EFFECTS OF MANIPULATIVE INSTRUCTIONAL RESOURCES ON CHILDREN'S PERFORMANCE IN NUMBER RECOGNITION IN LIKUYANI DISTRICT, KAKAMEGA COUNTY, IN KENYA

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DECLARATION

This research Proposal is my original work and has not been used for the

Award of a degree in any university

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This Research Proposal has been submitted for examination to by my approval as the

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DEDICATION

I dedicate this work to my father Japheth B. Kagasi my mother Jeridah Kaveza and my daughters Jewell Zawadi Kaveza, Edith Muhonja, Elizabeth Vodembeke, Faith Adamba, Naomi Kayesi and Eunice Aoko.

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ABSTRACT

The study set out to establish whether manipulative learning resources influenced children performance during their learning of number recognition. A quasi experimental research design was used. Data was collected through questionnaires for teachers an observation schedule in the class and pretest and posttest for the children in the participating schools. Data was presented in tables, line graphs and bar graphs. Data analysis was done by the use ANCOVA at alpha of 0.05.The results indicated that use of learning manipulative instructional resources helped the learners perform well in the learning of number recognition. And that teacher's attitude towards use of manipulative instructional resources affected their frequency of use during the lessons. The study recommends concerned parties should ensure that preschool classes are equipped with relevant manipulative instructional resources. There is need for the Quality and Standards Assurance officers visit preschool teachers more frequently and provide their guidance on the importance of using manipulative instructional resources in teaching mathematics.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Mathematics education for young children is not new. Mathematics has been a key part of early childhood education around the world. Since ancient times, people from different civilizations have used physical objects to help them solve mathematical problems. The ancient civilization of Southwest Asia used counting boards. The late 1800s saw the invention of first true manipulative instructional resources that appealed to different senses and are designed for teaching mathematical concepts. Froebel introduced first kindergarten in Germany in 1837 He designed and used geometrical blocks and pattern activity blocks among other educational play materials to teach mathematics. His materials were known as' Froebel gifts' as cited in Sowell, 1989.

Table 1.1: Summery of Grade Related Studies Dealing with the Impact of Manipulative Resources Achievement

Grade	No. of studies favoring manipulative resources	No. of studies favoring non manipulative resources	No. of studies showing no significant differences	Total
1 and 2	7	2	3	12
3 and 4	9	1	3	13
5 and 6	6	0	3	9
7 and 8	2	1	3	6
Total	24	4	12	40

The results summarized in Suydam in and Higgins are similar in nature to those found in earlier reviews of research dealing with manipulative materials and mathematics laboratories (Fennema, 1972, Fitzgerald, 1972, Kieren, 1971, Vance and Kieren 1971 & Wilkinson, 1974).

There is a huge elephant in the mathematics classrooms; it is the idea that only some learners can do well in math. Learners believe it, parents believe it and teachers believe it. The myth that math is a gift that some learners have and some do not is one of the most damaging ideas that pervades education in Kenya and that stands in the way of learner's achievement (Donlan, 2003). All students can adapt and grow in response to any learning opportunity. The idea that some students are not capable of learning high level content should be rejected because the structure of the human brain can change in response to presence of manipulative instructional resources that allow the brain to interact with the environment and allow learning to take place. Some learners seem to grasp math concepts much faster than others this is because, they have had multiple opportunities to make brain connection during their childhood and this includes use of a number of manipulative instructional resources (Boaler, 2009). Manipulative instructional resources are very important in teaching of mathematics at all levels of learning. They are more important in the teaching of number recognition at early childhood (Sowell, 1989). In Hungary, it has been observed that learning number recognition is very successful when manipulative instructional resources are used during teaching and learning. It is even better when the manipulative instructional resources used are those that are found within the learners' environment (Lio, 2009).

Acquisition of new knowledge is largely attributed to the interaction between the learner and the learning environment since it is during the process of interaction that learners existing structures are adjusted to accommodate new knowledge (Wendoh, 2012). Manipulative instructional resources are used by children to think with. When manipulative instructional resources are used correctly during lesson presentation, they help learners to grasp the concepts with greater ease and make learning more effective (Lio, 2009).

The most commonly used and studied manipulative instructional resources include; flashcards, models and counters (Silver, 1981, Wendoh, 2012, Jenny, 2012 & Boaler, 2009). Very few studies have been made on the effects of this manipulative instructional resource on learning number recognition in Kenya (Gachuki, 2011 & Wendoh, 2012). This study will use the above mentioned manipulative instructional resources in relation to learner performance in number recognition.

Flashcards cards can be used by all types of learners including children with learning problems (Fiona, 2011). Flash cards as manipulative instructional resources have been noted for improving the performance in mathematical areas but not much has been done in relation to learning number recognition (Silver 1981).

Research has shown that, use of flashcards serve the following functions in the learning of number recognition (mathematics); they include, enabling the learner to learn faster, hence reducing the time taken to learn new mathematical concepts (Kelly, 2006), they enhance memory and recall of information (Treacy, 2012), they help in sequencing of number /knowledge, helps in correcting misconceptions and they are used as a method of

self testing and give a quick feedback to the learner (Puncher, 2008), create quick learning of comprehension skills (Anthony, 1997), they are also good for visual learning which is a powerful visual communication tool (Silver, 1981 & Jason, 2012).

Models refer to three dimensional simplified representation of a real object (Joyce, 2000). Examples of commonly used models include number cut-outs, plastic or wooden number symbols, cuboids kites and concrete devises (Askew 1997). Models are very useful during learning process because they help the learner to clarify their thoughts and problems (Mutunga 1992, Lesh, 1979 & Suydam and Higgins 1976). Models add pleasure in the learning process as children handle them. d'Augustine, (1973), adds that models are devices which can help pupils to solve their problems, discover or create new ideas, systems, relationships, and generalization, expressing ideas and facilitating creative thinking. He also emphasized usefulness in creating meaningful activities for slower achievers in mathematics.

When models are used by students they tend to perform better than those who have not used models in mathematics (Namsoo, 2012), children generalized about the concept of six and could Identity the numeral 6 from a group of other number symbols. Dominoes, cuisine rods analogue clock faces when used in the introduction of numeral six (6) a Hungarian class room children generalized about the concept of six and could Identity the numeral 6 from a group of other number symbols (Jenny, 2012). In experiment using models as manipulative instructional resources, it was observed that the analysis of covariance revealed that the experiment group using models as manipulative instructional resources scored significantly higher in mathematical achievement on posttest scores than the control group (Munger, 2007).

Counters are real or tangible objects that are three dimensional they are arrangable and learners can easily manipulate them in terms of moving them from one position to another with an intention of putting them in sets or groups and give them a value (number symbol name) (Puncher, 2008). They are good for teaching number recognition because they make abstract concept of a number to be concrete (Burris, 2006). They also help in the teaching of isomorphism.

Over the few decades, researchers have studied the use of counters as manipulative instructional resources in several different foundation classes and in several different countries (Churchill, 1961). The majority of the studies indicate that mathematics achievement increases when counters as manipulative instructional resources are put to good use during the learning process (Joyce, 2006). Other studies also suggest that counters improve long term retention of mathematical concepts including number recognition (Silver, 1981). They do this because, of the considerable amount of time that children spend with counters engaging in activities related to number and the number system (Fiona, 2011).

Counters in preschool help in the counting process which is hierarchical in nature. In counting the lower numbers are simple whereas the understanding of the later number is a bit challenging (Fiona 2011). They learn to count formally and informally through interaction with their peers and their environment. For successful counting, the child needs to follow the five principles of counting as developed by Gelman & Gallistel (1986). These principles are:

The one to one principle is a one to one correspondence between physical objects and mental *tag*,

The stable order principle – in counting the number position does not change.

The cardinal principle –The last number represents the total items in the set

The abstraction principle – All varieties of objects can be counted.

The order irrelevant principle –It does not matter in which direction one counts the number of objects in the set remains the same (the principle of conservation). Counters play a major role in the success of the above principles in the learning process (Fiona, 2011).

Dolman (2003), it is important that teachers are able to provide appropriate activities accompanied with counters to support a child's learning of Numeracy. Counters are important in number value teaching (Jenny, 2012). Counters when used to teach one- to-one correspondence on ordinal numbers helped learners to understand math processes and procedures easily (Fennema, 1972). The use of counters as manipulative instructional resource is recommended because it is supported by both learning theory and Educational research in the classroom (NCTM, 2000).

Children benefit greatly when a variety of manipulative learning resources are used each time in the process of learning mathematics, because this helps them grasp concepts on at their own rate, gain confidence and independence and ready for all rounded development (Cass, 1990). Kananu (2005) established that there is a strong relationship between frequent use of manipulative instructional resources and children's performance in

number value tests. Learners are more alert and participate actively, in the learning process (Gachuki, 2011). Children that use manipulative learning resources more frequently had higher rate retention of what they learnt compared to the learners who did not use manipulative learning resources (Suydam, 1984).

Teachers who are not trained find it challenging to use manipulative learning resources effectively therefore develops a negative attitude towards their use (Moyer, 2001). Preparing and using manipulative resources takes a lot of time this discourages teachers from using them. Most preschools in Kenya do not have storage facilities for manipulative instructional resources, especially the distribution and collection of the same after the lesson. The learners are often frustrated to leave the manipulative learning resource or change to another learning activity (Wendoh, 2012). Teachers get frustrated to come back to find what they had prepared destroyed or not in good condition to be used in their intended lessons. High classroom enrollment in preschools with inadequate human resource or staff combined with poor remuneration makes it difficult to prepare and use manipulative learning resources for all the learners in the process the lessons are noisier, not neat and normally develops fear of breakdown in classroom control (Sowell, 1989).

Long before the coming of Arabs and Europeans to Africa, the African people had developed their own systems of education although the systems varied from one community to another, their goals were often strikingly similar (Sifuna & Otiende, 1980). At independence in 1963 education was viewed as the foundation of scientific and technological knowledge that is vital in socio-economic development of the nation .Because of this mathematics is a compulsory subject at both primary and secondary

levels and therefore examinable (Republic of Kenya, 2005). Mathematics is also used as a basic entry requirement into any of the prestigious courses at the university such as medicine architecture and engineering among other degree programs. Despite the important role that mathematics plays in society, there has always been poor performance in the subject at National examinations (Aduda, 2003), this is demonstrated on Tables 1.a and 1b below in both Kenya Certificate of Primary Education and Kenya Certificate of Secondary Education.

Table 1.a: KCPE Mathematics Mean over Time

Year	2002	2003	2004	2005	2009	2010	2011
Mean score	43.27	43.56	43.54	44.97	45.47	44.42	42.43

Source: daily nation 30th December (2010).

This figure presents the mean scores over time. Mathematics performance over the years of observation is nearly flat in the mean score. The range is very closet 3 points/marks. The mean mark is 250 marks which over the years have not been attained.

Table 1.b: KCSE Performance in Mathematics over time

Year	1991	2000	2001	2002	2003	2004	2005	2006	2007	2008
Mean Score	12.23	16.61	18.72	13.23	18.25	16.24	17.62	12.24	16.26	18.73

Source: Daly nation29th December (2010).

Performance in Mathematics as reflected by the KCSE results has remained poor over the years. Hence the need to investigate the factors contributing to poor performance in mathematics in Likuyani District so that poor performance in this subject can be reversed.

Perhaps one of the reasons for poor performance in mathematics at the two levels is due to a poor foundation in number work at preschool (MOEST, 2010).

Number work and especially number recognition forms the foundation to the success of learning mathematics at the next level of schooling (Wendoh, 2012).

The teaching of number work at preschool has left a lot to be desired due to the following factors; teachers concentrate on drilling, memorizing or lecturing children repeatedly for them to shout and work with numbers without understanding (Mwaura, 2009 & Wendoh, 2012). Teachers are under pressure to cover the curriculum as well as prepare the children to go through vigorous interviews to enable them enroll in class one. Teachers do not use manipulative instructional resources yet children are concrete learners and thinkers (Copley & Padron, 1998). The integrative preschool curriculum makes teachers to concentrate on areas that they feel comfortable with excluding number work. Teachers avoid number recognition as an independent topic because of the misconception that number work activities are too difficult for young children (Mwaura, 2009).

