

**TEACHER'S USE OF PLAY AS MEDIUM FOR
BRIDGING PRE-SCHOOL CHILDREN'S
MATHEMATICAL EXPERIENCES: A STUDY OF
KASARANI DIVISION, NAIROBI, KENYA**

BY

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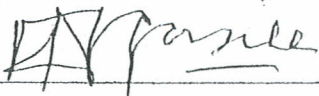


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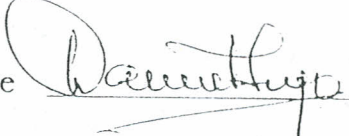
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DEDICATION

This thesis is dedicated to my mother and dear wife, my children Ikai, Aukot, Akuya, Musungu, Engomo, Erupe and Lolidia without whose support I would not have had the drive and motivation to complete it.

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ACRONYMS AND ABBREVIATIONS

Acronyms

DICECE - District Centre for Early Childhood Education

FAWE- Forum for African Women Educationists

FEMSA - Female Education in Mathematics and Science in Africa

MANOVA – Multivariate Analysis of Variance

NACECE - National Centre for Early Childhood Education

NAEYC – National Association for Education of Young Children

UNICEF- United Nations Children’s Educational Fund

Abbreviations

EAS - East African Standard

ECD - Early Childhood Development

ECE - Early Childhood Education

Gok - Government of Kenya

KCPE- Kenya Certificate of Primary Education

KCSE - Kenya Certificate of Secondary Education

KHA - Kindergarten Headmistress Association

KIE - Kenya Institute of Education

MoE- Ministry of Education

MoEHRD - Ministry of Education and Human Resource Development

NCTM – National Commission for Teachers of Mathematics

PTQ - Pre-school Teachers Questionnaire

RoK - Republic of Kenya

TSOD - Teaching Strategies Observation Differential

ABSTRACT

Mathematical skills are basic requirement for socioeconomic development. However, poor performance in mathematics by pupils is a major concern worldwide. In Kenya, researchers have addressed the causes of poor performance of pupils in mathematics at primary and secondary school tiers, but there are no known studies focused on mathematics teaching methods in ECE. Mathematical skills developed in early years through play could affect learning and attitudes of children towards the subject at higher levels of learning. It is most likely that the problem of poor performance in mathematics lies in teaching methods in early childhood.

The purpose of this study was to establish the extent to which pre-school teachers use play as a medium for bridging classroom mathematics experiences in selected pre-schools. The main objective of the study was to establish the extent to which teachers used children play activities to contextualise their learning of mathematical concepts in pre-schools in Kasarani Division of Nairobi Province, Kenya.

The study used an ex post facto descriptive survey research design. Nairobi Province was purposefully sampled while Kasarani Division was randomly sampled using the lottery method. The study used a sample of 132 randomly selected pre-school teachers. A further sample

of 31 pre-school teachers was similarly selected for observation. The data were collected using a questionnaire (PTQ) and an observation schedule (TSOD). Three observations were carried out per pre-school teacher leading to n=93 observations. The research instruments were adapted from other relevant studies to ensure validity and reliability. The data were analysed using both qualitative and quantitative techniques. The main descriptive methods used were tabulations of frequencies and percentages. Pearson product moment correlation (r) and Analysis of Variance (ANOVA) were used to test the hypotheses at alpha (α) level of 0.05. Probability values and f - values were determined using the Statistical Package for Social Sciences (SPSS).

The main results of the study are that only 10% of pre-school teachers used children's play activities to bridge mathematics concepts. Majority of the Pre-school teachers encouraged direct teaching, which emphasized marking of written exercises (97%) and homework (93%), despite the fact that 90% of them were trained in child development theories and had adequate experience. Other findings are that only 3.4 % of pre-school teachers used thematic teaching approach. From the above contexts, it was concluded that the use of play in teaching mathematics was grossly inadequate. In view of this, the study recommended strengthening of DICECE training by adapting play as teaching strategies and providing adequate supervision of pre-schools.

1.0 Introduction

This chapter examines mathematics methods of teaching in Early Childhood Education (ECE) by considering the background to the study leading to the statement of the problem. In addition, the purpose, objectives, research questions and the significance of the study are outlined. Finally, the scope and limitations of the study are explained, while the chapter ends with the definition of terms and a summary of the main issues raised in the chapter.

1.1 Background to the Study

Both children and adults in understanding and exploring their immediate world need mathematics skills (NCTM, 1989 and NAEYC, 1988). For example in Early Childhood, children encounter mathematical experiences as they compare quantities, when they move in space, when they engage in block building and when sharing objects during play activities. In primary and secondary schools, children need mathematics skills to engage effectively in other fields of knowledge such as sciences, technology and social studies. Adults equally require a broad range of mathematics skills to effectively make informed choices in their jobs, households, communities and civic lives. This

means that sound mathematical foundation is a necessity for all members of a society. This can be done by empowering children as early as possible with intellectual stimulations needed to make them effective learners of mathematics. Whether this has been researched was a subject of this study.

In spite of mathematics having great value to the society, pupils' performance in examinations in schools has generally been poor worldwide. Studies carried out in Africa by FEMSA (1997), indicated that in 1993 secondary examination results, 100% of girls and 74.6% of boys had failed in mathematics in Ghana, while in Uganda only 11.4% of girls and 20.7% of boys had attained a pass grade in mathematics in 1991. In Tanzania, only 1.6% of girls achieved grades A or B in mathematics as compared to 7.95% of boys in the same year. Although girls generally perform poorly in mathematics than boys in Kenya, the overall combined performance in mathematics for both sexes is dismal. The table below presents the KCSE mathematics results for 1996 – 1998.

Table 1.1 KSCE Results for 1996-1998

<u>Year</u>	<u>Grade</u>	<u>Total</u>	<u>Percentage</u>
	D-E	Entry	%
1996	114,071	155,022	73.58
1997	119,822	156,591	76.52
1998	126,834	169,356	74.89

(Source: KNEC Statistics quoted by Kigotho in EAS, 3rd March 2001 p. 15 Coln 3-5).

