts have been emphasized to the detriment of other strands of mathematics. We all understand that student's proficiency in these areas is essential for students to be successful in understanding math concepts. With guidance and meaningful experiences, students will gain a sense of number, improve their ability to solve problem and develop useful strategies to estimate reasonableness of answers.

For each level of mathematics a specific set of basic computational and procedural skills must be learned. Computation and procedural skills are necessary for the actual solution of both simple and complex problems and the practice of these skills are necessary for the actual solution of both simple and complex problems and the practice of this skills

provides a context for learning about the associated concepts and for discovering more sophisticated ways of solving problems (Siegler and Stern 1998).

Studies conducted by (Peterson et al. 1988) Huntington 1994; Maccinin & Hughes, 2000, Marsh Cooke, 1996; Witzel, 2001): Funkhouser 1995, Mercer & Miller, 1992. Miller et al, 1998, Jordan et al 1998 revealed that the use of manipulative material on learners classified as having Learning Difficulty (LD) was effective on teaching place value skills, word problem-solving skills, computational skills and fraction solving skills.

Today manipulative can range from bottle caps; unifix cubes base-ten blocks, clocks and money just name but a few. Abella, I.C. (2012), assert that place value concepts are difficult for primary students to grasp students often memorize the steps and rules for getting the correct answers resulting to frustrations and misunderstandings. According to NCTM, 2000, developing and understanding of place value and base ten number system was considered a fundamental goal of the early primary grades. Students with number sense naturally decompose numbers, solve problems using the relationships of place the base ten system, estimate a sensible result for a problem and have a developed ability to make sense of numbers (NCTM, 2000). Unfortunately content knowledge of Place value systems is a common problem area experienced by university pre-service teachers and their conceptual understanding of Place Value is underdeveloped, (Taplin, 1992).

A tutorial process to the first year university students where the use of base ten and base five were to be applied to convert 245 to either of the bases the students used direct observation and apparently they possessed inadequate content and conceptual understanding of place value to work out the solution unassisted. The vast majority easily built 245 in base- 10 with the base -10 blocks. The material that is probably the most frequently used in developing place-value concepts (English & Halford 1995, p.105) is place value blocks. The reasons for the prevalence of use of place-value blocks relate to the systematic structure of the blocks as a system and the parallels between the blocks system and the base-10 numeration system. The sizes of the blocks are proportional to the numbers represented so that they form a system of proportional analogues of numbers.

2.7 Summary of The related Literature

The basis of reference of this study is constructivist learning theory which originates from the work of cognitive theorists like Jean Piaget, John Dewey, Jerome Bruner and Lev. Vygotsky, which is based on the belief that learning occurs as learners are actively involved in a process of meaningful construction of knowledge as opposed to passively receiving knowledge. It is important to take into account the background and the culture of the learner throughout the learning process, so as to shape the knowledge and truth of the learner creates, discovers and attains in the learning process (Westsh, 1997).

Many studies indicate that mathematics achievement improves when manipulative are put in good use. Driscoll, (1981), Sovel (1989), are among the researchers who assert that students who use manipulative outperform those who do not use them.

However, some researchers including Hunt, Nipper and Nash (2011) perceived drawbacks in use of manipulative, some teachers for example; do not use concrete materials due to time investment. This perception was shared by the researchers such as Carboneau, K. Marleys, & Selig, J. (2013).The study also explored the use of authentic assessment to develop students, geometric thought using Van Hiele model (Crowley 1987).

2.8 Theoretical Framework

This study is based on the constructivist learning theory which originates from the work of cognitive scientists like Jean Piaget, John Dewey, Jerome Bruner, Vygotsky among others and Van Hiele theory of geometric thought.

Constructivist teaching is based on the belief that learning occurs as learners are actively involved in a process of meaning and knowledge construction as opposed to passively receiving information. Through interaction with the physical situations, or concrete objects, a child's physical experience accumulates and he is able to conceptualize, think creatively and logically. The child therefore develops skills to abstract problems. According to this theory, learners are the makers of knowledge and meaning.

Constructivists' teaching fosters critical thinking, and creates motivated and independent learners. Constructivists suggest that learning is more effective when a student is engaged in the learning process rather than attempting to receive knowledge passively. Children learn best when they are allowed to construct a personal understanding based on experiencing things and reflecting on those experiences.

Piaget's theory focuses on how learners interact with their environment to develop complex reasoning and knowledge. As children interact with their environment and new objects, they learn and develop ideas. According to Piaget, knowledge is the interaction between the individual and the environment. He further asserts that experimenting and manipulation of physical objects is the main way by which children learn.

Jerome Bruner's theory concurred with Piaget's that learning is promoted by direct manipulation of objects, for example, in math education, the use of algebra tiles, coins and other items that could be manipulated. After a learner has the opportunity to directly manipulate the objects, s/he should be encouraged to construct visual representations, such as a drawing of a shape or a diagram.

John Dewey rejected the notion that Schools should focus on repetitive memorization and proposed a method of directed living where students would engage in real world practical workshops in which they would demonstrate their knowledge through creativity and collaboration. He called for education to be grounded in real experience.

According to Lev Vygotsky (1962), learning always occurs and cannot be separated from a social context. He affirms that knowledge construction occurs within social context that involves student- student, student- expert collaboration on real world problems or tasks that build on each person's language, skills and experience shaped by individual's culture.

In the classroom, constructivist view on learning can point towards a number of different teaching practices. In the most general sense, it usually means encouraging students to use active techniques (experiments, real world problems) to create more knowledge and then to reflect on and talk about what they are doing and how their understanding is changing. The teacher makes sure s/he understands the students pre-existing conceptions and guides the activity to address them and then build on them. Students in the constructivist classroom ideally become “expert learners”. This gives them ever broadening tools to keep learning. With a well planned classroom environment the students learn how to learn. Constructivism transforms the student from a passive recipient of information to an active participant in the learning process. Always guided by the teacher, the students construct their knowledge actively rather than just mechanically ingesting knowledge from the teacher or the textbook.