Learning number work at preschool involves a variety of skills, including; number recognition (recognizing the number symbols from 0-9), grasping each number by name counting, patterning and creating, sorting and classifying. The number recognition topic should be handled as an independent topic and it entails the following seven elements; (identifying number symbols, putting together and naming the symbol, arranging

numbers, matching number activities, matching number symbols to their value, counting, and sorting and grouping numbers) because this topic forms the base for all number work activities and mathematics in general (Munger, 2007). The skills needed to be learned in number recognition demand the use of manipulative instructional resource (Bobis, 1999). Many teachers do not use manipulative instructional resource in number recognition activities because of the time taken in preparing and using manipulative instructional resources (Wawire, 2006). The importance of utilization of manipulative learning resources is underscored by the session paper no.5 of 1988. Visual aids are basic tools for educational development must be available for the learner to learn more skills using learning aids.

The factors that affect learning number recognition are; varied and colored manipulative instructional resources (Field and Wasik, 2006), sequencing of the activities (children should learn number symbol names before they learn how to sequence them and attach value to them) (Bobis, 1999), teaching approaches and pedagogical strategies adopted by preschool teachers, location of schools, parents economic status and expectations (Karen, 1999). Teachers' attitudes towards use of manipulative instructional resources determine their frequency of use in the class (Blossier, 1993 & KIE, 2005). Inadequate, poor use of manipulative instructional resources and teachers attitude towards use of manipulative instructional resources has contributed to poor performance in public primary schools. Mathematics is the poorest performing subject at the national level compared to other subjects.

Use of manipulative instructional resources and teachers' attitude towards use of manipulative instructional resources are major factors in determining the children's performance in preschool number recognition activities. It was therefore important to study the effects of use of manipulative instructional resources in children's performance in number recognition for this lays the foundation for further learning of mathematics in schools.

This study sought to establish to what extend this problem affected children in Likuyani district public schools. It was with this in mind that this study examined the use of manipulative instructional resources as a factor that influenced performance in number recognition. This study involved preschool children of 4-6 years from Likuyani District.

1.2 Statement of the Problem

There are many factors that influence the performance of preschool children in number recognition activities. The factors includes; teaching approaches/ pedagogical strategies, teachers' experience, attitude, enthusiasm and charisma in lesson presentation, completion of the syllabus, class enrolment, the location of schools, parents' economic status and expectations, and proper nutrition. Manipulative instructional resources play a major role as compared to other factors in the learning of number recognition. According to principles and standards for mathematics "the foundation for children mathematical development is established in the early years (Field & Wasik, 2006).

Smith (2009) confirmed that, most valuable learning occurs when the learners actively construct their own mathematical understanding, which is often accomplished through the use of manipulative instructional resources. Therefore; this study sought to investigate

the influence of manipulative instructional resources on the children's performance in number recognition activities in Likuyani District Kakamega county Kenya.

1.3 Purpose of the Study

The purpose of the study was to determine the influence of manipulative instructional resources on children's performance in number recognition activities in pre-school. In addition the study also looked at how teachers' attitudes and their perception of learners' attitudes towards use of manipulative instructional resources influenced their use in class.

1.4 Research Objectives

i. Determine the children's performance in number recognition when different types of manipulative instructional resources are used during teaching.

ii. Examine the influence of frequency in using manipulative instructional resource on children's performance in number recognition.

iii. Identify the relationship between teachers' attitude on use of manipulative instructional resources and children's performance in number recognition.

1.5 Hypotheses

i. There is no statistically significant relationship between the use of manipulative instructional resources and children's performance in number recognition.

ii. There is no statistically significance influence of frequency of use of manipulative instructional resource on children's performance in number recognition.

iii. There is no statistically significance relationship between teacher's attitudes on the use of manipulative instructional resources and children performance in number recognition.

1.6 Significance of the Study

The findings of the study may add to the growth of knowledge of the factors affecting learning and teaching in Early Childhood Education. Preschool Curriculum developers may use the information to improve on the weaknesses in the curriculum. Most importantly this study will provide feedback to the education sector especially of the teacher trainers or those charged with the responsibility of teacher capacity building, monitoring and evaluation.

1.7 Limitation of the Study

The results of this study can only be generalized to schools in areas with similar conditions as those of Likuyani District. The study limited itself only to the use of number flash cards, models, and counters as the manipulative instructional resources in teaching number recognition.

1.8 Delimitations of the Study

The study covered public early childhood Centres in Likuyani District. It also covered Preschool teachers and preschool children in these schools.

1.9 Basic Assumption of the Study

The teachers are properly trained to handle preschool children of ages 4-6. The respondents were able to give honest answers.

1.10 Definition of Key Terms

Preschool children ---- persons aged 4-6 years

Effects---- the impact that manipulative instructional have on performance in number recognition

Manipulative instructional resources--These are physical objects that are used as teaching tools to engage pupils in the hands on learning of number work

Number recognition---- in the study indicated the ability to visually recognize and name number symbols.

Performance- refers to the achievement in number recognition as indicated by the results of the pretest and posttest.

1.11 Organization of the study

This research project is organized into five chapters where: chapter one deals with introduction which includes; Background of the study, Statement of the problem, Purpose of the study, Research Objectives, Research Questions, Significance of the study, Limitations of the study, Delimitations of the study, Basic assumption and the organization of the study. Chapter two deals with literature review that involves that which other researchers or authorities have done in relation to mathematics and it entails; Introduction, Types of manipulative instructional resources, Frequent use of manipulative instructional resources and Teachers attitudes towards use of manipulative instructional resources. Chapter three details the research methodology. In this case researcher will use the quasi experimental research design. The population, Sampling, and sample size,

instruments, Validity and Reliability of the instruments, Procedure for Data Collection, Data Analysis and Ethical concerns are also found in this chapter. Chapter four is about the researcher's findings and discussions then finally chapter five highlights on the conclusions and recommendations of the researcher.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section reviewed what other researchers have done in the area of use of manipulative instructional resources in mathematics in pre-school. The main focus was on the types of manipulative instructional resource, frequency of their use in preschools during number work activities, the attitude of teachers towards the use of manipulative instructional resources, and how they affected children's performance in number recognition.

2.2 Types of Manipulative Instructional Resources and Performance in Number Recognition

Manipulative instructional resources can come in a variety of forms and they are often defined as 'physical objects that are used as teaching tools to engage learners in the hands on learning of mathematics (NAEYC, 2009). A good manipulative instructional resource bridges the gap between informal math and formal math. To accomplish this objective, the manipulative instructional resources must fit the developmental level of the child (Smith, 2009). The children in ECE should have individual models, flash cards and counters where the manipulative instructional resources should be brightly coloured. (Charbonneau, Marley & Selig, 2013). The manipulative instructional resources should fit the ability of the learner or it is useless (Clement, Hand & Battisa, 1990). Learners should make sense of the manipulative instructional resource and use them to support their argument.

It is only when learners themselves use the artifacts to support their own sense making process that they will begin to see their own power as tools to calculations and not just rely on manipulative instructional resources as crutches to support them blindly following taught procedures.

In Hungary manipulative instructional resources are central during learning especially mathematics. In number recognition, one number symbol is introduced at a time and different manipulative instructional resources are used to introduce the number symbol for example; numeral 5 dominoes, Cuisenaire, rods, analogue clocks faces, cut out of numeral 5 flash cards, Hungarian number symbols pictures are provided and used during the lesson (Lio, 2009). This helps the learner to generalize about the given number symbol across different manifestations and open access to all manipulative instructional resources that are available to allow the children free reign in choosing what to use to models and solve the problem they maybe tackling. This means in Hungarian mathematics lessons, the range of manipulative instructional resources are as wide as possible because different manipulative instructional resources have different strength for different problems.

Manipulative instructional resources in conjunction with the following play a key role in teaching mathematics: teaching approach and strategies, teachers experience, attitude, enthusiasm. Other factors include; the location of schools, parents' economic status, and expectations (Karen, 1999). Many manipulative instructional resources introduce to children a variety of words, symbols, models and images to represent the same concept or process of acquiring number recognition. Important to note is that child in preschool should be given many opportunities to play freely with manipulative instructional

resources before their mathematical structure and relationships are drawn out when now in a learning lesson. If learners are not allowed to freely play with manipulative instructional resources before setting the mathematics task, they will be distracted by their desire to play and explore various properties of the manipulative instructional resource (Carbonnneau & Marley, 2013 & Moyer 2001). Pointed out that, the learner needs to be familiar with the manipulative instructional resources at hand to reduce the cognitive demand of it is use. If the learner is very conscious of various attributes of the manipulative instructional resources, it is unlikely to facilitate its use as a representation of a specific mathematical structure.

Whereas teachers should ensure a variety of manipulative instructional resources are available in class and enough for all the learners in Kenya, there are challenges facing learning of mathematics lack of adequate materials for teacher resources. Allen and Hart (1996) observed that learning resources presented in early childhood setting should be chosen to provide many and varied opportunities for the children to practice and master familiar skills. Touching of different types of manipulative instructional resource allows the learners to use their senses and making learning math more interesting. The teacher can readily adapt to individual as well as group learning needs. The more skills a particular manipulative instructional resource prompts a child to learn the better the manipulative instructional resource is.

Children's character and behavior is that they want to see different things each time. A teacher that uses different types of manipulative instructional resources each time or during her lesson, achieve more positive results compared to one who uses the same manipulative instructional resources each lesson (Clement & Battisa, 1990).

Accompanying the different types of manipulative instructional resources is also the colour of the manipulative instructional resources presented to the learners. The children at this level love the primary colours red, blue and yellow because of their brightness (Olie, 2007). The manipulative instructional resources should be easy for the learner to manipulate easily without getting frustrated (Weller, 1999). Different types of manipulative instructional resources increase chances of greater perception understanding and retention rate. Availability of teaching materials in mathematics provides a lot of hands on experience to the learner. The teacher should also ensure that a variety of enough manipulative instructional resources are available in class for all the learners. Acquisition of new knowledge is largely attributed to the interaction between the learner and the learning environment since it is during the process of interaction that learners existing structures are adjusted to accommodate new knowledge (Wendoh, 2012).

Flash cards are a type of data-based instruction strategy that is usually associated with direct instruction (DI) procedures described by Silber, Carnine and Stain (1981) for teaching math. Flash cards were invented to overcome that old age problem everybody seems to encounter that is never having enough time. Flashcards are one of the fastest paced learning tools one can use. They allow learners to quickly revisit information and test knowledge. Research findings show that, using flash cards to embed knowledge into the brain is based on psychological theories.

Dienes (1971), Fennema (1992), Lesh (1919), Wilson (1991) & Askew (1997), flash cards work and produce results in the following ways; they burn information into the brain of the learner meaning as they engage they actively recall. When a learner practices a flashcard deck, their brain is given a clue on the front side and they attempt to actively

recall the information on the back each time a student practices this process it means that they are forcing their brain to remember a concept. This makes using flashcards a compelling method of memorization. Flash cards aid space repetition that is spacing learning events apart rather than massing them together. Psychology study carried out with students at the University of California, found that spacing using flash cards is more effective study technique than cramming before an exam with 90% of participants performing better using this method (Jason, 2012).

Flashcards activate metaco-gnitive faculties meaning that if a child believed certain aspect to be true later gets surprised that that belief was incorrect, then the correct answer is remembered because it shocked the learner and became part of the memory and deepens the learning association. Correct answers are on study flash cards are encoded into knowledge to be retrieved when needed.

Flash cards are also a method of self-testing they deliver away to make practicing for exams easy namely by remembering key facts, vocabulary and definitions. They enhance retention to learn in chain reaction self-testing knowledge which improves ability to remember information which helps capture and retain knowledge over a long time. Flash cards especially image flash cards help learners to build comprehension skills. Finally flash cards allow visual learning, visual communication which is very powerful. Students who studied using flash cards had significantly higher exam scores over all other students.