Table 1.1 shows that entries in mathematics increased each year and the percentage of those scoring D-E remained high. Even with this kind of data available every year, there appear to be no solution found to reverse trend in pupils' poor performance in mathematics.

Performance in mathematics at the primary level is not in any way better. KNEC results for the same period (1996-1998) indicate that only 25% of candidates were able to score between grades B to A in KCPE annually. In addition, an earlier study by Nyangayo (1986) indicated that between 1978-1983, the average score in KCPE mathematics examination in Kenya was between 51.5% and 48.6%. These studies show that the performance of mathematics at both KCPE and KCSE levels keeps declining on

average. The availability of these statistics does not seem to help teachers and educators improve the pupils' results in mathematics examinations. This suggests that the problem of poor performance probably lies elsewhere and most likely in ECE. Hence, the need for research in this area of learning. This was the essence of this study.

Available research in teaching methods in mathematics in Kenya, have focused their attention on teacher training colleges (Murithi, 1990; Tumbo; 1991), secondary schools (Eshiwani, 1982; 1983; Rukangu, 2000; Dongo, 1999; Ogola, 1997 and Kiswili, 1993) and in primary education (Wamani, 1980; Obayi, 1983, Chirchir, 1984, Muhadik, 1982; Munguti, 1984; and Wando, 1992). There are virtually no known studies with regard to the teaching of mathematics in ECE in Kenya, even though this level is important for laying the foundation for life-long education in children (Kamunge, 1988; Koech, 1999, and MoEHRD/UNICEF, 1999). This reflects inadequate knowledge regarding learning mathematics at ECE level. For this reason, this study embraced the teaching of mathematics at the ECE level

Early learning experiences in pre-school are important in shaping the child's future potentials in later school life. Young children need learning and teaching environment that is supportive to the development of problem-solving skills to prepare them to become competent learners. Study by Gakuru (1979) pointed out that most teaching in pre-schools is done through direct instruction using blackboard and chalk. He further found that many pre-schools lacked physical facilities and adequate playing grounds that are conducive to the holistic growth and development of young children. The use of resources in teaching mathematics in ECE centres needs to be systematically researched through a study. This was the purpose of this study.

Children acquire much of their knowledge through exploration in the real world by freely and actively constructing their vision of reality of the environment rather than being instructed about it. Children are taught indirectly through the help of the environment (Seefeldt, 1980). In ECE, young children learn through their senses by manipulating and interacting with real objects in a rich and varied environment (GoK, 1999). This makes learning holistic, integrated, stimulating and enjoyable. When children are encouraged to construct their own

knowledge, they become creative, independent and autonomous. Children actively learn mathematics by constructing and coordinating relationships of events, actions and objects when they are actively playing (Kamii, 1982; Wadsworth, 1978). Whether pre-school settings in Kenya provided a conducive environment or not for learning mathematics needed to be documented. This was the intention of this study. .

The practice of most teachers of mathematics is to drill children to producing “right” answers, which they promote by either reinforcing correct answers or by providing correct answers (Kamii, 1982). As a result, children are reduced to passive learners, making them dependent on adults for all their learning. The dependency syndrome created at the ECE level is likely to be carried on through primary to secondary levels. This makes children unable to face the challenges of mathematics learning, which demand skills in independent thinking and reasoning. Teaching children through play ensures that children take ownership of their learning by manipulating objects and making their own discoveries. This study intended to address these issues of teaching in selected Kenyan pre-schools.

Mathematics experiences should be presented to children in a way that makes them both physically and mentally active. It is not appropriate for young children to sit for extended periods of time in a day learning mathematics through direct instruction. Opportunities for physical expression through games, modeling role-play, experimentation, and exploration are important for mathematics learning. When children play, they construct knowledge about the world in relation to their experiences (Whitebread, 1996; Lee, 1990; Seefeldt, 1980, Seefeldt and Barbour, 1994; Hodgkin, 1985; Almy, 1975, 1970; Smilanky, 1968; Gardner, 1971). In spite of the enormous support play receives in the field of child psychologists (Read, Gardener and Mahler, 1993) and in Kenyan ECE curriculum (GoK, 1999; Koech, 1999; Kamunge, 1988), as an important medium of instruction in ECE, there is no documented evidence to show how play has been useful in teaching mathematics in ECE. There was therefore need for research in this area to systematically document the use of play in teaching mathematics in ECE.

Young children join pre-school with some understanding of numbers, which they had acquired through their activities at home. However, mathematics taught in pre-schools is very

formal and it is introduced to children in symbols and words in an unfamiliar context to the children. For example, it is a general practice by teachers in some pre-schools to drill children to recite either the words one, two, three, or the number symbols 1,2,3,4... Study by Kamii (1982) however shows that for pre-school children, words like one, two, and three... are just like names such as Peter, John, or Paul. They may not find it easy to associate words of numbers with their quantities. Saying a number word is one thing and using the skill of counting is something else (Kamii, 1982). What children need are opportunities to interact with real and familiar objects through games and other activities like playing with sand and water in their natural environment. Whether this was done or not in Kenyan pre-schools needed to be established. This was the essence of this study.

1.2 Statement of the Problem

Mathematics skills are basic requirements that enable all members of society to productively engage in everyday technologically advancement life activities. However, pupils continue to perform poorly in mathematics examinations worldwide. To address these concerns, educationists in Kenya have focused research on the teaching of mathematics in primary, secondary schools and other higher institutions of

learning. In spite of the available statistics from these researches documenting the poor state of mathematics performance by pupils in learning institutions, there appears to be no appropriate solution to the problem. This suggests that solutions to the problem of poor performance in mathematics in schools probably lie in teaching methods in ECE. This is especially critical when research in other countries of the world indicates that high quality, challenging and accessible mathematics education for 3–6 year-old children is a vital foundation for future mathematics skills at higher levels of learning. However, such studies especially focusing on the use of play as a teaching strategy have not been empirically established in Kenya in spite of the effort the Kenya Government is making in the development of ECE. This study would therefore focus on how the pre-school teacher bridges children's learning of mathematics concepts through play activities in selected pre-schools in Kasarani Division, Nairobi Province.