Van Hiele model of the development of geometric thought

The model of geometric thought and the phase of learning developed by the van Hieles propose a means for identifying a student’s level of geometric maturity and suggest ways to help students to progress through the levels. Students cannot be expected to prove geometric theorems until they have developed an extensive understanding of the systems of relationships between geometric ideas. These systems cannot be learnt by rote but must be developed through familiarity by experiencing numerous examples and counter examples, the various properties of geometric figures, the relationships between the properties and how these properties are ordered.

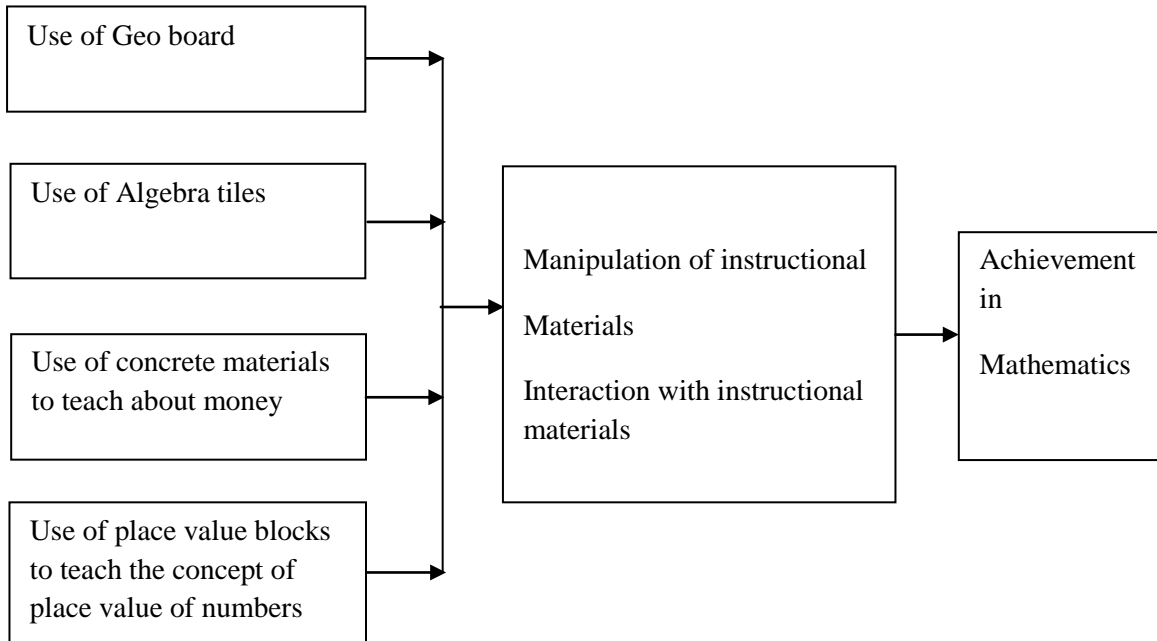
Research has supported the accuracy of the model for assessing students understandings of geometry (burger, 1985, burger and Shaughnessy, 1986 Geddes et al 1982, Geddes fuys and Tischler, 1985; Mayberry 1981 among other researchers. The need now is for classroom teachers and researchers to refine the phases of learning develop Van Hiele-based materials and implement those materials and philosophies in the classroom setting. Geometric thinking can be accessible to everyone.

Van Hiele model of geometric thought can be used to guide instruction as well as assess student abilities. The model consists of five levels of understanding. The levels, include, visualization, analysis, informal deduction, formal deduction and rigor. (Shaughnessy and burger 1985, p.420) describe characteristics of the thinking process. Assisted by appropriate instructional experiences, the model asserts that the learner moves, sequentially from the initial or basic level (visualization) where space is simply observe- the properties of figures are not explicitly recognized, through the sequence listed above the highest level, rigor) which is concerned with formal abstract aspects of the highest level of deduction.

2.9 Conceptual Framework

This study was based on a conceptual framework that depicts mathematics achievement as dependent variable and instructional materials as independent variables. It shows how the use of concrete materials, geo board, algebra tiles and place value blocks can be used to improve mathematics achievement in the concept of money, geometry, algebra and place value operations respectively.

Figure 2.1: Conceptual framework on Mathematics Achievement in Primary Schools



Independent Variables

Intervening Variable

Dependent variable

The use of concrete materials to teach the concept of money created enthusiasm in the learners. As they were engaged in money activities they would be able to learn about giving balance, change, denominations and this would increase their ability to understand the concept better. Geo board is an instructional material which can be used to learn about various shapes and angles in Geometry in. The board can also be used to teach other concepts in mathematics including area, perimeter and volume since these require a prerequisite knowledge on shapes.

Algebra tiles make the learning of algebra real as the tiles are used to represent the symbols which are a bit abstract and cannot be understood easily. As the learners use the tiles they get engaged and their attention span is retained for a long time.

Blocks can be used to represent various values of different figures. Learners who use place value blocks are able to align figures in their right places. This can in turn lead to better achievement when it comes to operation on numbers.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter represents the research design, target population, sample size and sampling procedure, data collection, validity of instruments, reliability of the instruments and data analysis procedure.

3.2 Research Design

Ogula (2005) describes research design as a plan, structure and strategy of investigation to obtain answers to research questions and control variance. Additionally, a study design is the plan of action the researcher adopts for answering the research questions and it sets up the framework for study or is the blueprint of the researcher (Kerlinger, 1973). The study design used experimental design. Montgomery (D. C, 1997) defines an experimental design as the process of planning a study to meet specified objectives and experiment as a process or study that result in the collection of data where the results of the experiment are not known in advance.

The design involved students from intact classes. The study made use of experimental group and the control group. The experimental group was taught with instructional materials while the control group was taught without instructional materials. The population of the study consisted of 392 primary four pupils from eight schools. Simple random sampling was carried out to select the experimental and the control groups. The instrument for data collection was an achievement test which comprised a 20 item multiple choice questions developed by the researcher and based on the selected contents in the primary four mathematics curriculum which proved challenging for the pupils over the years

A pre-test on mathematics achievement on the selected topics was administered by the teachers to ascertain the present level of achievement of the Control and experimental groups of pupils. After the pre test, the regular teachers of mathematics commenced the

experiment in the selected Schools, adhering strictly to the topics given by the researcher. The experimental group was provided with the instructional materials needed to teach the selected topics, including coins, paper money, Geo board, Algebra tiles, place value blocks etc. The control group was taught without using the instructional materials. The experiment lasted 4 weeks after which the same instrument was administered on the two groups as post test.