Research on the effects of using flash cards and math facts to elementary students with learning disabilities (Gachuki, 2012) established that flashcards can be implemented in almost any setting and teaches specific skills quickly and easily (Van Hourten & Rolider, 1989). It was shown that when students are taught using this teaching method they perform higher and post better scores than those who were using traditional method in math (Wilson & Sindeler, 1991). Use of flashcards increase students fluency on basic multiplication facts and seemed to be effective for the two children involved in the study.

The outcome of the research on the use of flash cards was helpful in improving reading or math skills. The procedure increased the accuracy of sounds, sight words and addition facts. Flash cards are effective and easy to use in elementary resource classroom. These materials can be incorporated in general and special classroom routines (Rachael, 2011).

Models refer to three dimensional simplified representation of a real object. Children learn written symbols through having such symbols (models) around them named by their number word. A study done by Namsoo (2012) on effects of models on student's performance in mathematics showed that, those who used models outperformed those who did not use them. In Hungary the use of models in teaching is central to the early development of mathematics ideas especially for children under the age of eleven. In a lesson observed by Jenn (2012) the introduction of numeral 6, available models to help the teacher achieve her objective were; dominoes, cuisine rods analogue clock faces. The learning outcome was children generalized about the concept of six and could Identity the numeral 6 from a group of other numbers symbols.

Wendoh (2012) findings on influence of models on the learning outcomes in mathematical activities in preschools in Kakamega municipality there was clear evidence that learning outcomes when models were used in teaching number work was positive. The same results reflected when models were used to teach measurement and geometry. Teachers who use models in teaching mathematical concepts get better results (Monsoon, 2012). In Hungary, models are central to the teaching of mathematics in early childhood. Dominoes, cuisine rods, analogue clock faces are dominant models in teaching number recognition (Jen, 2012).

Wendoh (2012) found out those teachers who used models in teaching measurement and geometry got better results than those who use traditional methods. Munger (2007) did a study on the benefits of models as a manipulative instructional resource, using 26 students' third–grade classes. The findings showed that the experimental group that used models as manipulative instructional resource to teach the concepts presented in the unit and the control group teacher used only drawings and diagrams to teach the same concepts. Analysis of covariance revealed that the experiment group using models as manipulative instructional resources scored significantly higher in mathematical achievement on posttest scores than the control group.

Lesh (1979) suggested that models can be effectively used as an intermediate between the real world and the mathematical world. He contends that models tend to promote problem –solving ability by providing a vehicle through which children can model the real world situation. Suydam and Higgins (1976) noted that models are effective in promoting student achievement but emphasize the need for additional research. They believed that

lessons involving models will produce greater mathematical achievement than will lessons in which models are not used if the models are used well.

Models refer to three dimensional simplified representation of a real object. Children learn written symbols through having such symbols (models) around them named by their number word. Models are very useful during learning process because they help the learner to clarify their thoughts and problems they can also be handled and manipulated (Mutunga, 1992). Models also add pleasure in their making that is if the teacher them allows to creates some. For pupils models may be number cut-outs, plastic or wooden number symbols cuboids kites, concrete devises. The models are devices which can help pupils to solve their problems, discover or create new ideas, systems, relationships, and generalization express ideas and facilitate creative thinking (d'Augustine, 1973). Models are also useful and meaningful activity for slower achievers in mathematics. Model making lends the teacher variety to the regular classroom activities and thus it is useful change of pace.

There are innumerable numbers of different models which can be made and used by the pupils to suit almost all topics in preschool mathematics (Askew, 1997). However, models making can be time consuming and expensive. Teachers need to watch out hat models may are those which effectively help the pupils attain the objective of learning a particular topic for example in our case number recognition, models made should be simple and inexpensive. After completion should be evaluated for their originality completeness craftsmanship organization and accuracy and above all for the mathematical and thus may learning which the students demonstrate as they present the models (Mutunga, 1992).

After all the models are completed the teacher should then display the best models and use them in classrooms during presentations of mathematics lessons. The misuse of concrete models in teaching mathematics sometimes adds qualities which are not mathematical and thus may lead to misconceptions and confusing .For example if we consider the use of a ball, a wheel or coin in teaching the concept of circle we find that some the pupils may think that a circle is a sphere, disk or circular region which is not (Mutunga & Breakel, 2004).

There is need to be a greater recognition from teachers that mathematical conceptions are much more deep rooted than errors and that it takes time for children and other learners to resolve long term misconceptions (Askew, 1997). Research demonstrates that teaching to avoid children developing misconceptions is unhelpful and could result in misconceptions being hidden, from the teacher and from themselves (Munn, 2008).

A study done by Namsoo (2012) on effects of models on student's performance in mathematics showed that, those who used models outperformed those who did not use them. In Hungary the use of models in teaching is central to the early development of mathematics ideas especially for children under the age of eleven. In a lesson observed by (Jenn 2012) the introduction of numeral 6, available models to help the teacher achieve her objective were; dominoes, cuisine rods analogue clock faces. The learning outcome was children generalized about the concept of six and could Identity the numeral 6 from a group of other number symbols.

Wendoh (2012) findings on influence of models on the learning outcomes in mathematical activities in preschools in Kakamega municipality there was clear evidence that learning outcomes when models were used in teaching number work was positive. The same results reflected when models were used to teach measurement and geometry. They are real or tangible objects that are three dimensional they are arrangable and learners can easily manipulate in term of moving them from one position to another with an intention of putting them in sets or groups and give them a value (Jason, 2012).

Number is an abstraction no one has ever seen a number and no one will "two ness "2 is used to elicit a whole series of recollections and experience that we have had entailing the concept of two, but the squiggly line 2 and itself is not the concept, How then do we teach children about a concept of an isomorphism (relationship between the real world and mathematical world) (Burris, 2006).

Over the few decades, researchers have studied the use of counters as manipulative instructional resources in several different foundation classes and in several different countries (Jason, 2012, Silver 1981, Peterson, McLaughlin, Treacy, Derby, NCTM, 2000 & Anderson 2008). The majority of the studies indicate mathematics achievement increase when counters as manipulative instructional resources are put to good use during the learning process (Kelly, 2006). Many studies also suggest that manipulative instructional resources improve long term retention of mathematical concepts.

Children spend a considerable amount of time engaging in activities related to number and the number system (Fiona, 2011). In preschool many number concepts are taught in a hierarchical sequence because the ability to understand and engage with more difficult

concepts relies upon a sound understanding of ideas met earlier in the curriculum. Place value for example, underpins much of the number curriculum activities of counting (Fiona, 2011).

Counting is one of the earlier mathematical concepts that children learn. They learn to count formally and informally through interaction with others and their environment. (Gelman & Gallistel, 1986). Spend six years researching children's cognitive development in number and formulated five principles of how to count.

The one–one principle - where a child a understands that each item (counter) to be counted has a name and that we only count each item once during the counting process. The learner needs to make a physical and mental *tag* of the items to be counted and the counted items and keep them separate.

The stable order principle –the child's understanding the stable order principle knows that every time we use number names to count a set of items, the order of the number of the number names does not change, In English the order of number names is always one, two three four five six seven eight, nine, ten every time a set of objects is cm is counted.

The cardinal principle –A child understanding of cardinal principle knows the answer to how many? The child knows that the last number counted represents the number of items in the objects.

The abstraction principle –The child understanding the abstraction principle knows that anything can be counted and that not all things need to be the same type.

The order irrelevant principle – A child understanding the order – irrelevant principle knows that we can start to count from left to right. For the child to go through the process of learning and understanding the above mentioned principles, counters play a major role because the child has to manipulate them. Munn (2008), researched children's belief about counting and found preschool children appear to have little or no understanding of what adult purpose of counting means.

The interesting point about Munn's research is that the children believed they could count because they understood counting as saying the number name words in the right order. No doubt readers have heard friends or relatives boasting that their child could count at only three years old. Teachers need to be aware that children who can apparently count fluently may just be 'reeling off' the number names by rote. The danger here is that the child might be introduced to more complex concepts before s/he understands what is meant by counting. Since counting underpins early arithmetic concepts (Dolman, 2003).

It is important that teachers are able to provide appropriate activities accompanied with counters to support a child's learning of Numeracy (Dolman, 2003). Having an awareness of the how to count principle will enable practioners to understand the nature of counting and the potential difficulties that the children may face during their journey to successful counting. For a child to count consistently, the child needs to know the English counting or the number names of the language of the catchment area counting sequence before they can count effectively.

In Hungary, Jenny (2012) observed in a math lesson when the concept of numeral six was being presented by the teacher the children used counters, six sets of objects, identified a set of things that were tangible in order to ascertain the value of six. This worked well when learners were given a test to find out whether they were able to establish the value of six. Children were independently able to go for counters like beads strings to try and solve problems of number identification. Counters when used to teach one- to- one correspondence on ordinal numbers helped learners to understand math processes and procedures easily (NAEYC, 2000). The use of counters as manipulative instructional resource is recommended by the (NCTM, 2000) because it is supported by both learning theory and Educational research in the classroom. The counters help pupils learn by allowing them to move from concrete experience to abstract reasoning.

2.3 Frequent Use of Manipulative Instructional Resources and Performance in Number Recognition

Preschool teaching resources should be available in the class most of the days (Feshbach 1973). These includes; cut outs, flash cards and building block, models counters. Cass (1990) conducted a research on teachers in London about their role in pushing schools to provide the child with enough manipulative instructional resources each day. The preschool teacher's response was that, children benefit greatly from interacting with manipulative instructional resources each time they are learning and also children have opportunity to develop at their own rate, gain confidence, independence and prepared for all round development.

This agrees with Jean Rousseau (1912-1978) who observed that children interacted actively with manipulative instructional resources that appeal to their senses. Preschoolers take a lot of time to play with manipulative; the learners also use the manipulative instructional resources for other games they know.

He had the idea of naturalism where he felt that a child should be educated by his/her surrounding (Hiebet, 2001). In keeping with the natural development, the learning is more open ended and their use is determined by children. For instance mathematics learning manipulative instructional resources might be cut-outs, sticks brought in class by children.

Kananu (2005) found a strong relationship between manipulative instructional resources availability and effective use of as related achievement. Teachers who avail manipulative instructional resources each time they present a lesson found the learners more alert and willing to participate in their lessons.

Gachuki (2011) in her findings observed that manipulative instructional resources had a great impact on the children's performance in number value and she brought out a fact that the manipulative instructional resources helped children with mathematical learning difficulties to achieve more. Most teachers know that frequent use of manipulative instructional resources encourages the learners to have an interest in the lesson and what is going on in the class (Strike, 1975). Children that use manipulative instructional resources frequently show a tendency of wanting to come to school to learn (Gachuki, 2011).

Research done by Suydam (1984) found out that learners who used manipulative instructional resources frequently had a higher rate of retention of what they learnt compared to those who did not use manipulative instructional resources frequently. Brunner (1915) was an advocate of learning by discovery talked about improvement of learning as cited by Gachuki (2012).

Brunner points out that one must consider three areas of knowledge and sequence of manipulative instructional resources. The teacher should create an environment where the desire to learn is stimulated and where children are free to discover mathematical concepts. As for the structure of knowledge, the content should be presented in a form that the child understands. The vocabulary terminology, symbols and examples should be at the child's level as far as sequence of presentation is concerned.

Brunner says that there are three levels through which children move, enactive, iconic and symbolic. At the inactive level the learner manipulates concrete materials as objects directly, while at iconic the child thinks objects and deals with mental object. At the symbolic level manipulation is strictly by use of language or words (Mutunga & Breakel, (1992). This notion supports the idea that learners should be exposed to manipulative instructional resources more frequently in order to have to create known images in their mind they participate explore concepts relate ideas and find alternative solutions to problems.

According Moyer (2001), teachers believed that using manipulative instructional resources was more enjoyable than doing math that is solely abstracted and symbolic. Learners are actively engaged and interested in lessons. The enjoyment, experienced by

teachers and learners in using manipulative instructional resources meant that the teachers tended to use them as a reward for good behavior rather than solely when they would be useful adjunct to learning (Fiona, 2011). Some used them only at the end of the week end of the year or when they felt like. They did not seem to view the use of manipulative instruction resources as intrinsic to the substance of the core of the curriculum but rather addition that enhanced enjoyment frequent use of manipulative instructional resources impact on children's learning through exploration (Askew, 1997).