1.3 The purpose of the study

The purpose of this study was to establish the extent to which pre-school teachers used play as a medium for bridging classroom mathematics concepts and skills.

1.4 Objectives of the Study

The study had the following specific objectives:

- 1) To find out the extent to which pre-school teachers used play activities to actively involve children in learning mathematics concepts in pre-schools.
- 2) To find out the extent to which teachers used thematic play activities in teaching mathematics concepts in pre-schools.
- 3) To find out the language the teachers used in teaching mathematics skills to pre-school children.
- 4) To establish whether academic qualifications and the training levels of pre-school teachers improve their mathematics play teaching strategies.
- 5) To establish whether mathematical objects, number of children and class sizes of the pre-schools improve mathematics play teaching strategies of pre-school teachers.

1.5 Research Questions

- 1) To what extent did teachers use children's play activities in teaching mathematics in pre-schools?
- 2) To what extent did teachers use thematic play activities to enhance the development of mathematical concepts to pre-school children?
- 3) Which language did teachers use in teaching mathematics skills to pre-school children?

- 4) To what extent did the academic qualifications and training of pre-school teachers influence their mathematics play teaching strategies?
- 5) To what extent did pre-school teacher's experience, use of mathematical objects, number of children and class sizes of the pre-schools affect mathematics play teaching strategies of pre-school teachers?

1.6 Significance of the study

The findings of this study would be useful to the following:

- (i) **Pre-school teachers:** It is expected that the results of the study would be useful in improving the skills of pre-school teachers in teaching mathematics. The findings of the study would be used by KIE/NACECE to develop guidelines to be used by pre-school teachers for teaching mathematics.
- (ii) **KIE/NACECE:** The findings of the study would be used by staff at KIE/NACECE in developing mathematics curriculum that would be child-centred and sensitive to the use of children's environment and culture through play in the development of mathematics ideas and concepts.

- (iii) **Teacher trainers:** The study findings would be used to improve the mathematics skills of trainers of ECE teachers to improve the quality of training of teachers especially in mathematics.
- (iv) **Parents/Caregivers:** The study findings would be useful in developing a manual for stimulating children's mathematical skills by caregivers at home.
- (v) **The MoE:** The findings of the study would be useful in formulating a clear policy guideline on the use of play as a medium of instruction in ECE. The data from the study could be useful in providing concrete evidence on the use of play for teaching in ECE to the Ministry of Education (MoE) for dissemination to the parents.

1.7 Scope and Delimitation of the study

1.7.1 Scope

This research was limited in scope to a study of public and private pre-schools in Kasarani Division of Nairobi City Council. Financial constraints could not allow for a broader coverage of many divisions in Nairobi. However, adequate schools were sampled for the purpose of the study.

1.7.2 Delimitation

The findings in this study may not be generalisable to all pre-schools in Kenya. However, the research could be useful in stimulating further research in other areas of Kenya.

1.8 Assumptions of the study

- 1) Teaching in Early Childhood centres in Kenya was child-centered and based on thematic learning.
- 2) All public and private pre-schools follow the KIE/NACECE developed curriculum.
- 3) Teaching in pre-schools allowed opportunities for optimum interaction of teachers, children and peers through play learning.
- 4) The learning environment in pre-schools was conducive to young children's development through the provision of adequate learning resources, play space and physical facilities.

1.9 Limitations of the Study

- 1) Problems of inaccessibility occurred due to insecurity and congestion of slum settlements. This resulted in the researcher receiving 101 questionnaires for data analysis instead of the envisaged actual sample of 132.
- 2) Financial constraints also affected the time of data collection.

1.10 Operational Definition of Terms

Play activities - a structured play environment enriched with materials like books, toys, objects, pictures, blocks, water and sand play areas, learning corners in both indoor and outdoor play areas.

Play Bridging Teaching Strategy - includes such teacher's teaching behaviours like open questions, responding to children, guidance, structured, planned activities and children-structured activities.

Private Pre-schools- pre-schools managed by private organizations, individuals and churches.

Public Pre-schools - pre-schools managed by Nairobi City Council.

Teacher Training - DICECE, Montessori, KHA, and others.

Academic Qualification - refers to teacher's academic level such as CPE, KCPE, KCSE or degree.

Teacher's Experience - pre-school teacher's teaching period from the time of leaving college

Thematic Activities- integration of mathematics concepts in activities like creative, block area, shop, household, and nature corner, etc.

Direct Teaching Strategy - includes teacher's teaching behaviours such as giving facts, directing children's activities, asking closed questions, carrying out demonstrations, and use of exercises.

Lecturing - factual teaching

Directing - teachers directing children's learning activities

Limiting Questions - questions that require only specific answers

Demonstrations – directing the use of a material or objects or teaching using the blackboard

Exercises – solving mathematical problems using exercise books

Teacher Questions – open ended questions.

Teacher Response – responding to children's questions and ideas.

Teacher Guidance – observing, joining and challenging children in play Activities

Teacher Structured Play Activities – play activities arranged by the teacher to stimulate concepts and ideas of mathematics

Children structured activities – free choice play activities in indoor and outdoors

Mathematics Experiences – mathematics concepts and skills in ECE

Play Objects/Materials – play objects such as beads, bricks, seeds, bottle tops, tins etc

Number of Children – population of children in pre-school Classrooms

Class size – the space in pre-school classrooms

LITERATURE REVIEW

2.0 Introduction

This chapter reviews relevant literature and the theoretical framework in which the study is based. It starts by discussing the main theories and then key issues in the study.

2.1 Theoretical Framework

This research thesis is based on three theories: Piaget's cognitive theory, Vygotsky's proximal development theory, the transactional view of ability by Haywood and the affective theories of play by Erikson and Freud.

Piaget's cognitive theory postulates that, thought processes develop sequentially (Haywood, Brooks and Burns, 1992; Wadsworth, 1978). These thought processes develop in stages and Piaget conceptualized them into four broad categories in order of occurrence; as the sensorimotor stage (0-2 years), (ii) the preoperational stage (2-7 years), (iii) the stage of concrete operations (7-11 years) and (iv) the stage of formal operations (11-15 years). The first two stages have relevant important implication in this study. However, the latter two stages are beyond the scope of this study.