3.3 Target population

According to Ogula (2005) a population refers to any group of institutions, people or objects that have a common characteristics. According to the statistical record from the Siaya County Office, the total number of primary schools in the county is 696 and the total population of standard four children in the County are 20564. Siaya County has a total of six sub-counties – Siaya, Gem, Rarieda, Bondo, Ugunja and Ugenya; the study population included the Head teachers, Standard four teachers of mathematics and pupils. There are 696 head teachers and the same applies to the standard 4 teachers assuming there is one mathematics teacher per school.

3.4 Sample and sampling procedure

Sampling is the procedure a researcher uses to gather people, places or things to study. It is a process of selecting a number of individuals or objects from a population such that the selected group contains elements representative of the characteristics found in the entire group, (Kombo & Tromp, 2006).

The sample of the size of standard four pupils was determined using Slovena’s formula of determining the sample (n) for a finite population. According to Yara and Ndirangu (2012) the formula is given as:

$n = N \div (1 + Ne^2)$, where; N=population, n=sample size, and e=desired degree of confidence level. A 95% degree of confidence level was used.

Using the formula, the sample size was determined as:

$$n = 20564 \div [1 + 20564(0.05^2)] = [1 + (20564 \times 0.0025)] = 20564 \div [1 + 51.4] \\ 20564 \div 52.4 = 392.4427$$

Since we are dealing with human beings and not figures, the study went to the nearest whole number making the sample to be 392 pupils. The study also included eight Head teachers and six standard four teachers of Mathematics from each of the eight Schools in the County.

3.5 Research instruments

Research instruments to be used for data collection for this study included; Mathematics Achievement Tests which was administered at a pre-test and later post-test and oral interviews to the teachers. The test was constructed by the researcher and vetted for use by the supervisor and Educational Test and measurement experts. The test was administered to standard 4 pupils in the experimental and control groups after the end of four weeks of teaching.

3.6 Validity of Instruments

Validity of an instrument is based on how an instrument fulfils the functions it is supposed to perform. Mugenda and Mugenda (2003) emphasized that validity is a degree to which results obtained from the analysis of the data actually represent the phenomenon under study. The research instrument was piloted in two schools which are not part of the selected schools for the study. The piloting was done to establish the construct validity of the instruments (Mugenda & Mugenda, 1999). The test items were found to be valid.

3.7 Reliability of Instrument

Reliability refers to the consistency of the scores obtained, how consistent they are from one administration of an instrument to another (Kombo & Tromp, 2006). A reliable one will constantly produce the expected results when used more than once to collect samples from two samples randomly drawn from the same population. The researcher used test-retest reliability on the total number of students tested. A reliable coefficient was calculated to indicate the relationship between the test scores in the two groups of students. Kuder Richardson (21), which is the most appropriate for the yes or No questions, was used. The reliability (p) was 0.72, which showed that the test was very reliable.

3.8 Data collection procedure

After getting permission from the University of Nairobi, the researcher then made a courtesy to Siaya county education office, informing them of the intention to conduct research in primary schools in Siaya County. The researcher then wrote to the Head teachers seeking permission to conduct research and explaining the purpose of the study and treatment implementation. A pre -test on Mathematics achievement on the selected topics for the experiment was administered by the teachers to ascertain the level of achievement of pupils. After the pre test, the regular teachers of mathematics commenced the experiment in their respective schools. The experimental group was provided with the instructional materials needed to teach the selected topics, including coins, paper money, geo boards, Algebra tiles and place value blocks. The experiment lasted four weeks after which the same instrument was administered on the two groups as post test. An interview schedule was also prepared to collect data from the teachers.

3.9 Data analysis techniques

Data analysis techniques are statistical methods used to analyze data so that it can be interpreted (Kombo & Tromp, 2006).It involves computation of certain measures along with the searching patterns of relationships that exist between the dependent variable and independent variables. The data was analyzed using descriptive statistics based on the themes and objectives of the study. The descriptive technique involved calculating means, standard deviation and correlations. Correlation analysis was used to determine the relationship between dependent and independent variables.

Data was screened, coded and analyzed through statistical package for social science (SPSS, version 21.0)

3.10 Ethical Considerations

Ethics is the division in the field of philosophy that deals with values and morals .people may disagree because it is based on peoples' personal value system on a topic. What one person or group considers being good or just might be considered bad or wrong by another group or person. In this chapter we define ethics as the principles and guidelines that help us uphold the things that we value.

The researcher explained to the respondent about the research and that the study was for academic purpose only. It was made clear that participation would be voluntary and the respondents would be free to decline or withdraw anytime during the research period. The respondents were not coerced into participating in the study .The participants had informed consent to make the choice to participate or not. They were guaranteed that their privacy would be protected by strict standard of anonymity. High standard of professionalism was observed as the researcher avoided fabricating or altering result by scientists to suit her study.

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION AND DISCUSSION

4.1 Introduction

The purpose of this study is to determine the impact of using instructional materials to teach mathematics when compared with only abstract mathematics symbols in order to improve achievement in mathematics in primary school pupils in Siaya County. This chapter focused on response rate, demographic information consisting of; gender, level of education and length of service of respondents, analysis and discussion of research findings of the study. The findings are discussed under the following research questions: What impact do concrete materials have on achievement in measurement involving money? What is the impact of Geo board on achievement in geometry? What impact do algebra tiles have on achievement in Algebra as a concept in mathematics? What is the impact of place value blocks in achieving basic operations in mathematics?

4.2 Response rate

The sample size of children was 392, the head teachers were 8 and 8 standard four teachers responded to the interviews. The response rate was 100 percent. Mulusa (1998) says that 50 percent response rate is adequate, 60 percent is good and 70 percent very good. The 100 response rate was hence considered very good to provide required information for the purpose of data analysis.