2.4 Teachers' Attitude towards Use of Manipulative Instructional Resources and Number Recognition

Teacher's attitude towards the use of manipulative instructional resources is an important factor for successful use of them. It is important for teachers to feel at home with the materials they have chosen to work with in order for children to benefit the most from them. Many teachers have no clue that it is the learners that are sense makers in the classroom and the need for them to grand learners' opportunities to make sense of both the manipulative instructional resources used and their relation to the math ideas and problems which they are being used to solve (Moyer, 2001).

The reasons teachers give for failure to use manipulative instructional resources vary for example some say; lack of training they feel that they do not know how to teach using manipulative instructional resources and therefore not comfortable to use them in the classroom (Burn, 1992). Very few teachers are fortunate to have access to numerous classes and workshop to learn how to teach using manipulative instructional resources (high cost private schools).

Burn (1975), lack of facilities for storage of the manipulative instructional resources also an issue that frustrated, for those teachers who make effort prepare manipulative instructional resources they get discouraged when they come back and find that what they made the day before has been destroyed. The size of the class, the children's enrollment in public schools is high the age of the children also is a discouraging factor such that in some schools ,all children from age 3 -6 learn in the same class enrolment this is frustrating for any teacher (Sowell, 1989). Lessons using manipulative instructional resources may perhaps be noisier and not as neat, a fear of breakdown in classroom control when using manipulative instructional resources. Also manipulative instructional resources require a great need of prior planning and organization (Hawden, 1986).

Most teachers need support on making decisions regarding manipulative instructional resources use, including when and how to use manipulative instructional resources effectively in the classroom as well as opportunities to observe, first-hand the impact of allowing learning through exploration with concrete objects (Kelly, 2000). To some extent teachers are confused about what manipulative instructional resources to use in what contexts. One manipulative instructional resource might appear to teach a given concept and disappear never to be seen again in the classroom (Jenni, 2009).

Most of the interviewed teachers seemed to agree that manipulative instructional resources provide the most rewarding experience for the learners and teachers, but successful implementation is often time consuming which is when conventional teaching aids come in handy and sometimes become an appropriate choice. Teachers know the importance of using manipulative instructional resources.

Yet a teacher interviewed by Gachuki (2011) response was that they find using manipulative instructional resources as time consuming. They felt that time taken to distribute the manipulative instructional resources to the learners and also collecting them back was too much and that the learners resisted changing to the next lesson because they want to continue playing with the manipulative instructional resources. The teachers also did think that preparation of the different types of manipulative instructional resources was very expensive and needed a lot of time to prepare. Most teachers did not have enough space to store the manipulative instructional resources that discouraged them from preparing them.

Most preschool teachers prefer not to use manipulative instructional resources instead they would prefer to use few pupils to demonstrate the use of manipulative instructional resources and believe that as the rest of the class observes they grasp the concept. Since the head teachers do not bother much about what goes on in the preschools attached to their mainstream schools, they do not feel supervised hence lack of the feeling to be obligated to use manipulative instructional resource. The poor remuneration of preschool teachers has played a major role in low morale in the use of manipulative instructional resources (Wendoh, 2012).

A study conducted in Ikolomani showed the most teachers showed a very high negative attitude towards the use of manipulative instructional resources because they were not trained hence ignorant of the importance of using manipulative instructional resources in their lesson presentations and also poor remuneration (Muhonja, 2003). Wawire (2006) also observed was a very wide spread conception by teachers that, children in preschool are not ready for mathematics education, this is because teachers underestimate the

children's mathematics abilities, children's learning of mathematics begins long before they enter school, mathematics is for some bright children(NAEYC & NCTM, 2000). In Kakamega County where Likuyani District falls a study by Wendoh (2012) found out that many teachers had this strong misconception that teachers should provide an enriched physical environment and step back and let the children play and that mathematics should not be taught as a standalone subjects.

2.5 Theoretical Framework

This study will be anchored on the constructivist theory which says that learners actively construct new knowledge for themselves. Constructivism is the synthesis or multiple theories diffused in one form. Just as cognitive learning psychology began replacing the predominant cognitive approach. According to constructivist, learning may be defined as a process of constructing meaning. The theory views learners' activities as paramount in learning process that begins with relevant experience, background knowledge and proceeds through experimentation.

Education, according to constructivist should be viewed as learners actively constructing their own knowledge with teachers being coaches, facilitators, or even partners with learners in the leading process. Constructivist learning theory maintains that knowledge is not received from outside, but that we construct knowledge in our head. The teachers should create educational environment that facilitate the construction of knowledge.

Dewey (1859-1952) believes people actively learn from their environment by reflecting on experiences around them. Active learning requires the learner to continually assimilate and accommodate new information to construct knowledge. He believed in social

learning to solve problems using democratic, process or the scientific method of enquiry. Dewey felt that the pupil was an active learner that could achieve his own on learning using the teacher as a guide as cited in (Sowell, 2009).

According to Rebecca & Moncreft (2007), students (children make concepts their own by manipulating concrete objects through hands on activities by playing with realia and having a concrete relationship with their environment. For purpose of this study, Piaget's operational stage (2-6) year is important. Piaget's theory of constructivism emphasizes learning, rather than teaching. It says that knowledge is constructed by the learner rather than transmitted by the teacher he views the learner activities as paramount in the learning process that begins with relevant experience, background and proceeds through experimentation (Kierian, 1985). This theory is relevant to the study in that child at preschool are at the pre-operational stage and activities in preschool should provide them with experience to help them construct new knowledge.

2.6 Conceptual Framework

The conceptual framework involved the interaction of the variables. The variables included independent, dependent and extraneous variables. The independent variables in this study included types of material, frequent use of materials, attitude of teachers, and teaching methods.

The dependent variable was the performance in the several aspects of number work recognition. The extraneous variables included school administration and the location of the school. The process involved in the interactions and manipulations of manipulative instructional resources, their proper use and availability enhanced learning of number

recognition. Mathematics activities were facilitated by materials and the intervention which involved manipulation of manipulative instructional resources by the children.

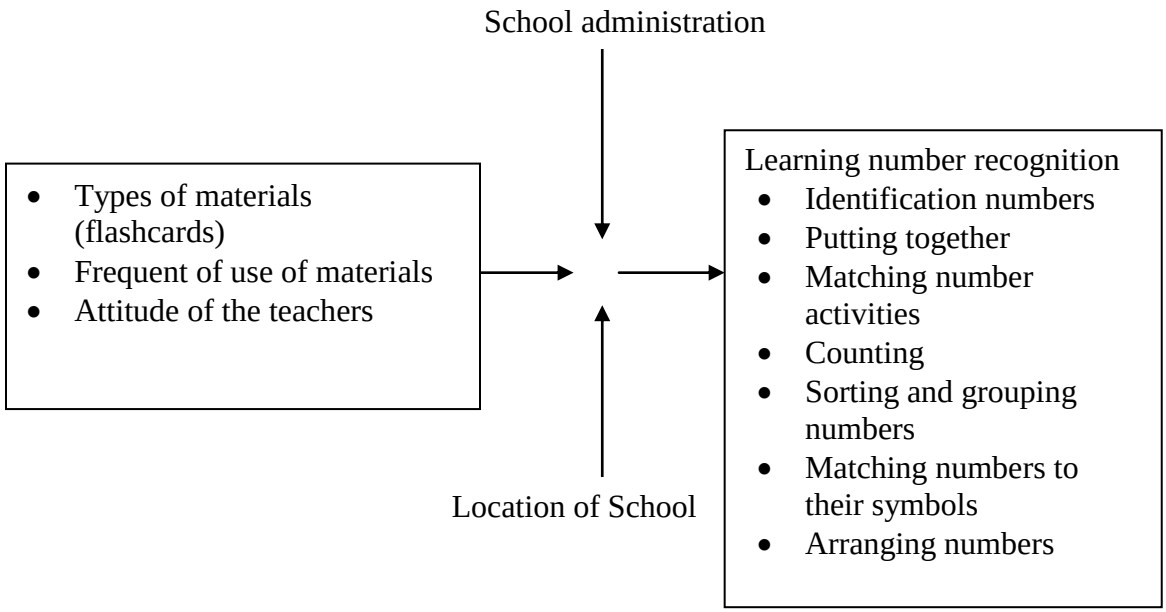


Figure 2.1: Conceptual Framework

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research design, the target population, the sample size and the sampling procedure. It also goes ahead to describe the research instruments, their validity and reliability, data collection procedure and data analysis.

3.2 Research Design

This study was conducted using Quasi Experimental Research design. This design was appropriate because, it involved independent variables being manipulated by the researcher and their effects upon other variables observed (Mugenda and Mugenda, 1999). It did not interfere with the children in class and did not introduce any changes in classroom arrangement.

3.3 Target Population

The target population was all the public preschool in Likuyani District of Kakamega County. The study involved all public preschool teachers and children. According to statistics there were 50 public pre-schools attached to public primary schools in Likuyani district with a total of 2580 children. Table 3.1 indicates the distribution of preschools in Likuyani District.

Table 3.1: Preschool Population

Educational zone	Number of Schools	Pupils population	No. of teachers
Likuyani North	19	950	38
Likuyani Central	16	880	32
Likuyani South	15	750	30
Total population	50	258 0	100

Source: DEO's office Likuyani 2014.

3.4 Sampling Procedure and Sample Size

A Sample of thirty (30) preschools was taken, twelve (12) from Likuyani North, ten (10) from Likuyani Central and eight (8) from Likuyani South zones. A sample of seven hundred and ninety two (792) children and sixty (60) teachers were used (Table 4). This met the requirement of 10% and above of the total population (Mugenda and Mugenda, 1999). Stratified random sampling was used to select schools from each zone. Simple random sampling was used in the choosing of the teachers. In order to determine experimental and control schools in each zone, another simple random sample was taken for each of the selected schools in each zone. In total there were fifteen (15) experimental schools and (15) control schools.

Table 3.2: Sampled Schools Teachers and Children

Zone	Control schools	Experimental schools	Total (schools)	Teachers	Children
Likuyani North	6	6	12	24	310
Likuyani Central	5	5	10	20	282
Likuyani south	4	4	8	16	200
Total population	15	15	30	60	792

3.5 Instruments

This research used the following instruments, Pretest and Posttest, classroom observation schedule and questionnaire for teachers. Each of these instruments is described below.

3.5.1 Pretest and Post test

Both tests were oral and practical. They tested the seven activities that are elements of number recognition. The activities are; identifying number symbols, putting together and naming the symbol, arranging numbers, matching number activities, matching number symbols to their value, counting, and sorting and grouping numbers. In total each test had nine questions based on the activities observed in the class. (See appendix i)

3.5.2 Classroom Observation Schedule

Observation schedule comprised of seven activities and how frequently the manipulative instructional resources were used in each of those activities in learning number recognition. The outcome of the observation was used to indicate whether the use of manipulative instructional resources improved the performance in number recognition. The uses of flash cards, models, counters and others were observed. (See appendix ii)

3.5.3 Questionnaire for Teachers

The questionnaire for teachers was used to collect information on all the research questions with greater emphasis on attitudes of teachers and how they perceive children's attitude towards the use of manipulative instructional resources (flash-cards, models, counters and others) in the teaching and learning of number recognition. The first three (3) questions are on bio data. Three questions dealt with types of manipulative instructional resources and their frequency of use. The rest six (6) questions addressed teacher's attitudes and their perception of children's attitudes towards the use of manipulative in the teaching and learning of number recognition. A total of thirteen (13) questions were in the questionnaire. (See Appendix iii)

3.5.4 Validity and Reliability

Validity is the degree to which an instrument measures what it is intended to measure (Borg and Gall 1989). In this study to ensure validity a pilot study was carried in two schools not in the sample. The results of the pilot study for all instruments were used to determine the validity of each instrument.