Wadsworth (1978) writing on Piaget's theory, postulates that infants and toddlers' active exploratory actions on objects characterize the stage of sensorimotor development by use of their senses. According to Piaget, the initial behaviour of infant's actions is reflexive in nature and consists of sucking, grasping, crying and other sensory stimulations. As the infants mature and their interaction with the environment widens, the sensorimotor reflexes become differentiated and more complex behaviours begin to emerge. These behaviours later develop into mental schemes, which form the basis of experiences that children will compare their future knowledge.

Fein and Rivkin (1986) further support Wadsworth's argument that the major cognitive accomplishment in sensorimotor period is the development of mental symbolic representations of objects in children's play activities. The understanding of sensorimotor thought processes of children has important teaching implications for pre-school mathematics teachers. For example, teachers should be aware that children need opportunities to interact with objects to be able to conceptualize mathematical ideas about shapes, size and weight. Whether teachers had the awareness and skills to provide a stimulating learning environment in pre-schools was an issue to be investigated

through a systematic research study. This was the essence of this study.

The other important thought process of pre-school children described by Piaget is the preoperational stage of cognitive development, which is characterized by rapid development of spoken language (Kavanagh, 1991; Wadsworth, 1978). In addition, Wadsworth reports that children's thinking at the preoperational stage is partly logical, dominated by perceptions and inadequate understanding of conservation tasks. However, Wadsworth indicated that children conserve different quantities at different ages and these include; length at 6-7years, number at 6-7years, area at 7-8 years, mass at 7-8 years, liquid at 7-8 years, weight at 9-10 years and volume at 11-12 years. This means that at the preoperational stage, children can only conserve length and number. What does this mean to the teachers of mathematics at the ECE level? Teaching children at this stage requires teachers to understand the way children think and what they are capable of learning. To grasp ideas of conservation, children require plenty of play opportunities with objects. The extent to which this is done in Kenyan pre-schools requires a study. This is the essence of this study.

Cognitive theorists argue that children from their actions on objects construct logico - mathematical knowledge. This type of knowledge includes number and its related concepts, which children acquire by manipulating objects. Wadsworth (1978), Kamii (1982) and Aspy (1972) have rightfully argued that to know an object is to act on it and transform it into operational structures. For example, number is an invention of the child's mind as a result of his actions on a set of mathematical objects. This means that children construct number knowledge when they interact with mathematical objects and events (Von Glasersfeld, 1990). There should be opportunities in pre-school classrooms for children to interact with mathematical objects. The extent to which these issues were addressed in Kenyan pre-schools was the basis of this study.

Vygotsky (1978), postulated that learning is a form of social transaction that involves children's interaction with more competent peers and adults in a social environment. Vygotsky proposed the concept of the zone of proximal development to account for the performance difference between the actual and the next developmental level in children's learning (Haywood et al., 1992; Whitbread, 1996; Vygotsky, 1978). The concept of zone of proximal development explains the role of the adult and more competent peer in helping a child to acquire the potential

for solving his own problems. The adult (caregiver) and the peer act as the bridge of children's thought processes. To what extent have pre-school teachers used Vygotsky's ideas of zone of proximal development in teaching mathematics in ECE in Kenya? This suggested the need for a study that could systematically document what teaching methods teachers' used in teaching mathematics in ECE centres. This was the focus of this study.

Haywood theory (Haywood, H.C. et al, 1992) is based on the view that even the most intelligent persons must learn fundamental cognitive processes before they become effective thinkers and learners. According to Haywood, academic failure is a reflection of inadequate acquisition of the cognitive processes that are necessary for effective learning to take place. The role of teaching is to unmask the native intelligence that exists in an individual child, by employing strategies, that calls for one's intelligence to be applied to specific problem of perceiving, thinking, learning and problem solving. For example, activities that include exploration, the search for novel stimuli, reasonable risk taking, engaging in tasks for the sake of information itself are essential for the development of specific cognitive processes and enthusiasm for learning. Such activities are intrinsically motivated. To what extent do teachers in ECE help to strategise

their teaching in such a way that cognitive skills are developed in children? Teaching in ECE should be strategic and aimed at developing children who are effective learners to survive higher levels of learning. There was need for a study to address these issues of teaching at the ECE level. This study was intended to do just that.

Bruce (1991), writing on affective theorists, postulated by Freud and Erikson indicated that the affective theories consider play to be an important activity that prepares a child for his/her future adult social roles. According to these theories play is a way children cope with anxieties and conflicts and reflecting on positive experiences (Bruce, 1991). Play helps children to develop initiative and become equipped to overcome disappointments, failures, unfulfilled goals and to approach life with a sense of increasing focused purpose. This means that play can have a significant contribution in teaching young children and it is most likely to be a suitable medium for stimulating challenging concepts of mathematics to young children. The extent to which teachers used play in teaching in ECE needed to be established through a study. This was the essence of this study.

In early childhood learning is in an integral part of development that takes place spontaneously as children grow and interact with the environment at home and at school. Pre-school children can learn mathematics concepts directly from the objects they play with. In addition, parents, teachers and peers can be useful in stimulating children's further development of mathematics skills by socially enriching the play environment through bridging of these concepts. Figure 2.1 shows a model of interactive play teaching that can take place at school or at home.