4.3 Demographic information

Demographic information of the respondents was sought; the researcher deemed it necessary to look into demographic information of teachers because they make a person who he or she is. Personal characteristics such as educational level, gender, educational experience, Teachers need to know when, why and how to use manipulative effectively in the classroom as well as opportunities to observe, first-hand impact of allowing learning through exploration with concrete objects. Students who use manipulative during mathematics instruction outperform students who do not (Driscoll, 1981, Sowell,

1989). The respondents were requested to indicate their personal information which was categorized into gender, academic qualification and duration of service.

4.3.1 Gender of teachers

The study sought information on the gender distribution of teachers in involved in this study. The findings are presented on Table 4.1.

Table 4.1: Distribution of teacher's gender

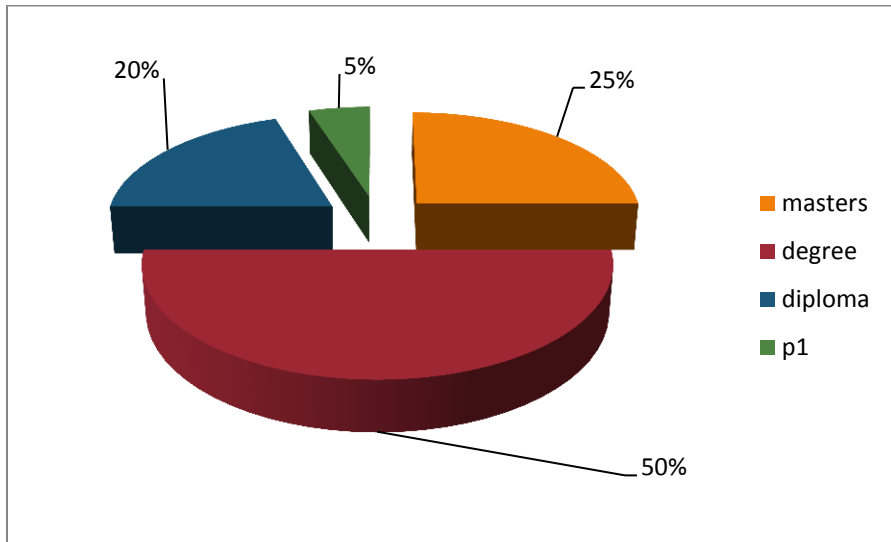
Gender	Frequency	Percent
Male	6	75.0
Female	2	25.0
Total	8	100.0

From the study findings majority of the respondents were males represented by 75% while the rest were female teachers represent by 25%. These findings depicts that male teachers were in representation as compared to their female counter part.

4.3.2 Distribution of teachers by Level of education

The researcher enquired on the teachers' level of education. The findings are presented on the figure 4.1.

Figure 4.1 : Distribution of teachers by Level of education



According to the study findings half of the respondents were degree holders, 25 % represented master’s degree holders, 20% were diploma holders while only 5% were p1 teachers. High levels of confidence result to high levels of competency, the availability of knowledge requires that teachers possess skills and knowledge appropriate for their responsibilities.

4.3.3 Distribution of teachers by teaching experience

The study enquired on the teachers teaching experience. The findings are presented on the Table 4.2.

Table 4.2 : Distribution of teachers by teaching experience

Respondents	Frequency	Percent
1-5 years	1	12.5
6-10 years	4	50
11-15 years	2	25
15 and above	1	12.5
Total	8	100.0

According to the findings half of the respondents had been in service for 6-10 years, 25% of teachers had a teaching experience of 11-15 years, while 12.5% had been min service for period between 1-5 years and 15 years and above concurrently. This implies that teachers have undergone an education system that had enlightened them on need to know when, why and how to use manipulative effectively in the classroom as well as opportunities to observe; first-hand impact of allowing learning through exploration with concrete objects.

4.4 Instruction materials in teaching and learning.

Teachers were requested to answer the following questions on instruction materials in teaching and learning materials. Tick according to your level of agreement.

Key: Use a scale of 1-3, where 1=strongly agree, 3 strongly disagree, 2= agree

Table 4.3 : Instruction materials in teaching and learning

Instruction materials in teaching and learning materials	Mean	Std. Deviation
1. Do you use the following instructional materials to teach mathematics (a)Money activities? Our shop, paper money, coins, pupils, textbooks	1.9	0.434
(b) Geometry? Set instruments, Blackboard ruler, pair of compasses, protractor, geo board	1.6	0.660
(c)Algebra? Algebra tiles, pupils textbooks	1.3	1.462
(d)Place value? abacus, place value blocks, sticks, stones	1.5	0.767
2. Does the use of instructional materials during teaching and learning have any impact in the achievement on geometry, algebra, money activities, and place value in number operation?	1.3	0.576

From the findings in Table 4.3 on instruction materials in teaching and learning materials; the study shows that respondents strongly agreed on the use of instructional materials on Money activities their shop, paper money, coins, pupils' textbooks and use of geometrical set instruments, Blackboard ruler, pair of compasses, protractor, geo board and in place value they use abacus, Place value blocks, sticks, stones to teach mathematics as shown by mean scores 1.9, 1.6 and 1.5 respectively. However teachers just agreed that use of instructional materials during teaching and learning have impact in the achievement on geometry, algebra, money activities, and place value in number operation. Algebra tiles, pupils' textbooks have an impact as shown by mean scores 1.3 consecutively. This study have corroborated this idea by showing that use of physical manipulative does positively affect student performance (Cass & Smith, 2003; Martin & Schwartz, 2005, Raphael & Wahlstrom, 1989).

4.5 The impact of using instructional materials in mathematics compared with only abstract mathematics symbols in order to improve achievement in mathematics in primary school pupils in Siaya County

In order to achieve all the objectives of the study on the impact of using instructional materials in mathematics, the researcher and teacher set the tests for the study. There were pre-test for all groups, and then same tests were administered to children in control groups as well as to the children in experimental group, researcher and teacher marked tests out of 100%. The results for analyzed data are shown in Table 4.4, Table 4.5 and Table 4.6.