An instrument is reliable when it can measure a variable accurately and obtain same results under same conditions over a period (Mugenda and Mugenda, 1999). In this study to ensure reliability a pilot study was carried out in two schools not in the sample. The results of the pilot study for all instruments were used to determine the reliability of each instrument.

3.6 Data Collection Procedure

The researcher obtained an official permission from the ministry of Education Science and Technology. The researcher then proceeded to the County Director of Education Kakamega County who introduced her to the District Education Officer Likuyani. The DEO allowed the researcher to proceed to schools where she accessed classrooms with the authority of head teachers of the participating schools. Before data collection the research assistants were trained for two days on how to carry out classroom observation during number work.

The teachers who participated in research had three days training by the researcher. Those in the experimental schools were trained on how to use the flash cards, models and counters. Those in the experimental group were then supplied with flash cards, models and counters for their respective classes. The participating teachers from the control schools joined the training on the last day when schemes of work were agreed upon. The teachers and researcher agreed on the content to be taught from the teacher's schemes of work. Those in control group were in the training for only one day, in order to agree on the schemes of work and were informed to prepare their children for a pretest. Administration of the pretest and the marking was done by the teachers and the researcher.

Data was collected using an observation schedule, questionnaire for teachers and two-test**s** (pretest and posttest). These instruments were administered by the researcher, two research assistants and the participating teachers. Specifically the researcher administered the questionnaires by handing them to the teachers and coming to pick them later after they were filled. The researcher and the two research assistants carried out observations

in classrooms. The post test was administered and marked by the participating teachers and the researcher using an agreed marking scheme at the end of the experiment.

The duration of the experiment was one month in which seven activities that form number recognition were taught. The researcher and the teachers in both groups agreed on the pretest which they administered at the beginning of the experiment. They also agreed on the post test. The observation started in the second week by the researcher and the two research assistants. There were seven activities that formed number recognition namely; identifying number symbols, putting together and naming the symbol, arranging numbers, matching number activities, matching number symbols to their value, counting, and sorting and grouping numbers. Three activities among the seven were observed in each class in a participating school. Since the teachers were only handling one activity in each lesson, the researcher and the two research assistants scheduled themselves to observe all activities equally in all participating schools. This implies that there is no activity among the seven that was not observed adequately in the fifteen (15) experimental and fifteen (15) control schools.

3.7 Data Analysis

Data was analyzed qualitatively and quantitatively. Quantitative data was organized through tabulation where means and standard deviation were calculated. The major analysis was done by using ANCOVA. The hypotheses were tested by using the t-test at an Alpha level of 0.05. The pre-test and post-test were standardized to ensure consistence and uniform procedure scoring and interpreting the behavior of subjects was done. The norm referenced test was used because it was standardized test that compares subject performance to others who have similar characteristics like age and geographical region.

Data from the various instruments (questionnaires for teachers, observation schedules and the two tests) were organized as follows.

Data from the teacher's questionnaires were tabulated based on the school and each question. Most of the questions were of likert scale and dealt with teacher's attitudes and their perception of learners attitudes towards use of manipulative instructional resources. From there bar graphs and line graphs were drawn.

Data from the observation schedule was tabulated by school to indicate each activity taught (identifying number symbols, putting together and naming the symbol, arranging numbers, matching number activities, matching number symbols to their value, counting, and sorting and grouping numbers) and how many times each of the named manipulative resources(flash cards, models, counters and others). The teachers in the experimental schools only used the three manipulative instructional schools of flash cards, models and counters. The teachers in the control schools used any available manipulative instructional resources at their disposal.

Means and standard deviations were calculated for the frequencies of each use of the manipulative instructional resources in relation to each activity. The totals of each manipulative instructional resource were totaled put in a table. Line graphs were drawn using the activities as the base and the totals of the manipulative instructional resources as the height for both experimental and control schools. Analysis of frequency of use of manipulative instructional resources and related it to the post tests. Analysis of types of manipulative instructional resource and related it to post tests. Analysis of teacher's attitudes towards use of manipulative resources and related it to post tests.

3.8 Ethical Concerns

The research strictly adhered to the professional guidelines. The data collected was confidential, and only meant for the purpose of this research only .To hide the respondents identity and those of preschoolers, the researcher applied code letters instead of names.

CHAPTER FOUR

FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents data analysis, findings, presentation and interpretation of findings. The purpose of the study was to determine the influence of manipulative instructional resources on children's performance in number recognition activities in pre-school. In addition the study also looked at how teacher's attitudes towards manipulative instructional resources influenced their use in class. The chapter is organized into sections mainly based on the research objectives which include; determining the children's performance in number recognition when different types of manipulative instructional resources are used during teaching, examining the influence of frequency in using manipulative instructional resource on children's performance in number recognition and identifying the relationship between teachers' attitude on manipulative instructional resources and children's performance in number recognition.

4.2 Questionnaire Return Rate

This study targeted both the pre-school teachers and learners as respondents. All the targeted teachers from thirty schools were able to fill and return their filled forms making the response rate good for analysis. On the other hand all pre-school children from the targeted pre-schools sat their tests as required making the response for learners good for analysis.

Table 4.1: Questionnaire Return Rate

Target respondents	Sampled teachers	Responses	Return rate (%)
Preschool teachers	60	60	100

From the Table 4.1 it can be seen that return rate was good for all the targeted respondents since it was a 100 percent (that is, return rate for instruments was 100 percent and therefore it was good for analysis.)

4.3 Demographic Information

Demographic information was based on teacher's academic qualifications, teaching experience and how often they use manipulative instructional resource during the number recognition lessons, the teacher's demographic information is shown in Figures 4.1,4.2,and 4.3

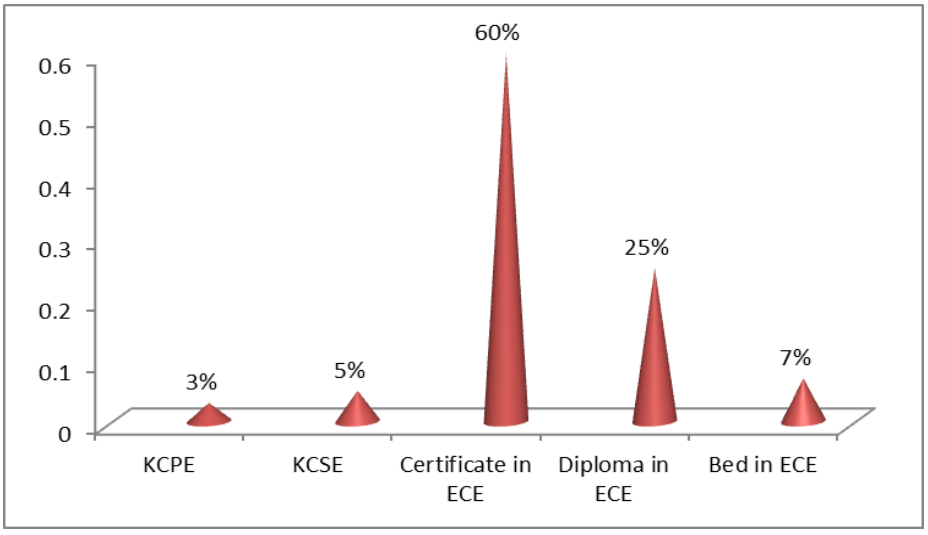


Figure 4.1: Sampled Teachers Academic Qualification

From the Figure 4.1 on teacher's qualification majority of teachers had attained certificate level in early child hood education this was 60%, teachers who had diploma qualification in early child hood education were 25%, 7% of teachers had bachelor in education, those with KCSE qualification were 5% and remaining3% had KCPE academic qualification.

4.2.1 Period of Time Teaching in Early Childhood Centre

The study sought to find out the teachers teaching period in the early childhood centre and findings are illustrated in Figure 4.2.

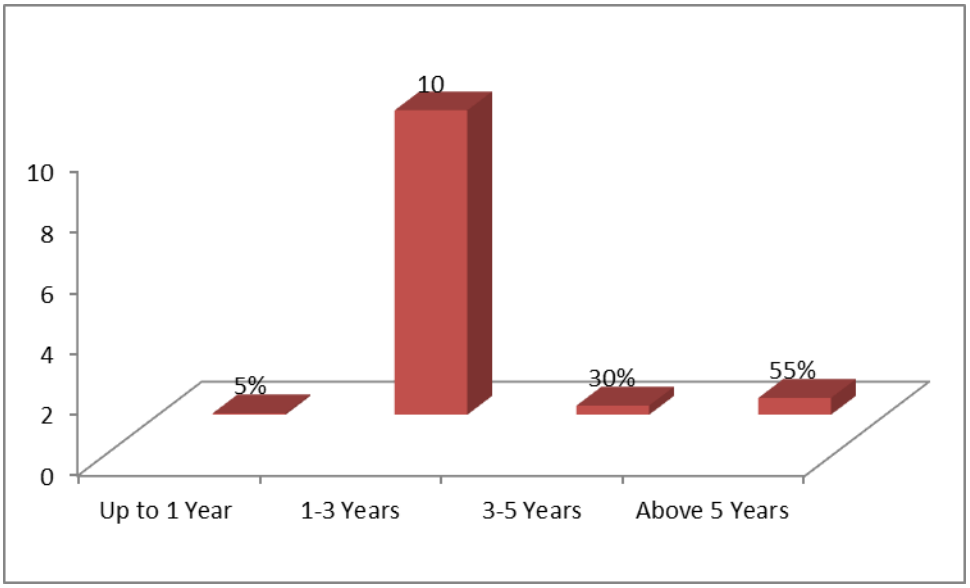


Figure 4.2: Period of Time Teaching in Early Childhood Centre

From the Figure 4.2, majority of the teachers had teaching experience of over 5 years in the earl child hood centre this was 55%, teachers with 3-5 years were 30%, 10% had teaching experience of between 1-3 years and only 5% had experience of up to 1 year.

4.2.2 The Use of Manipulative Instructional Resource during the Number Recognition Lessons

The research sought to find out how often the teachers use instructional resource during the mathematics lessons and the findings is shown in Figure 4.3.

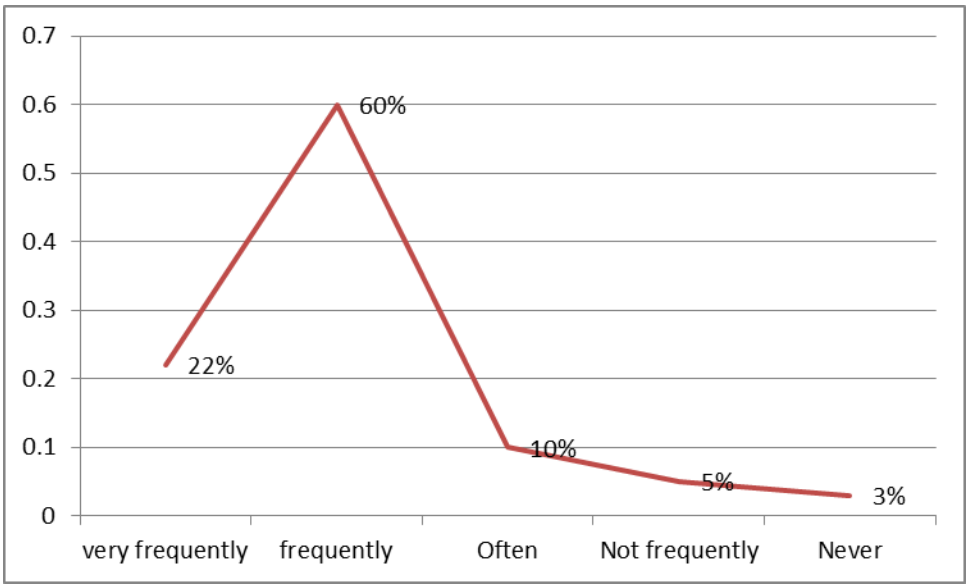


Figure 4.3: Manipulative Instructional Resources Used during the Number Recognition Lessons

From the Figure 4.3, majority of the teachers in the study frequently use instructional resource during the mathematics lessons this was 60%, 22% indicated they use instructional resource very frequently, 10% use instructional resource oftenly, 5% use instructional resource not frequently and only 3% never use instructional resource in teaching mathematics. These reveal that majority of teacher's t early child hood centre use instructional resource in teaching mathematic lessons.