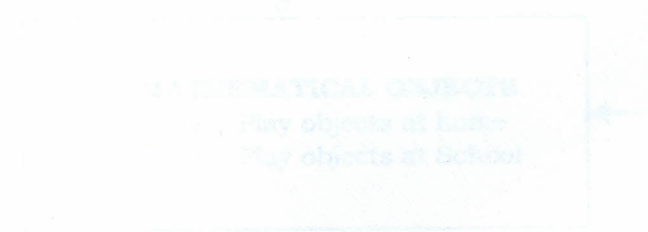
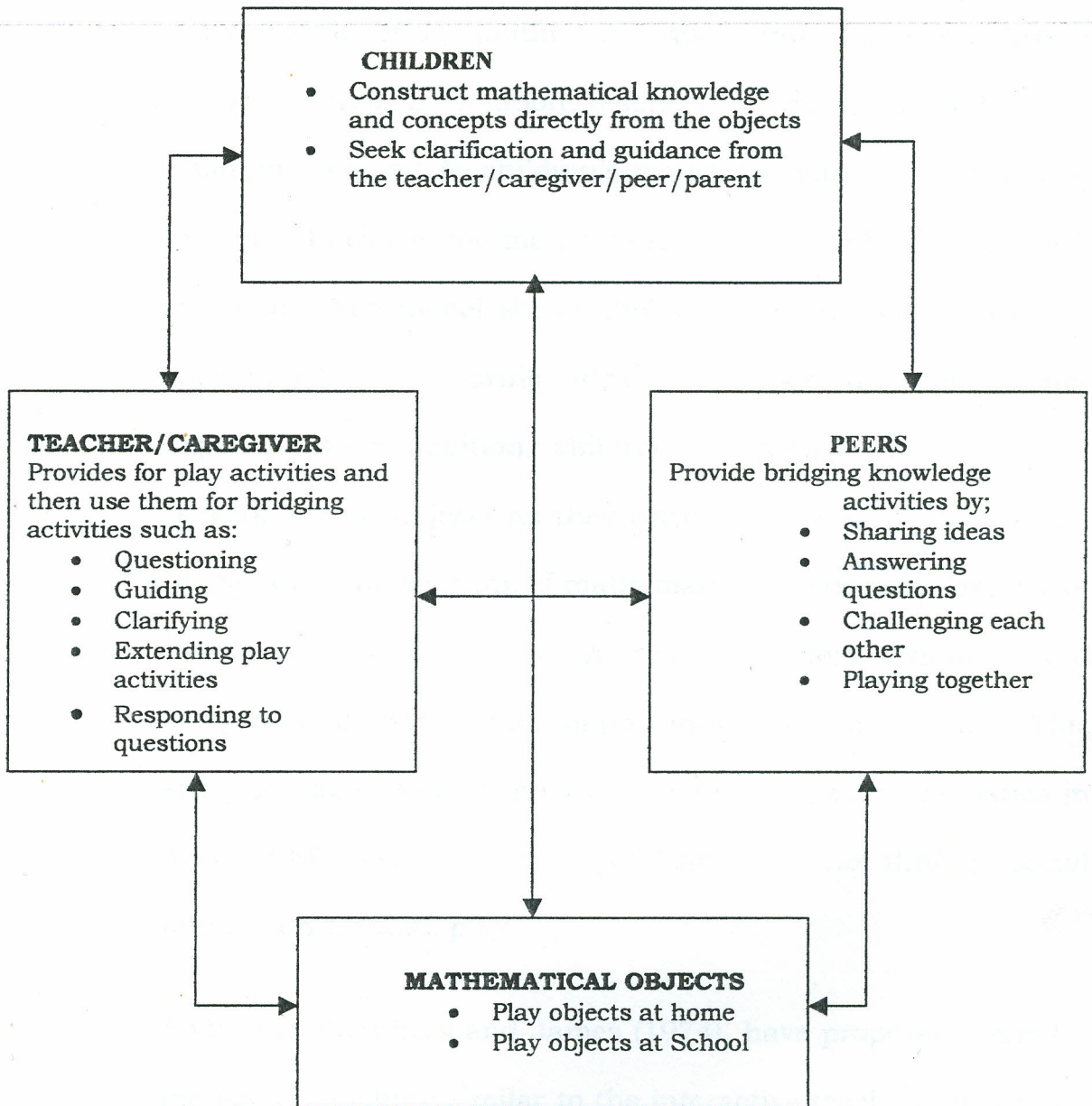


Figure 2.1 An interactive teaching model in a pre-school classroom



(Adopted from Bruce, 1991; Anderson, et al, 1974;Williams, et al, 1997)

Figure 2.1 shows that although children are capable of constructing mathematical knowledge directly from the objects, the role of the teacher and the peer is essential in helping to clarify and focus these ideas further through bridging. The model shows how these interactions are achieved as indicated by

the arrows. For example, teachers by observing children's play activities can bridge mathematics ideas from the object directly to the children. In addition, teachers can guide the activities of children, respond to children's questions, join children at play and help to clarify the mathematical concepts of children where necessary. The model shows that children can learn also from their peers by sharing ideas, materials and challenging experiences. In addition, children can modify and alter their perceptions on objects as they continue interacting with them. In this way, the learning of mathematics is conceptualized as an interactive social activity in which teachers, children and caregivers all have equal opportunities of participation. This study intended to find out whether teaching of mathematics in selected ECE centres encouraged learning or not through social interaction through play.

Anderson, Struthers and James (1974), have proposed a similar method of teaching similar to the interactive teaching illustrated in Figure 2-1 above. Anderson, et al., argued that both the teachers and the child could receive input from the object. These ideas are then shared between them in terms of the child asking questions to seek clarifications and the teacher answering the child's questions, giving further guidance, reinforcing, and giving further stimulations through open questions. This teaching can

occur in a play where the teacher observes the child as he/she plays while giving his/her feedback, reinforcement, and providing guidance. Consequently, this study adapted an observation method proposed by Anderson, et al, (1974) called the Teaching Strategies Observation Differential (TSOD). Information about the TSOD will be elaborated in chapter three.

2.2 Play as a Medium of Teaching and Learning

Young children are curiously active and spontaneous in their actions. They have an insatiable need to explore and experiment with objects within their surroundings. Children discover, unify experiences, knowledge and understanding of the world through play (Bruce, 1991; Piaget, 1962). Play is an avenue for learning and an important stimulant for intellectual growth of young children (Read et al.,1993; Seefeldt and Babour, 1994). This implies that play can have a significant role in teaching in ECE.