Table 4.4 : Children performance in pre-test schools

Schools	Money		Geometry		Algebra		Place value	
	T.m	M.s %	T.m	M.s %	T.m	M.s %	T.m	M.s %
1	380	47	220	28	400	50	460	58
2	420	52	220	28	360	45	440	55
3	460	58	240	30	340	43	400	50
4	400	50	300	38	440	55	480	60
5	460	58	340	43	440	55	440	55
6	540	68	360	45	420	53	500	63
7	520	65	260	33	320	40	380	48
8	520	65	200	25	470	5.9	360	45
Totals	3700	59	2140	34	3190	50	3460	54

Table 4.5 : Children performance in control schools

Schools	Money		Geometry		Algebra		Place value	
	T.m	M.s %	T.m	M.s %	T.m	M.s %	T.m	M.s %
1	640	80	600	75	580	73	580	73
2	660	83	640	80	580	73	680	85
3	620	78	620	78	660	83	700	86
4	620	78	540	68	540	68	520	65
5	540	68	560	70	540	68	600	75
6	580	73	580	73	600	75	620	78
7	560	70	620	78	580	73	580	73
8	580	73	640	73	540	68	580	73
Totals	4800	75	4800	74	4620	73	4860	76

Table 4.6 : Children performance in experimental schools

Schools	Money		Geometry		Algebra		Place value	
	T. m	M.s %	T. m	M.s %	T. m	M.s %	T. m	M.s %
1	760	95	700	86	620	78	560	70
2	640	80	760	95	740	93	580	73
3	700	86	640	80	680	85	640	8.0
4	780	98	740	93	700	86	600	75
5	700	86	700	86	780	98	620	78
6	660	83	640	80	760	95	600	75
7	700	86	740	93	720	90	640	80
8	720	90	660	83	740	93	560	70
Totals	5660	88	5580	87	5740	89	4820	75

4.5.1 The impact of concrete materials on achievement in measurement involving money

From the study findings presented on pretest table 4.4 children had total marks of 3700 and a mean grade of 59 percent this was the achievement in measurement involving money. According to the findings from the children in control group, Table 4.5 where the study explored the impact of only mathematical symbols on the concept of money using only mathematics symbols children had total marks of 4800 and mean scores of 75 percent. According to the findings in experimental group, Table 4.6 study explored the impact of concrete materials on the concept of money using instructional materials children had total marks of 5660 and mean scores of 88 percent.

The finding shows that students from the experimental group solved more problems correctly than the control group where instructional materials were not used. This depicts that instructional material had more impact in achievement in measurement involving money. This findings concurs with McNeil Uttal, Jarvin and Steberg (2009) who found that although some manipulative actually had a negative effect on student problem

solving ability, the type of manipulative employed during instruction appeared to be a relevant factor with respect to student learning.

4.5.2 The impact of place value blocks in achieving basic operations on numbers in mathematics

According to the findings on the Table 4.4 children had attained total of 3460 marks and mean grade of 54 percent on the achievement on place value operations in mathematics. According to the findings on the control group on the Table 4.5 where the researcher explored the impact of only mathematical symbols on the achievement on place value operations, Children in this group scored 4860 marks with mean grade of 76 percent. From the findings in experimental group where the study explored the impact of place value blocks in achieving basic operations on numbers in mathematics, Children scored 4820 marks with a mean grade of 75 percents. These findings show that children in control group scored higher marks than children in experimental group where instructional materials were applied. The findings are in agreement with Abella, I.C. (2012), findings that assert that place value concepts are difficult for primary students to grasp. Students often memorize the steps and rules for getting the correct answers resulting to frustrations and misunderstandings. According to (Taplin, 1992) content knowledge of Place value systems is a common problem area experienced by university pre-service teachers and their conceptual understanding of Place Value is underdeveloped.

4.5.3 The impact of Geo board on geometry achievement

From the study findings on the Table 4.4 the performance of children in the pre-test was fairly good with scoring 2140 marks with a mean grade of 34 percent. According to the finding in control group children scored 4800 marks with the mean grade of 74 percent. The researcher was exploring the impact of only mathematical symbols on geometry achievement in mathematical performance.

According to the findings on the Table 4.6 the study was exploring the impact of Geo board on geometry achievement symbols in order to improve achievement in

mathematics in primary school pupils. Children scored highest of 5580 marks with the mean grade of 87 percent. This finding shows that students from the experimental group using Geo board solved more problems correctly than the control group where only mathematical symbols were used. The finding depicts Geo board as an instructional material that had big impact on geometry achievement as compared to only mathematical symbols in learning mathematics.

4.5.4 The impact of algebra tiles on achievement in Algebra as a concept in mathematics

The researcher explored on the impact of the algebra tiles on achievement in Algebra as a concept in mathematics compared to the only mathematics symbols. According to the findings on table 4.4 pre-test result children had average performance with 3190 marks and mean grade of 50 percent. According to the findings of the control group of children presented on the Table 4.5, the total marks were 4620 with a mean grade of 73 percent; in this case the researcher was exploring the impact of only mathematical symbols on achievement in Algebra as a concept in mathematics.

According to the performance of experimental group of children presented on Table 4.6 where the researcher explored the impact of algebra tiles on achievement in Algebra as a concept in mathematics, the children scored highest, with 5740 marks and a mean score of 89 percent. This depicts that algebra tiles on achievement in Algebra as a concept in mathematics had greatest impact compared to only mathematical symbols. The finding concurs with Gatley (1991) who claimed that a pilot project in an algebra by some Vancouver schools, showed that students learned concepts more quickly and remembered them better when the manipulative. “Algebra tiles” was used. Study further differs with study by Edge and Kant (1992) they argue algebra can be difficult to learn because it is often taught with no recognizable meaning. They claim that learning a language is easy because it means something as words generally represent something touched or experienced. ‘If you look at a word like “mango” or “computer” you will obviously visualize an object’ mathematics on the hand can be difficult because, it is often taught with no recognizable meaning $2x$: or x^2 cannot be visualized to stand for anything.

Table 4.7 : Impact in schools using instructional materials to teach mathematics when compared to the schools taught using only abstract mathematics symbols

Groups	Mean	S.D	Df	T	P
Control –schools	52.70	13.57	9	-5.482	.004
Experimental -schools	74.30	8.74			

According to findings it can be seen that the control group of schools had mean and standard deviation of 52.70 and 13.57, respectively, while the experimental group of schools had a mean and standard deviation of 74.30 and 8.74, respectively. The difference in performance of children in control group of schools and those in experimental group of schools was found to be statistically significant ($t(8) = -5.482, p = .004$, two tailed). This suggests that children who are taught mathematics using instructional materials perform better than those who are only taught mathematics using abstract mathematics symbols only. The difference in performance is due to interventions (treatment) done to the experimental group of schools. This finding suggests children should be taught by use of instructional materials as well as abstract mathematics symbols for better performance in mathematics.