4.4.3 The Frequency of Use of Manipulative Instructional Resource

The study sought to know the frequency of use of manipulative instructional resource according to use, and the findings is as shown in table 4.2

Table 4.2: Frequency of Use of Manipulative Instructional Resource

Manipulative Instructional Resource	**Frequency**	**Percentage**
Very frequently	40	67
frequently	10	17
Not frequently	5	8
rarely	5	8
Total	**60**	**100**

From Table 4.2, majority of teachers 67% use cut outs manipulative instructional resource very frequently, 17% of teachers use models manipulative instructional resource frequently and 8% use flash cards not frequently and rarely.

4.4.4 Effectiveness of Using Manipulative Instructional Resources in Assisting Children to Grasp the Concept of Number Recognition

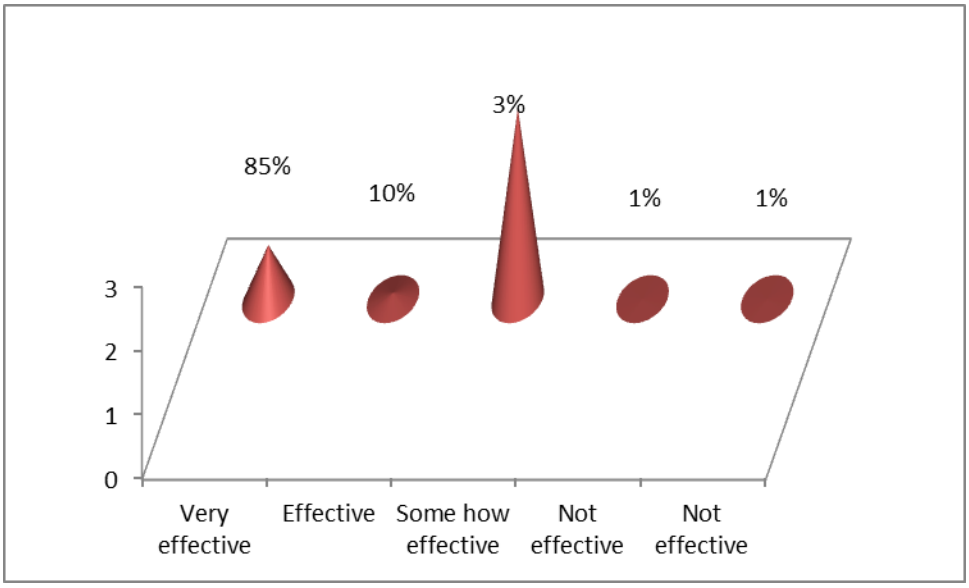


Figure 4.4: Effectiveness of Using Manipulative Instructional Resources in Assisting Children to Grasp the Concept of Number Recognition

From Figure 4.4 majority of teachers indicated that manipulative instructional resources are very effective in assisting children to grasp the concept of number recognition that was 85%, 10% said that instructional resource are effective, 3% said instructional resource are somehow effective and only 1% indicated that instructional resource are not effective or were not sure. This confirms the study by Moyer (2001) that teachers believed that using manipulative instructional resources was more enjoyable than doing math that is solely abstracted and symbolic. Learners are actively engaged and interested in lessons. The enjoyment, experienced by teachers and learners in using manipulative instructional resources meant that the teachers tended to use them as a reward for good behavior rather than solely when they would be useful adjunct to learning.

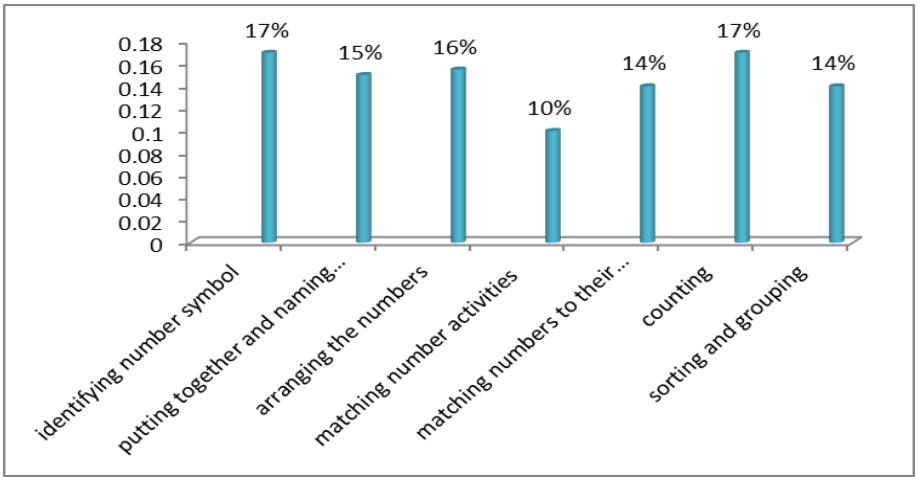


Figure 4.5: Average Percentage Use of Models, Flash Cards, Counters and Others in Control Preschools

From Figure 4.7, amongst the seven elements of number recognition manipulative learning resources were used more to teach identification of number symbols and counting at 17%, matching number activities was had the least use of manipulative instructional resource at 10%.

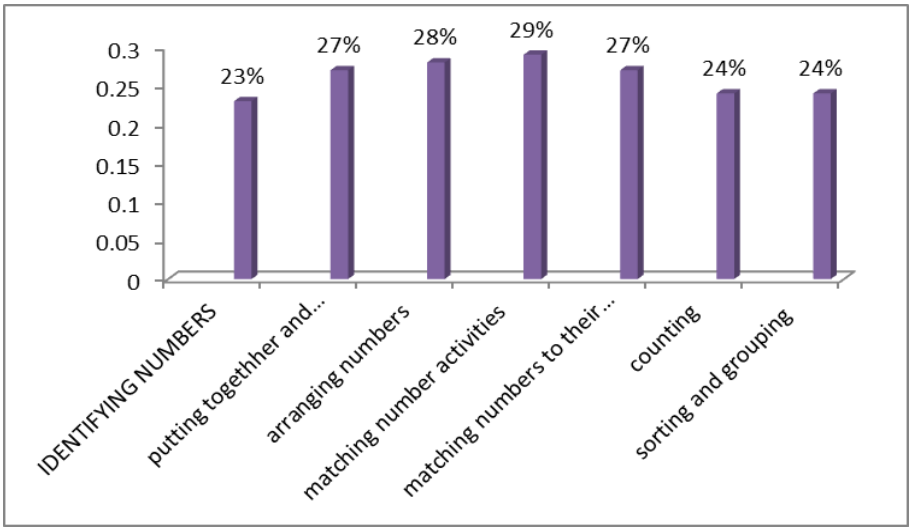


Figure 4.6: Average Percentage Use of Models Flash Cards and Counters in Experimental Schools

From the Figure 4.8, the of models flush cards and counters was used in all the seven elements of number recognition with matching number activities taking the highest percentage at 29% the use of above mentioned manipulative had a positive impact6 in learning number recognition.

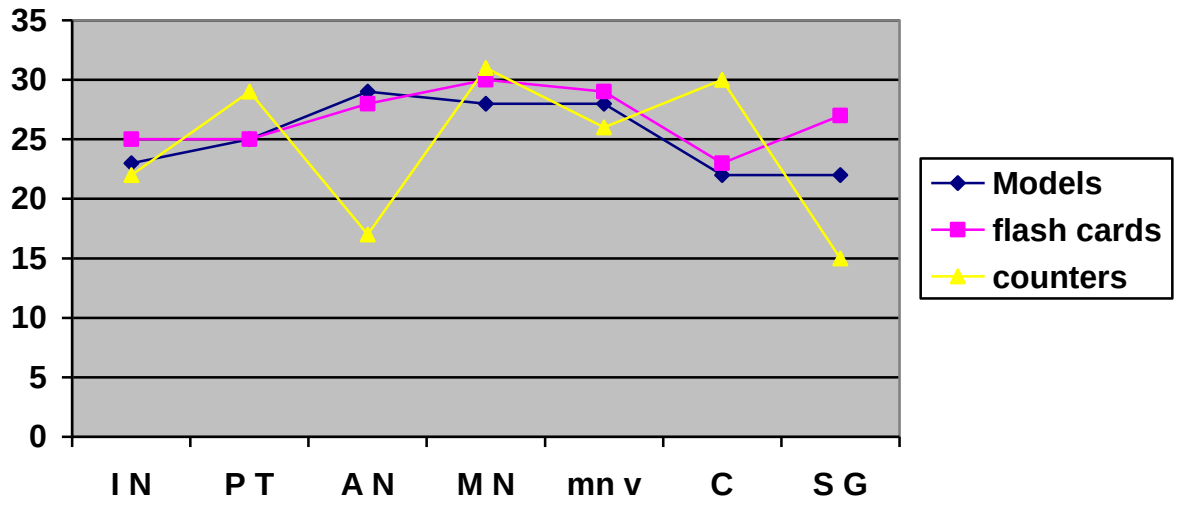
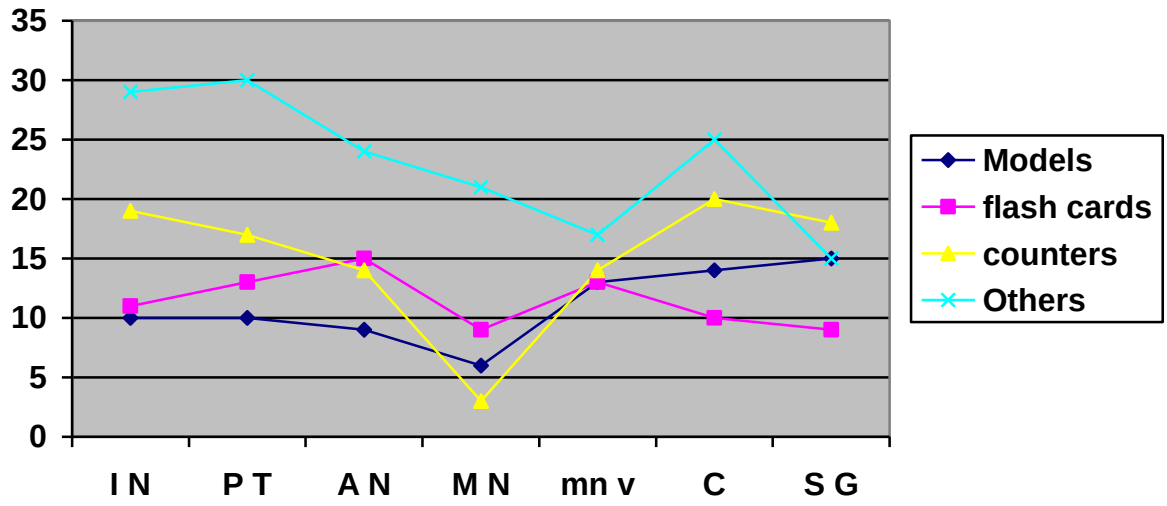


Figure 4.7: The Frequency of Use of Different Manipulative Instructional Resources in Experimental Schools

From Figure 4.7 it is observed that, counters were popularly used in the following activities; putting together, matching number activities and counting. They were poorly used in, arranging numbers and sorting and grouping numbers. They were averagely used in identifying numbers and matching numbers to their values. Flash cards were averagely used in all activities. The variation from one activity to another was minimal except in the activity of counting.

Models almost formed a normal curve in their frequency of use. With the lowest use being in identifying numbers and sorting and grouping numbers. With apex being in arranging numbers, matching numbers to their symbols and matching numbers to their value.

Overall models were the most frequently used manipulative instructional resources in the experimental schools in the seven activities. They were followed by, flash cards. Counters were erratically used in that in activities like putting together, matching number activities and counting they were used more frequently whereas in the areas where low frequency was observed, were really low. The variation between the highest frequency and the lowest frequency were very high.