Vygostky supports this thinking when he asserts:

In play, a child always behaves beyond his average age, above his daily behaviour; in play it is as though he were a bit taller than himself, (Vygotsky, 1978, p. 102).

This statement means that play can stimulate children to think at a higher level. Hence its significance as a medium of teaching mathematics in ECE. However, the extent to which play was used in teaching mathematics concepts in early childhood had

not empirically been established especially in the Kenyan context. This suggested the need for a study to document the use of play in teaching mathematics at the ECE level.

Studies by Moyles (1989) and Seefeldt (1994), indicated that creativity and cognitive development is strongly linked with play processes in children's learning. In a play, children interact with mathematical objects and at the same time challenge one another. In this way, thought processes are facilitated to advance to higher levels. So children become inventive and more capable of approaching challenging tasks with innovative ideas. Teaching mathematics through play is most likely to make learning enjoyable, real, creative and intrinsically motivating. A study by Haywood et al., (1992) indicated that effective learners are more creative and are prepared for challenging activities. Teaching strategies in ECE should tap children's creativity as they engage in their play activities. The extent to which this was done in ECE needed to be established. This study was required to fill this gap.

Through play children learn in a social environment that is fostered by an interdependent mutual relationship between them, other children and adults. A study by Lee (1980), indicated that children seek and structure adult's attention

when they are faced with a challenging task. Adults on the other hand respond to children's demand by giving cues, props, and guidance and extending children's play ideas by altering their play materials. Studies by Seefeldt (1994) and Lee (1980), indicated that infants of mothers who provide adequate stimulation through talking and questioning are more creative and demonstrate reasonable degree of intelligence. Cross-cultural studies indicate that play is a learned behaviour, which is nurtured through adult input (Seefeldt, 1994; Fuglesang, and Chandler, 1990). Teachers can support children's play activities and use them to integrate classroom teaching. This means that play can be a natural strategy for teaching young children's mathematics experiences. However, it was not yet established whether this was the practice in ECE centres in Kenya. This suggested the need for a study in this area.

Studies by NAYEC, (1988) and NCTM, (1989) indicated that children use play to explore, imitate, test and to construct reality from the world around them. Children's actions on play object begin with exploration to try to make meaning out of it. Understanding of the object is followed by the production of a parallel behaviour through imitation. Testing will then follow as a way of predicting the outcome of the behaviour for the purpose of establishing the truth. Finally, the construction stage to try to

put things into relationships. This means that to understand a new concept, children must become aware, explore, inquire, use, and apply. According to Piaget (1962), children compare new experiences with previously acquired mental schemes. Therefore, the need for adequate opportunities for children to interact with mathematical objects in a play. Teaching methods that embrace this mode of learning should create opportunities for new and varied environments to stimulate children's mathematical thought processes. The extent to which this was practised at the ECE centres was an issue of research. Hence, this study.

The role of play in teaching is further supported by the evidence that pre-school children who were permitted to play freely with objects score higher on tests involving alternative use of these objects than children who were not given opportunity (Seefeldt, 1976). Experiment conducted by Brunner reported in Whitebread (1996) showed that children who were given the opportunity to play with objects out performed children who were exposed to the tasks through direct teaching when left alone to tackle problems. Further, results from this experiment indicated that children who had contact with materials through play were more inventive and had very innovative strategies of solving problems (Whitebread, 1996). This means that play stimulates children's thought processes and for this reason can

be a useful medium for teaching mathematical concepts to young children. Vygotsky's theory elaborated earlier in section 2.1 supported this perspective using his idea of zone of proximal development. There was need for teachers in ECE to embrace the use of play in teaching mathematics. This could only be possible through the results of a systematic study to document the value of play in teaching mathematics at the ECE level. This study was intended to carry out this purpose.

Play is linked to intrinsic motivation in children's learning. Studies by Whitebread (1996) and Vygotsky (1978) have established that play enhances children's sense of individuality and self-worth. Play activities have been found to result in concentration, mental effort, motivation and achievement. At play, children have been found to persevere longer in seeking solutions to problems in the tasks they are engaged in (Whitebread, 1996). Bruce (1991) further emphasized that play helps children to develop self-control, self-esteem, self-confidence, autonomy, intrinsic motivation, the desire to take risks and to solve problems and the ability to make decisions and to choose. Study by Haywood et al., (1992), further indicated that children who are effective learners are intrinsically motivated by such tasks as challenge, creativity, opportunities to take responsibility, aesthetic aspects of task involvement, and

the sheer psychological joy of information processing and achievement. This implies that motivated learners are ready to engage in challenging mental activities. There is therefore the need for teachers to use teaching strategies in ECE centres that encourage opportunities that foster development of intrinsic motivation in young children. This will impact upon children's later mathematics learning at higher levels. However, there was need for an empirical evidence to support this issue of teaching in ECE. This was the focus of this study.

Studies done in Kenya by Gakuru (1979) and Swadener, et al., (2000) indicate that the Kenyan society considers children's play to be a waste of learning time. Parents especially those at higher socio-economic status emphasize training in academic skills that will give their child an advantage or an equal chance with other children (Gakuru, 1979). Consequently, the main teaching resources in most pre-school centres in Kenya consist of chalk and blackboard. This means that studies by Gakuru and colleagues have not been influential enough to change teaching in ECE to make it play-oriented.

2.3 Children as Active Recipients and Renovators of Knowledge

Children are active recipients of stimulus as well as active renovators of their world (Anderson, 1957; Read et al., 1993). According to Wadsworth (1978), writing on Piaget's theory, learning is an adaptive process. Weber in Wadsworth (1978), defined adaptation as the ability of the organism to adjust to environmental conditions. That is, any stimulus received by the child from the environment undergoes a dynamic mental process of adaptation. The child will either assimilate the stimulus in its existing mental schemes or modify the stimulus through the mechanism of accommodation into new mental schemes. This means that children are capable mentally of modifying environmental stimulus to fit into their mental processes to add to the existing knowledge or to generate new one. This implies that children themselves are potential resources for learning in ECE. This suggested the need for innovative teaching approach in mathematics that was child centred. This study found that the teaching in ECE was teacher directed using traditional learning resources such as the blackboard and chalk. Hardily were children given the opportunity to participate in actively generating their ideas in learning mathematical concepts play objects.