4.6 Discussions

The findings of the study concurs with Ngaroga, (2007), who talks of teaching and learning materials as those that are accessed in the School environment, collected and brought. They can be three dimensional, two dimensional real objects and others are electronic. The “term mathematical instructional resource” is defined as any form of specific mathematical apparatus (Structured or unstructured), image, ICT game, tool, paper, or everyday material which could be utilized to provide a mathematical teaching or learning (Dorine, et. Al, 2007). Concrete manipulative are concrete objects used as tools that allow students to experiment and explore mathematical concepts (Burns & Hamm, 2011). Boggan, Harper, and Whitmire, (2010) state that manipulative have been used for many years and from several different civilizations to solve mathematical problems that they could have encountered.

Table 4.8: Descriptive Statistics

	Mean	Std. Deviation	N
pre-test schools	1.2083	.41485	130
control schools	2.0833	.40825	130
experimental schools	2.7917	.58823	130

According to the findings in table 4.8 the mean for pre-test was lowest as shown by mean score 1.2083 and mean was highest after intervention as shown by mean score of 2.7917. This depicts that the instructional materials had a lot of impact in children performance in mathematics as compared to the pre-test schools.

Table 4.9 : Multivariate Tests^a

Effect	Value	F	Hypothesis	Error df	Sig.	
			df			
	Pillai's Trace	.808	46.184 ^b	2.000	22.000	.000
performance	Wilks' Lambda	.192	46.184 ^b	2.000	22.000	.000
	Hotelling's Trace	4.199	46.184 ^b	2.000	22.000	.000
	Roy's Largest Root	4.199	46.184 ^b	2.000	22.000	.000

According to the findings the value for Wilks lambda is .192 with probability value of .000 (which really means that the $p < .0005$). The p value is less than .05. Therefore the study concludes that there is a statistically significance effect of performance. This suggests that there was change in performance scores across the three groups tested.

Table 4. 10: Multivariate Tests^a

Effect		Partial Eta Squared
	Pillai's Trace	.808
	Wilks' Lambda	.808
Performance	Hotelling's Trace	.808
	Roy's Largest Root	.808

According to the findings from the multivariate second test the Eta squared given in multivariate tests is .808, using the commonly used guidelines proposed by Cohen (1998) (.01 = small, .06= moderate, .14 = large effect) this results suggest a very large effect size. This interpreted means change in performance across all groups under the study was very large.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a summary of the study, draws conclusions and makes recommendations and suggestions for further research. The purpose of this study is to determine the impact of using instructional materials to teach mathematics when compared with only abstract mathematics symbols in order to improve achievement in mathematics in primary school pupils in Siaya County.

5.2 Summary of the Study

From the study findings majority of the respondents were males represented by 75% while the rest were female teachers represented by 25%. These findings depict that male teachers were in representation as compared to their female counter part. From the findings half of the respondents were degree holders, 25 % represented master's degree holders, 20% were diploma holders while only 5% were p1 teachers. High levels of confidence result to high levels of competency, the availability of knowledge requires that teachers possess skills and knowledge appropriate for their responsibilities.

Findings indicate that half of the respondents had been in service for 6-10 years, 25% of teachers had a teaching experience of 11-15 years, while 12.5% had been in service for period between 1-5 years and 15 years and above concurrently.

Study shows that respondents strongly agreed on the use of instructional materials on Money activities their shop, paper money, coins, pupils' textbooks and use of geometry set instruments, Blackboard ruler, pair of compasses, protractor, geo board and in place value they use abacus, Place value blocks, sticks, stones to teach mathematics as shown by mean scores 1.9, 1.6 and 1.5 respectively. However teachers just agreed that use of instructional materials during teaching and learning have impact in the achievement on geometry, algebra, money activities, and place value in number operation as well as in algebra, algebra tiles, pupils' textbooks have an impact as shown by mean scores 1.3 consecutively.

From the study findings presented on pretest table 4.4 children had total marks of 3700 and a mean grade of 59 percent. This was the achievement in measurement involving money. According to the findings from the children in control group, Table 4.5 where the study explored the impact of only mathematical symbols on the concept of money using only mathematics symbols children had total marks of 4800 and mean scores of 75 percent. According to the findings in experimental group, Table 4.6 study explored the impact of concrete materials on the concept of money using instructional materials children had total marks of 5660 and mean scores of 88 percent.

The finding shows that students from the experimental group solved more problems correctly than the control group where instructional materials were not used. This depicts that instructional material had more impact in achievement in measurement involving money. This findings concurs with McNeil Uttal, Jarvin and Steberg (2009) who found that although some manipulative actually had a negative effect on student problem solving ability, they also pointed out that the type of manipulative employed during instruction appeared to be a relevant factor with respect to student learning.

According to the findings on the Table 4.4 children had attained total of 3460 marks and mean grade of 54 percent on the achievement on place value operations in mathematics. According to the findings on the control group on the Table 4.5 where the researcher explored the impact of only mathematical symbols on the achievement on place value operations. Children in this group scored 4860 scores with mean grade of 76 percent. From the findings in experimental group where the study explored the impact of place value blocks in achieving basic operations on numbers in mathematics. Children scored 4820 marks with a mean grade of 75 percent. This from the study findings show that children in control group scored higher marks than children in experimental group where instructional materials were applied. These findings are in agreement with Abella, I.C. (2012), findings that assert that place value concepts are difficult for primary students to grasp. Students often memorize the steps and rules for getting the correct answers resulting to frustrations and misunderstandings. According to (Taplin, 1992) content knowledge of Place value systems is a common problem area experienced by university

pre-service teachers and their conceptual understanding of Place Value is underdeveloped.

From the study findings on the Table 4.4 the performance of children in the pre-test was poor, with 2140 marks, a mean grade of 34 percent. According to the finding in control group children scored 4800 marks with the mean grade of 74 percent. The researcher was exploring the impact of only mathematical symbols on geometry achievement in mathematical performance.