From Figure 4.10, the average total frequency of use of models, flash cards, counters and others in control schools. Counters have formed an inverted normal curve with high frequencies in the following activities; identifying numbers, and counting. The lowest frequency was observed in matching number activities. The frequency of use of Flash

cards and models were very low. A sign that they were not available in most control schools.

However, other manipulative instructional resources were fairly used in terms of frequency in the control schools. A sign that, there are manipulative instructional resources other than the three that were supplied in the experimental schools. The other manipulative instructional resources were still lower in frequency as compared to the manipulative instructional resources used in the experimental schools.

4.4.5 Children's Attitude towards Manipulative Instructional Resources

Teachers were asked to indicate their opinion on the children attitude towards instructional resources and findings is as illustrated in Figure 4.5.

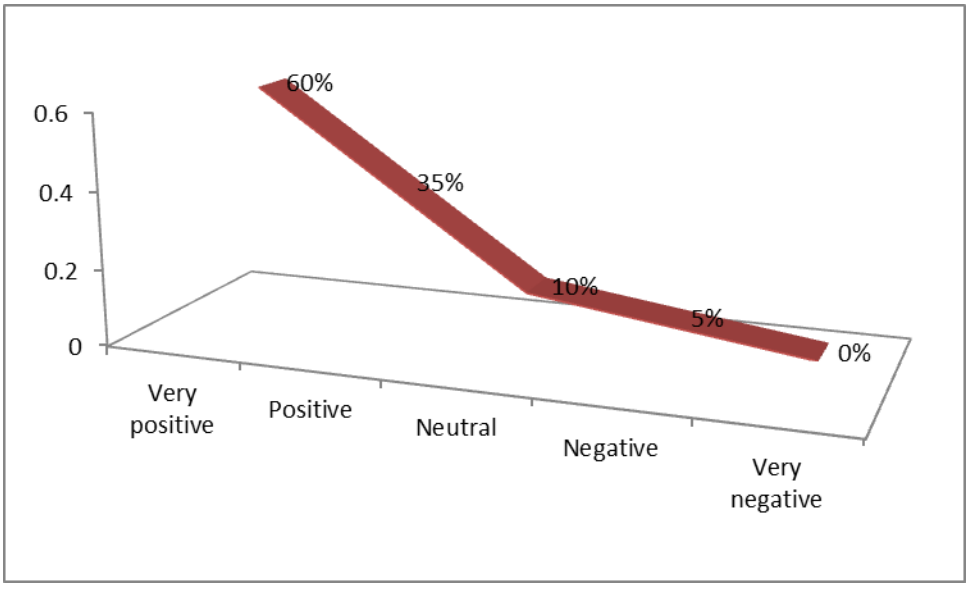


Figure 4.8: Children's Attitude towards Manipulative Instructional Resources

From the Figure 4.5, majority of the teachers 60% indicated that children had a very positive attitude towards instructional resources, 35% said children had positive attitude

towards instructional resources, 10% indicated that children were neutral only 5% of the children had negative attitude towards instructional resources with none having very negative attitude towards instructional resources.

4.4.6 Common Mistakes Children Make When Learning Number Recognition

Among the mistakes that children make while being taught mathematics by use of manipulative instructional resources failure to identify numbers, sequencing. Place value, counting and finally writing.

4.4.7 Challenges in using Manipulative Instructional Resources in Your Class

The study sought to know the Challenges in using manipulative instructional resources in their classes. The responses were rated on a five point likert scale where: 1 highest challenge and 5 lowest challenge. The mean and standard deviations were generated from SPSS and were illustrated in Table 4.3.

Table 4.3: Challenges in using Manipulative Instructional Resources in Your Class

Challenges	Mean	Std. Deviation
Class size room	2.7778	0.8937
Enrolment	2.5556	0.8333
Lack of variety	2.4444	0.5681
In adequate storage facility	2.3672	0.4762
Class control	2.4554	0.3873
Time of their developments	1.3335	1.2300
Time for their use	1.3450	1.3005
Lack of expertise to use them correctly	1.2345	1.3404

From the Table 4.3, teachers ranked class size as the most challenging in using manipulative instructional resources in your at mean =2.778, enrolment was ranked second in at mean =2.556.lack of variety was ranked third at mea =2.444 and class control at mean 2.455 respectively. Lack of expertise to use them correctly had the least challenge ranked at mean =1.235, time for their development had lower challenge ranked a mean 1.334 and time for their use at mean =1.345 respectively. This reveals that classroom size and enrolment were the biggest impediments to use of manipulative instructional resources in class.

4.4.8 Teachers' Preferred Teaching Approach

The study sought to know the teachers preferred teaching approach and the findings is as illustrated in Figure 4.6.

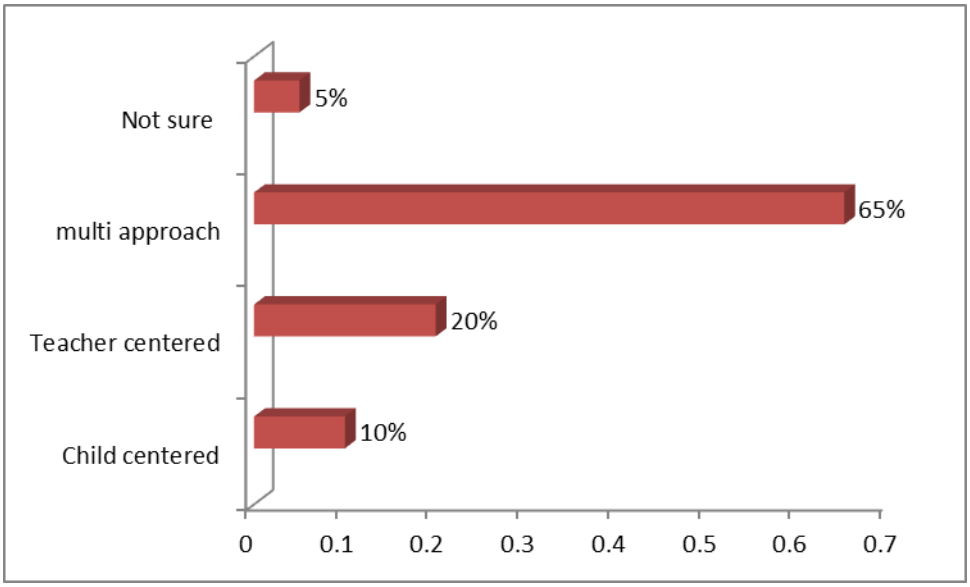


Figure 4.9: Teachers' Preferred Teaching Approach

From the Figure 4.6, it is seen that majority of teachers preferred teaching mode was multi approach which accounted for 65%, 20% indicated that they preferred teacher

centered teaching mode, 10% were child centered while only 5% of the interviewed teachers were not sure of the preferred teaching mode.

4.4.9 The Frequency of Appraisal from the Managements

The study sought to know how often teachers get appraisal for using manipulative instructional resources in teaching mathematics. The responses were rated on a five point likert scale where: 1=Never, 2=Not frequently, 3=Often, 4=frequently, 5=very frequently. The mean and standard deviations were generated from SPSS and were illustrated in Table 4.4.

Table 4.4: The Frequency of Appraisal from the Managements

Officers	Mean	Std. Deviation
Head of departments	4.767	0.793
Head teacher	4.505	0.633
QUASO	3.440	0.968
Tac tutor	2.067	1.406

From the Table 4.4, head of departments very frequently appraise teachers for using manipulative instructional resources at mean=4.767, head teachers frequently appraise teachers for use of manipulative instructional resource at mean =4.505 respectively. QUASO and Tac tutor rarely appraise teachers at mean =3.440 and 2.067 respectively.

4.4.9 The Level of Agreement or Disagreement with These Statements

The study sought to know the level of agreements on the statement about teaching mathematics in the pre-school. The responses were rated on a five point likert scale where: SA= strongly agree, A=agree N= neutral=disagree, SD=strongly disagree, N=Never. The mean and standard deviations were generated from SPSS and were illustrated in Table 4.5.

Table 4.5: Level of Agreement or Disagreement with These Statements

Statements	Mean	Std deviation
Effective teachers demonstrate to learners the correct way to use manipulative instructional materials	4.456	0.789
Manipulative instructional are very important in the teaching of number recognition	4.200	0.876
My role as a teacher is to facilitate pupils own enquiry by providing a variety of manipulative instructional resources	3.950	0.967
Teachers should allow learners to play freely with manipulative instructional resources before using them during the lesson	2.678	1.689
Children learn better when teachers use the lecture method during teaching number recognition.	1.679	1.845
Children learn better when teachers use the child centered method of teaching number recognition.	1.453	1.900
A lesson in number recognition without manipulative instructional resources is not effective	5.674	0.534
Preschool children are too young to be introduced to mathematics	4.005	0.867
Manipulative instructional resources can only be used as rewards for children who behave well during the lesson.	3.654	1.453

From the Table 4.5 majority of respondents agreed to greatest extent that a lesson in number recognition without manipulative instructional resources is not effective at mean =5.674, Effective teachers demonstrate to learners the correct way to use manipulative instructional resources at mean =4.456 and Manipulative instructional are very important in the teaching of number recognition at mean =4.200 respectively. respondents indicated that to a less extent Children learn better when teachers use the lecture method during teaching number recognition at mean =1.679 and Teachers should allow learners to play freely with manipulative instructional resources before using them during the lesson at mean 2.678 respectively .

Table 4.6: Effects of Manipulative Instructional Resource on the Children Performance

Source	**Type111sum of squares**	**df**	**Mean square**	**F**	**Sig**	**Eta squared**
Corrected model	234.986[b]	5	52.457	3.453	.022	.381
Intercept	206790.0567	2	4306790.002	10320.002	.034	7964
Total scores	150.975	2	64.234	32.900	.0723	.0134
Mean scores	5.567	1	34.087	.0453	.056	.000
Total mean	S_2 55.609	2	23.765	2.450	.014	.000
Error	7276.342	5425				
Total	65024.041	536				
Corrected total	7502.003	426				

Computed at alpha .05

From the Table 4.6, it can be revealed that significant values are less than the alpha .05 from the ANCOVAs Table 4.6. These means show that influence of manipulative instructional resources on children performance in number recognition the alpha values are at p>0.05 sig values are 0.022, 0.034, 0.056 and 0.014.

Table 4.7: Dependents Variable on Children Performance

Types of class	**Mean**	**Std deviation**	**N**
Maths skills	34.65	4.71	30
Confidence level	34.42	4.88	30
Total	**37.40**	**5.14**	**60**

This indicates that there is a significant relationship between the covariate and the dependent variable ,while controlling for the independents variable group in the line corresponding to our covariate the sig value is .000 which actually means less than than.0005 these is less than .05 therefore our covariate is significant.

Table 4.8: Estimated Margin Means

Types of class	**Mean**	**Std .Error**	**95%Confidence interval**	
			Lower bound	Upper bound
Maths skills	37.652[a]	.691	36.512	38.340
Confidence level	37.042[a]	.691	34.654	37.355

Evaluated at covariate appeared in the model

From the Table 4.8, it can be seen that the adjusted means on the dependent variable for each group has been statistically removed. From the findings a one way between groups analysis of covariance was conducted to compare the effects of manipulative instructional resources in number recognition in teaching mathematics. The independent variable was type of intervention math's skills examine the influence of the frequency in using manipulative instructional resource on children's performance in number recognition and identifying the relationship between teachers' attitude on manipulative instructional resources and children's performance in number recognition .participants scores on the experimental group were used as the covariate .after adjusting between the two interventions scores there was no significant difference between the two intervention group on pretest and posttest. On the post test scores F (3.453) =0.022 Eta squared .381 there was strong relationship between pretest and posttest intervention scores on the children performance.

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 the study was to determine the influence of manipulative instructional resources on children's performance in number recognition activities in pre-school. In addition the study also looks at how teacher's attitudes towards manipulative instructional resources influence their use in class.