Children actively construct knowledge as a result of their interaction with the physical and the social environment (Tobin and Tippins, 1993; Wadsworth, 1978). These views of Tobin and Tippins are supported by constructivism psychologists who believe that children come to pre-school with an established world view, formed by years of prior experience and learning which influences their interpretation of the stimulus reaching them from mathematical objects. Teaching with constructivism approach requires a learning environment in which opportunities are available to children to analyze, investigate, collaborate, share, build and generate mathematical ideas based on what they already know, rather than encouraging memorization of facts, skills, and processes. According to this study the learning of mathematical concepts was factual and unrelated to pre-school children's everyday life experiences.

2.4 Role of Social Interaction in Bridging Math Concepts in ECE

According to Kamii (1982), social confrontation among children, teachers and caregivers is indispensable for the development of logico-mathematical knowledge. Clermont (1980), demonstrated the importance of social interaction by conducting experiments with groups of three children each time and proved that the clashes of opinions and efforts to resolve a disagreement during ten minutes can stimulate the preoperational level child to make

new relationships and reason at a higher level than children who did not have such an opportunity. Kamii rightly argued that if one child thinks that $2+4=5$ and another that $2+4=4$, both may correct their reasoning while trying to convince the other that they are right. This means that social transactions reinforce learning through sharing of ideas. Teaching in ECE should adapt a participatory approach to the learning of mathematics. Whether teachers in ECE encouraged active social interaction in learning mathematics or not was an issue to be established through this study.

Ideal situations for the exchange of opinions among preoperational children involve the use of mathematical group games. According to Kamii (1982), in-group games children are motivated to check everybody else's counting and addition, to be able to confront those who cheat or make mistakes. Correcting and being corrected by peers in-group games are far better than what can be learned through worksheets. Group games that can be useful for teaching mathematics in ECE include aiming games, hiding games, races and chasing games, guessing games, board games, and card games.

However, this study established that pre-school teachers prefer very little play activities in teaching mathematical concepts to pre-school children. The responses of pre-school teachers in PTQ regarding their use of games in teaching mathematics were as follows; fishing game (13%), skipping game (6%), skittle game (13), hide and seek game (16%), sand play (4%), water play (2), skipping game (6%) and throwing and catching (2%). These reports indicate inadequate stimulation of mathematical activities through the use of games. In addition, observation records indicate very little game activities being integrated in the teaching of mathematical concepts.

2.5 Challenges of Mathematical Language in teaching in ECE

Study by Kamii (1982), indicated that understanding the relationship between number symbols and the words representing them can be a challenge to young children. For example, words like one, two, three, four and five can mean the same thing to children as names like, Peter, Paul, John, Esther and Margaret and not necessarily the mathematics symbols representing these words. Mathematical vocabularies like take away, subtract, more than, less than, taller, shorter, heavier, smaller, bigger, full, empty, more, length, weight, volume and others can be enhanced in children through play activities (Kamii, 1982). As mentioned in the preoperational stage of

Piaget's theory of cognitive development, children's language development is very rapid and flexible during the early years (Wadsworth, 1978). This means that teaching mathematics through social activities that encourage use of spoken language can help to strengthen the development of mathematical vocabulary in children. The extent to which teachers used this social approach in teaching mathematics in ECE prompted this study.

Language refers to the child's use of symbols (words) to represent mathematical objects (Wadsworth, 1978). In Piaget's view language development is not a prerequisite for cognitive development but its representational use is significant and instrumental in the development of the child's power of thought (Wadsworth, 1978). For example, although the sensorimotor thought period developed prior to language use, the preoperational period is found to be more efficient due to developed language skills in children at this level. In teaching, Piaget recommends that language should be used as a medium of stimulating children's intellectual skills and not as a necessary tool for cognitive development. Teachers who put great emphasis on spoken language may be hindering intellectual processes of the preoperational children. This study established that 64% of the teachers used English language in teaching

mathematics to pre-school children. This seemed to hinder children's willingness to engage in interactive mathematical activities due to their limited English skills.

2.6 The Need for Resources in Teaching Mathematics in ECE

Space is a key teaching issue in ECE. Children require sufficient indoor and outdoor physical space to enable them to actively engage in learning more creatively. Studies in different parts of the world including America, Thailand, Japan, and China indicate that children need at least 2-5 metres square in an indoor space and 5-12 metres square in an outdoor play space (UNESCO, 1984; Jackman, 1997). KIE (1984) recommended a class size of 8 metres by 8 metres or at least 1 metre square for an indoor space and 3 metres square per child for an outdoor play area. Classrooms and settings, which are not designed for discovery, often inhibit young children's explorative use of learning resources. This means that availability of adequate space in both indoor and outdoor play area is essential for effective teaching and learning of children. Whether availability of space was considered an important issue in teaching in ECE was an issue or not to be established in this study. This was the essence of this study.

Mathematical concepts are actively learnt through children's play activities with concrete objects. Children's interaction with play materials enables them to learn such characteristics as colour, weight and size (Jackman, 1997). Play materials such as blocks, seeds, toys, tins, sand, and water can help focus children's mathematical ideas. This means that pre-schools should foster a variety of stimulating resources for the development of mathematical skills in young children. Teaching in ECE should be based on children's active involvement in play materials. The extent to which this was practiced in ECE teaching needed to be established. This study intended to do just that.

2.7 Developing Children's Mathematical Thought Processes

Children's understanding of mathematical objects, events and actions can be empirical or reflective. Empirical abstraction means focusing on certain property of the object and ignoring others (Kamii, 1982; Hohn, 1995). For example, a preoperational child who abstracts on the colour of the object simply ignores other properties such as weight and shape. Reflective abstraction in contrast is the construction of relationships between objects. According to Kamii (1982) and Wadsworth (1978), mathematical relationships between objects are creation of the mind and not an external copy of reality. Piaget rightly

argues in support of these ideas in his concept of logico - mathematical knowledge discussed in section 2.1. Children must successfully pass through the empirical abstraction stage of thinking in readiness for the mental manipulations of objects required at the reflective level. This means that pre-school teachers should be aware of these levels of learning of preoperational children.