According to the findings on the Table 4.6 the study was exploring the impact of Geo board on geometry achievement symbols in order to improve achievement in mathematics in primary school pupils. Children scored highest of 5580 marks with the mean grade of 87 percent. This finding shows that students from the experimental group using Geo board solved more problems correctly than the control group where only mathematical symbols were used. The finding depicts Geo board as an instructional material had had big impact on geometry achievement as compared to only mathematical symbols in learning mathematics.

The researcher explored on the impact of the algebra tiles on achievement in Algebra as a concept in mathematics compared to the only mathematics symbols. According to the findings on table 4.4 pre-test result children had average performance with 3190 marks and mean grade of 50 percent. According to the findings in the control group of children presented on the Table 4.5, the total marks were 4620 with a mean grade of 73 percent; in this case the researcher was exploring the impact of only mathematical symbols on achievement in Algebra as a concept in mathematics. According to the performance of experimental group of children presented on Table 4.6 where the researcher explored the impact of algebra tiles on achievement in Algebra as a concept in mathematics, the children scored highest marks with 5740 marks and a mean score of 89 percent. This depicts that algebra tiles on achievement in Algebra as a concept in mathematics had greatest impact compared to only mathematical symbols. The finding concurs with Gatley (1991) who claimed that a pilot project in an algebra by some Vancouver schools,

showed that students learned concepts more quickly and remembered them better when the manipulative. “Algebra tiles” was used. Study further differs with study by Edge and Kant (1992) they argue algebra can be difficult to learn because it is often taught with no recognizable meaning. They claim that learning a language is easy because it means something as words generally represent something touched or experienced. ‘If you look at a word like “mango” or “computer” you will obviously visualize an object’ mathematics on the hand can be difficult because, it is often taught with no recognizable meaning $2x$: or x^2 cannot be visualized to stand for anything.

5.3 Conclusions

Instructional materials during teaching and learning have impact in the achievement on geometry; algebra and money activities, but no impact when it comes to place value in number operation when geo board, algebra tiles, coins, paper money and place value blocks are used as shown by the mean scores. Instructional materials had more impact in achievement in measurement involving money. Further findings show that children in experimental group scored higher marks than children in control groups.

Geo board as an instructional material had big impact on geometry achievement as compared to only mathematical symbols in learning mathematics. Algebra tiles on achievement in Algebra as a concept in mathematics had greatest impact compared to only mathematical symbols.

From the findings in experimental group where the study explored the impacts of place value blocks in achieving basic operations on numbers in mathematics, Children scored 4820 marks with a mean grade of 75 percent. The findings show that children in control group scored higher marks than children in experimental group where instructional materials were applied.

5.4 Recommendations

- i. This study recommends that since children taught mathematics using instructional materials perform better than those who are taught mathematics using abstract mathematics symbols only the, children should be taught by use of instructional materials for better performance in mathematics.
- ii. Concrete materials, geo boards and algebra tile manipulative be used as much as possible to introduce students to the concept of money, geometry and algebra
- iii. In study where impact of place value blocks in achieving basic operations on numbers in mathematics. Children in control group scored higher marks than children in experimental group where instructional materials were applied. Study recommends that all stake holders involved in the management of mathematics performance to rethink the way forward.
- iv. Workshops on the use of and updates of instructional materials should be organized on regular basis for teachers since knowledge gain is a continuous process and knowledge grows in itself.
- v. Government and ministry of education need to encourage elementary teachers to use manipulative to help teach mathematics thereby positively affecting student learning. Incorporating manipulative into mathematics lessons in meaningful ways helps students grasp concepts with greater ease, making teaching most effective.

5.5 Suggestion for the further study

Based on findings and the scope of this study, the researcher recommends further studies to be carried out in the following areas:

- i. A replica of the study should be carried out within the primary school context in other counties to determine the impact of using instructional materials to teach mathematics when compared with only abstract mathematics symbols in order to improve achievement in mathematics in primary school pupils.
- ii. A research study to be carried out in a different geographical region to determine the impact of using instructional materials to teach mathematics when

compared with only abstract mathematics symbols in order to improve achievement in mathematics in primary school pupils.

- iii. A research study to be carried out to determine the impact of mathematics performance when taught using both instructional materials and mathematical symbols to teach mathematics in primary school pupils.
- iv. A research study to be carried out to further determine the impact of place value blocks on the achievement in mathematics basic operations.

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APPENDICES

APPENDIX I: LETTER OF INTRODUCTION

University of Nairobi
Faculty of arts
Department of psychology
P.O Box 30197
Nairobi,
Kenya.
Date

Dear Sir/Madam,

**RE: RESEARCH ON IMPACT OF INSTRUCTIONAL MATERIALS ON
ACADEMIC ACHIEVEMENTS IN PRIMARY SCHOOLS MATHEMATICS IN
SIAYA COUNTY, KENYA**

I am a student at the University of Nairobi pursuing M.ED, Degree in measurement and evaluation.

I would like to carry out a research on the above topic.

Data will be collected using Mathematics achievement test at a group of standard four pupils. One group will do pre-test examination, two groups will do post-test examination. Experimental groups will be taught using instructional materials, while the control group will not be taught using instructional materials.

Yours faithfully,

Apondi Jeniper

APPENDIX II: THE PUPILS TEST

1. Joachim bought a bicycle for sh. 4,850 and sold it for 3,700. What is his loss
A. 1150 B. 8850 C. 7550 D. 1050

2. How many cents are sh. 18 75 cts
A. 1875 cts B. 187.50 cts C. 18750 cts D. 187500 cts

3. Work out :

Sh	Cts
4	80
18	55
+ 109	30
<hr/>	
<hr/>	

- A. Sh. 132 65 cts
B. Sh. 122 65 cts
C. Sh. 132 60 cts
D. Sh. 131 65 cts

Use the Price list below to answer questions 4 and 5

Price list

Bar soap	-	sh. 69.00
Sanitary pads	-	sh. 129.00
Rice 2kg.	-	sh. 150.00
Tooth paste	-	sh. 140.00
Cooking fat 2kg	-	sh. 268.00
Sugar 1kg	-	sh. 84.00
Bread 1kg	-	sh. 35.00

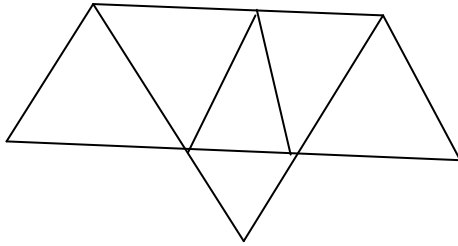
4. After buying tooth paste, 1kg sugar and 2kg rice, Atieno gave the Shop Keeper a sh. 500 note. How much balance did she get?