5.2 Summary of the Study

The researcher used a quasi- experimental design where the research structure included intensive and in-depth investigation on an issue at hand in a relatively small sample. Teachers and learners involved in the study were randomly selected from preschools selected. The researcher used simple random sampling technique with thirty teachers participating in the study whereby each preschool had one teacher involved from their preschools. A total of four hundred and fifty children participated in the study. This study was conducted by the researcher using prepared questionnaires which respondents were preschool teachers. The researcher also used the tests prepared for children mathematics tests. Instrument validity was measured through research objectives of the study.

The researcher visited the preschool she intends to collect the data from and introduce herself to the head teacher. The questionnaires were personally administered to the teachers by the researcher and record responses. The researcher analysed each questionnaire according to the opinion of respondents. The researcher used observation schedule to analyse the availability of the facilities and resources available for manipulative instructional resources Standard Deviations, t-statistics and P-values were also computed. The research findings are discussed below:

Majority of teachers had attained certificate level in early child hood education this was 60%, teachers who had diploma qualification in early child hood education were 25%, 7% of teachers had bachelor in education, those with KCSE qualification were 5% and remaining 3% had KCPE academic qualification.

Teachers had teaching experience of over 5 years in the earl child hood centre this was 55%, teachers with 3-5 years were 30%, 10% had teaching experience of between 1-3 years and only 5% had experience of up to 1 year.

Majority of the teachers in the study frequently use instructional resource during the mathematics lessons this was 60%, 22% indicated they use instructional resource very frequently, 10% use instructional resource often, 5% use instructional resource not frequently and only 3% never use instructional resource in teaching mathematics.

Teachers indicated that manipulative instructional resources are very effective in assisting children to grasp the concept of number recognition that was 85%, 10% said that instructional resource are effective, 3% said instructional resource are somehow effective and only 1% indicated that instructional resource are not effective or were not sure.

This confirms the study by Moyer (2001) that teachers believed that using manipulative instructional resources was more enjoyable than doing math that is solely abstracted and symbolic. Learners are actively engaged and interested in lessons. The enjoyment, experienced by teachers and learners in using manipulative instructional resources meant that the teachers tended to use them as a reward for good behavior rather than solely when they would be useful adjunct to learning.

60% of the teachers indicated that children had a very positive attitude towards instructional resources, 35% said children had positive attitude towards instructional resources, 10% indicated that children were neutral only 5% of the children had negative attitude towards instructional resources with none having very negative attitude towards instructional resources.

The most challenging in using manipulative instructional resources in your at mean =2.778, enrolment was ranked second in at mean =2.556.lack of variety was ranked third at mea =2.444 and class control at mean 2.455 respectively. Lack of expertise to use them correctly had the least challenge ranked at mean =1.235, time for their development had lower challenge ranked a mean 1.334 and time for their use at mean =1.345 respectively.

Majority of respondents agreed to greatest extent that A lesson in number recognition without manipulative instructional resources is not effective at mean =5.674, Effective teachers demonstrate to learners the correct way to use manipulative instructional materials at mean =4.456 and Manipulative instructional are very important in the teaching of number recognition at mean =4.200 respectively.

Respondents indicated that to less extent Children learn better when teachers use the lecture method during teaching number recognition at mean.

Between groups analysis of covariance was conducted to compare the effects of manipulative instructional resources in number recognition in teaching mathematics. The independent variable was type of intervention math's skills examine the influence of the frequency in using manipulative instructional resource on children's performance in number recognition and identifying the relationship between teachers' attitude on manipulative instructional resources and children's performance in number recognition .participant scores on the experimental group were used as the covariate .after adjusting between the two interventions scores there was no significant difference between the two intervention group on pretest and posttest. On the post test scores F (3.453) =0.022 Eta squared .381 there was strong relationship between pretest and posttest intervention scores on the children performance.

5.3 Conclusion

The study intended to investigate the influence of manipulative instructional resources on children's performance in number recognition activities in pre-school. The following conclusions can be drawn from the study.

According to teachers manipulative instructional resources are very effective in assisting children to grasp the concept of number recognition and that instructional resource are effective, instructional resource are somehow effective and this confirms the study by Moyer that teachers believed that using manipulative instructional resources was more enjoyable than doing math that is solely abstracted and symbolic. Learners are actively

engaged and interested in lessons. The enjoyment, experienced by teachers and learners in using manipulative instructional resources meant that the teachers tended to use them as a reward for good behavior rather than solely when they would be useful adjunct to learning.

Participant scores on the experimental group were used as the covariate .after adjusting between the two interventions scores there was no significant difference between the two intervention group on pretest and posttest. On the post test scores F (3.453) =0.022 Eta squared .381 there was strong relationship between pretest and posttest intervention scores on the children performance.

The most challenging issue in using manipulative instructional resources teaching was big numbers in enrolment was ranked second, lack of variety was ranked third and class control respectively. Lack of expertise to use them correctly had the least challenge and time for their development had lower challenge.

5.4 Recommendations

The study recommends the following:

District education boards and constituency development funds should prioritize early childhood education in allocations for development projects so as to provide necessary resources and facilities to teach mathematics using manipulative instructional resources. This will improve performance not only in mathematics but also in other areas. Extension of quality assurance services to Pre-schools will help to monitor and improve performance in mathematics.

Head teachers should move to ensure that their respective preschools have adequate instructional resources for children. This should be complimented by developing a working plan that gives preschoolers a balanced timetable for the entire subject.

Not all manipulative resources presented to the teachers was useful in each of the seven elements each manipulative instructional resource had its strength hence the need to use manipulative resources well. Without which they may not serve the purpose.

5.5 Suggestions for Further Research

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

A replica of the study should be carried out within the preschool context in other counties to investigate the influence of manipulative instructional resources on children's performance in number recognition activities in pre-school.

Studies on how school head teachers and other teachers' attitude including those of pre-school affect performance in mathematics are worthwhile. Since this study only targeted mathematics, a similar study should be done in teacher's classroom practices during mathematics as well.

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APPENDICES

Appendix I: Pretest and Post Test

PRETEST

1. Identify the following numbers **1 2 3 4 5 6 7 8 9**

2. Sort and group the same number symbols. (Three of each number 5 2 1 3)

3. Arrange the numbers in their order

4. How many are they?

5. Count and match to the correct number

6. Count the following objects.

7. Put together, count and say the number

8. Name the numbers **8 1 3 4 9 6 5 7 2**

9. Name the next number **1___ 3___ 5 ___ 7___ 9**

POST-TEST

1. Identify the following numbers **1 2 3 4 5 6 7 8 9 (**models)

2. Sort and group the same number symbols. (Three of each numbers 1-9 models and flash cards)

3. Match the numbers to their symbols (model and flash cards)

4. Arrange the numbers in ascending order (sequencing using models and flash cards)

5. Count and match to the correct number symbol. (use counters ,models and flash cards)

6. Count the following objects (counters)

7. Put together, count and give the name symbol (counters)

8. Name the numbers **9 7 2 4 8 1 5 3 6**

9. Name the next number **1___ 3___ 5___ 7___ 9**

Appendix II: Classroom Observation Schedule

Observation schedule for the researcher (insert date and time)

Name of the school……zone……Date……..Time……..

Indicate how many times each manipulative instructional resource is used by both the teacher and the learners.

Activity	Manipulative					
	Flash cards	Models	Counters	Charts	Others	Average
Identifying number symbol						
Putting together and naming the number symbol						
Arranging numbers						
Matching number activities						
Matching numbers symbols to their value						
Counting						
Sorting and grouping number						
Total						

Appendix III: Questionnaire for Teachers

This questionnaire is for purposes of collecting information relating to influence of manipulative instructional resources on the learning of number recognition in preschools. All information will be used for the purpose of the study only and will be treated with utmost confidence. Kindly respond to all questions as honestly as possible .Your cooperation will be highly appreciated.

1. In which age bracket do you belong? (Tick)

   a) 21-30 ☐

   b) 31-40 ☐

   c) 41-50 ☐

   d) above 50 ☐

2. State your academic/professional qualifications.

   a) K C P E ☐

   b) KCSE ☐

   c) Certificate in ECE ☐

   d) Diploma in ECE ☐

   e) Bed ECE ☐

   f) other specify .....

3. For how long have you been teaching in early childhood centre?

   a) up to 1 year ☐

   b) 1-3 years ☐

   c) 3-5 years ☐

   d) Above 5years ☐

4. Indicate how often you use manipulative instructional resource during the mathematics lessons?

a) 5- Very Frequently ☐

b) 4-Frequently ☐

c) 3- Often ☐

d) 2- Not Frequently ☐

e) 1- Never

5. List the teaching aids that you use in your class weekly in teaching number work.

1……..

2 ……

3…….

4 ……

5 ……..

6……..

6. Rank the following manipulative instructional resource according to how you frequently use each of them by indicating in the table as follows

a) 5- Daily

b) 4- Very frequently=4 days per week

c) 3- Frequently= 3 days per week

d) 2- Not frequently=2 days per week

e) 1- Rarely= 1 day per week

Table1: How often the teacher uses manipulative instructional resource

Manipulative instructional resource	Ranking
Models	
Flash cards	
counters	
others	

7. What is your opinion on the effectiveness of using manipulative instructional resources in assisting children to grasp the concept of number recognition?

   a) 5 -Very effective ☐
   b) 4- Effective ☐
   c) 3-Somehow effective ☐
   d) 2- Not effective ☐
   e) 1- not Sure ☐

8. What is the children's attitude towards manipulative instructional resources?

   a) 5- Very positive ☐
   b) 4- Positive ☐
   c) 3- Neutral ☐
   d) 2-Negative ☐
   e) 1- Very negative ☐

9. What are the common mistakes children make when learning number recognition

a)_____ b)_____

c)_____ d)_____

10. Rank the challenges in using manipulative instructional resources in your class by indicating in table 2 below using 1-5

5- Highest challenge and 1- Lowest challenge

Table 2.Challanges in using manipulative instructional resources

Challenge	Ranking
Class size (room)	
Enrolment	
Lack of variety	
Inadequate storage facility	
Class control	
Time for their development	
Time for their use	
Lack of expertise to use them correctly	

11. Which is your preferred teaching approach?

a) Child centered ☐

b) Teacher centered ☐

c) Multi-approach ☐

d) Not aware ☐

12. Indicate how often the following officers appraise you by using

a) 5- Very Frequently

b) 4- Frequently

c) 3-Often

d) 2- Not Frequently

e) 1- Never

Table 3.Frequency of appraisals by supervisors

Officer	Frequency				
	5	4	3	2	1
Head of Department					
Head Teacher					
QUASO					
Tac Tutor					

13. Please indicate how much you disagree or agree with each of the following statements about teaching mathematics in the preschool using Strongly Agree (SA),Agree (A), Neutral (N), Disagree (D),Strongly Disagree (SD) in table 5.

Table4: Please indicate how much you agree or disagree

Statement	**Responses**				
	SA	A	N	D	SD
Effective teachers demonstrate to learners the correct way to use manipulative instructional materials					
Manipulative instructional are very important in the teaching of number recognition					
My role as a teacher is to facilitate pupils own enquiry by providing a variety of manipulative instructional resources					
Teachers should allow learners to play freely with manipulative instructional resources before using them during the lesson					
Children learn better when teachers use the lecture method during teaching number recognition.					
Children learn better when teachers use the child centered method of teaching number recognition.					
A lesson in number recognition without manipulative instructional resources is not effective					
Preschool children are too young to be introduced to mathematics					
Manipulative instructional resources can only be used as rewards for children who behave well during the lesson.					

Appendix IV: Research Authorization Letter

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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NAIROBI-KENYA

Ref: No.

Date:

29th September, 2014

NACOSTI/P/14/2135/3474

Margret Muhunja Kagasi
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Effects of manipulative instructional resources on children's performance in number recognition in Likuyani District, Kakamega County, In Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Kakamega County** for a period ending **31st December, 2014.**

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

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

DR. M. K. RUGUTT, PhD, HSC.
Ag. SECRETARY/CEO

Copy to:

The County Commissioner
The County Director of Education
Kakamega County.