- A. sh. 374 B. sh. 226 C. sh. 126 D. sh. 26

5. Marete bought a bar soap, tooth paste and 2kg of cooking fat. How much money did he pay to the shopkeeper?

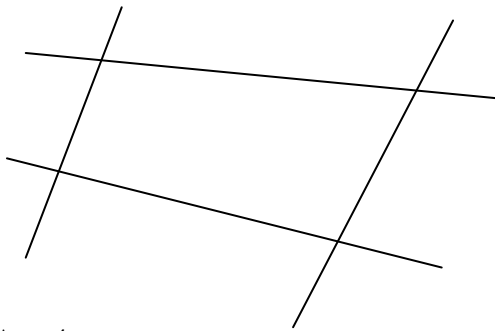
A.sh 467 B.sh 377 C.sh 477 D.sh 745

6. Count the triangles



- A. 12
B. 5
C. 7
D. 8

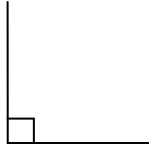
7. How many points of intersection can you see?



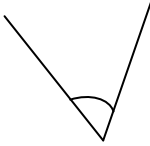
- A. 4
B. 3
C. 5
D. 6

8. Which of the angles below is obtuse

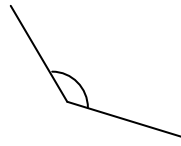
A.



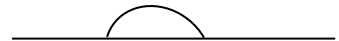
B.



C.

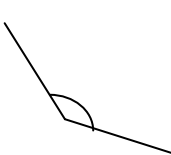


D.

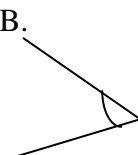


9. Which one is a right angle in the figures below?

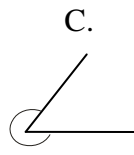
A.



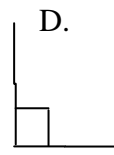
B.



C.



D.



10.



Which angle can be shown by the time on the clock face?

- A. Obtuse B. Acute C. Reflex D. Right angle

11. There are m people in a meeting .The number of adults is y . How many children are there in the meeting ?

- A. $m-y$
B. $m+y$
C. my
D. $y-m$

12. Work out : $20y-8y-4y$

- A. $12y$
B. $8y$
C. $24y$
D. $7y$

13. There are x animals in a farm .The number of cows is c and the rest are goats
How many goats are there in the farm?

- A. $x + c$ B. $x - c$ C. $c - x$ D. $x c$

14. Work out: $13y-2y-5y=$

- A. $7y$ B. $11y$ C. $8y$ D. $6y$

15. A school has t boys, n girls and y teachers. How many people are in the school altogether?
- A. $t + n - y$
 - B. $t n y$
 - C. $t + n + y$
 - D. $t - n - y$
16. Write in words: 10,010.
- A. Ten thousand and ten
 - B. One thousand and ten
 - C. Ten thousand one hundred
 - D. One hundred thousand and ten
17. A school has three minibuses. Each bus carried three pupils. How many pupils did the buses carry in total?
- A. 33 B. 90 C. 60 D. 150
18. Kamande had 3,000 bags of maize he sold 1999 bags. How many bags was he left with?
- A. 1101 B. 2001 C. 2101 D. 1001
19. What is the place value of 8 in the number 18723?
- A. Ten thousand
 - B. Thousands
 - C. Hundreds
 - D. Hundred thousand
20. $40,000 + 7089 + 470 + 8 =$
- A. 47,565 B. 46,575
 - C. 47,475 D. 47,575

APPENDIX III: TEACHERS INTERVIEW GUIDE

The purpose of this interview schedule is to collect data on impact of instructional materials on academic achievement in public primary school mathematics in Siaya County, Kenya.

Name of school

SECTION A: BACKGROUND INFORMATION

1. Gender

(a) Male

(b) Female

2. Level of education

(a) Masters

(b) Degree

(c) Diploma

(d) P1

3. Teaching Experience

(a) 1-5 years

(b) 6-10 years

(c) 11-15 years

(d) 15 and above

SECTION B

Answer the following question on instruction materials in teaching and learning materials. Tick according to your level of agreement. Use a scale of 1-3, where 1=strongly agree ,3 strongly disagree,2= agree

	1	2	3
1.Do you use the following instructional materials to teach Mathematics?			
a. Geometry Set instruments, Blackboard ruler, pair of compasses, protractor, geo board			
b. Algebra Algebra tiles, pupils textbooks			
c. Money activities Our shop, paper money, coins, pupils textbooks			
d. place value Abacus, Place value blocks, sticks, stones			
2. Does the use of instructional materials during teaching and learning have any impact in the achievement on geometry, algebra, money activities, and place value in number operation?			

APPENDIX IV: LETTER OF AUTHORIZATION



REPUBLIC OF KENYA

**MINISTRY OF EDUCATION, SCIENCE & TECHNOLOGY
State Department of Education**

Telephone:
Fax:

COUNTY DIRECTOR OF EDUCATION
SIAYA COUNTY
P.O. BOX 564
SIAYA

When replying please quote

Ref: SCA/10/VOL I /46

Date: Monday, June 08, 2015

TO WHOM IT MAY CONCERN

RE:RESEARCH AUTHORIZATION – APONDI JENIPHER ADIPO-E58/65590/2013

The above named who is a student at Nairobi University (department of Psychology) has been granted authority to conduct research on "Impact of Instructional Material on Academic Achievements in Primary School Mathematics in Siaya County" vide the institutions introductory letter dated 29th April, 2015.

By a copy of this letter you are requested to accord her the necessary assistance to enable her complete her studies.


**NERREAH OLICK
COUNTY DIRECTOR OF EDUCATION
SIAYA COUNTY**