Related to empirical and reflective thinking is young children's inability to conceptualize spatial relationships. Children who have difficulty in perceiving spatial relationships are deceived by objects arrangements in space. For example, these children consider objects that are spread in space as more than those that occupy a smaller area even though they are numerically the same. These children are also said to be illogical because they are unable to check their answers by counting the objects (Kamii, 1982). This means that children need opportunities to clarify, check and confirm their decisions about number activities. This can only be practised in ECE classrooms where teachers are keen observers of children's practical activities with mathematical objects. Through continuous observation, alert teachers can infer whether the child is approaching a mathematical problem intuitively, spatially or logically and intervene to influence the child's process of thinking instead of

responding to the answer. The extent to which teaching methods in ECE were focused to the development of spatial relationships in mathematics was established through this research.

2.8 Contextualizing the Teaching of ECE Mathematics

Mathematical concepts can be taught to young children in a context that makes meaning to them. For example, an activity such as cooking can be a rich source of learning number, and measurements (Donaldson, 1996; Whitebread, 1996; Bruce, 1991; Lee, 1980). Whitebread rightly emphasized in this quotation;

Unless they can incorporate the new idea into their existing view of mathematics – schema, and hence make sense of it, children are very unlikely to take it on board (Whitebread, 1996:36).

This means that the teaching of mathematics in ECE should relate to the children's experiences and knowledge. That is, the need to contextualise the teaching of mathematics in ECE centres to make it relevant to the daily life of children. In this way, concepts learnt in mathematics can have a direct impact on the practical daily activities of children. There was need for a study to harmonize the teaching methods in ECE.

Mathematical concepts can effectively be taught to children using thematic activities based on children's experiences. Studies by Hohn, (1995), Kamii, (1982) and Lee, (1980), indicated that in informal out-of-school settings, children's mathematics knowledge is significantly superior. For example, when selling items at a market stall, children are capable of constructing their own strategies for counting including the use their fingers and toes to help them work out the sums of quantities. The children have also been found to use other strategies of counting including chunking methods (Lee, 1980). Whitebread has rightfully argued in this quotation:

Mathematics without a context is not only dry for young children, but also harder to visualize and hence harder to engage with (Whitebread, 1996:37).

This means that mathematics concepts taught to children should be practical and directly linked to their daily life experiences both at home and at school. The use of themes like the market, the family, farm animals, water and sand play can be useful in introducing mathematical activities to young children. The extent to which this was practised in ECE was addressed by this study.

2.9 Factors Influencing Classroom Teaching in ECE

Study by Gakuru (1979), indicated that early childhood centres in Nairobi can be categorized by management as either private or public pre-schools. In Nairobi, private individuals and organizations including the churches manage private pre-schools. This study found out that private individuals manage 95% of the pre-schools in Kasarani Division. The public schools categories fall under the management of the Nairobi City Council and include day nurseries, institutional pre-schools and pre-primary classes attached to city council primary schools. These two categories of early childhood centres present varied learning environments to children. Most pre-schools in these categories are organized formally like primary schools. The private pre-schools are classified as low, medium and high-cost depending on the location and the socio-economic status of the community. Efforts to translate the ECE curriculum to child centred learning in these varied environments were found to be challenging. This study established that pre-school centres teach mathematics using standard one and two textbooks.

✱ Training, in addition to improving teacher's ability to plan classroom teaching effectively, has also been found to enhance teacher's use of appropriate child centred teaching methods in ECE. A Study of pre-schools in Nairobi by Gakuru (1979)

showed that trained teachers had prepared lesson plans, schemes of work and teaching materials for children. This is further supported by studies by Moyles (1989) and David (1993), which showed that trained teachers besides being knowledgeable in child development also demonstrate understanding of how children develop concepts at the early childhood level. However, this study showed that only 10% of the teachers in Kasarani Division used play-teaching strategies in teaching mathematics skills to pre-school children despite their training in child development.

A Study by Moyles and Adams (2000), indicated that teachers working in ECE should have sufficient academic background to give them the intellectual and personal moral strength to articulate issues related to their profession. In Kenya, the minimum academic requirement to train as a pre-school teacher is a KCPE certificate or a grade D in KCSE (Gakuru, 1979). The cadres of teachers who join ECE are rated by the society as low-level academically because the profession is not expected to require highly qualified people. The impact of low academic level of teachers to teaching methods in ECE prompted this study.

Study by Gakuru (1979), shows that teacher-pupils ratios in pre-schools in Nairobi are very low. However, this study showed that in Kasarani Division the number of pre-school children per teacher ranged from fifteen to thirty. Although the study found that large classrooms encouraged teachers to support children's use of play objects such as plasticine, pre-school teachers continued to use direct method (58%) even in small classes. This means that the quality of teacher child interaction in most pre-school classrooms is very low. In developed countries studies indicate a high teacher child ratio of 1: 10 in pre-school classroom of children aged three to seven years (Moyle, 2000). This will ensure that there is high quality of interactions between teachers and the children. In Kasarani Division, the issue is not large numbers of children but teachers' inability to translate their training skills effectively.

2.10 Conceptual Framework

Poor performance in mathematics at all levels of education has continued to be reflected in national examination results despite numerous efforts made to address the problem. Different scholars have suggested various possible causes affecting the learning of mathematics at primary, secondary and other higher levels of education. At the ECE level, the use of play teaching strategies in teaching mathematics is inadequate. This has been

necessitated by teacher's inability to contextualize mathematics teaching, inadequate use of learning resources, examination-driven society, inadequate training of teachers, inadequate classroom and outdoor space, high children-teacher ratios, inadequate supervision of mathematics teaching at the ECE centres and poor management of pre-schools among others causes. These causes require a number of intervention measures for rectification. These intervention measures together with the possible impacts of the study are conceptually presented in figure 2.2.

Figure 2. 2 Conceptual framework

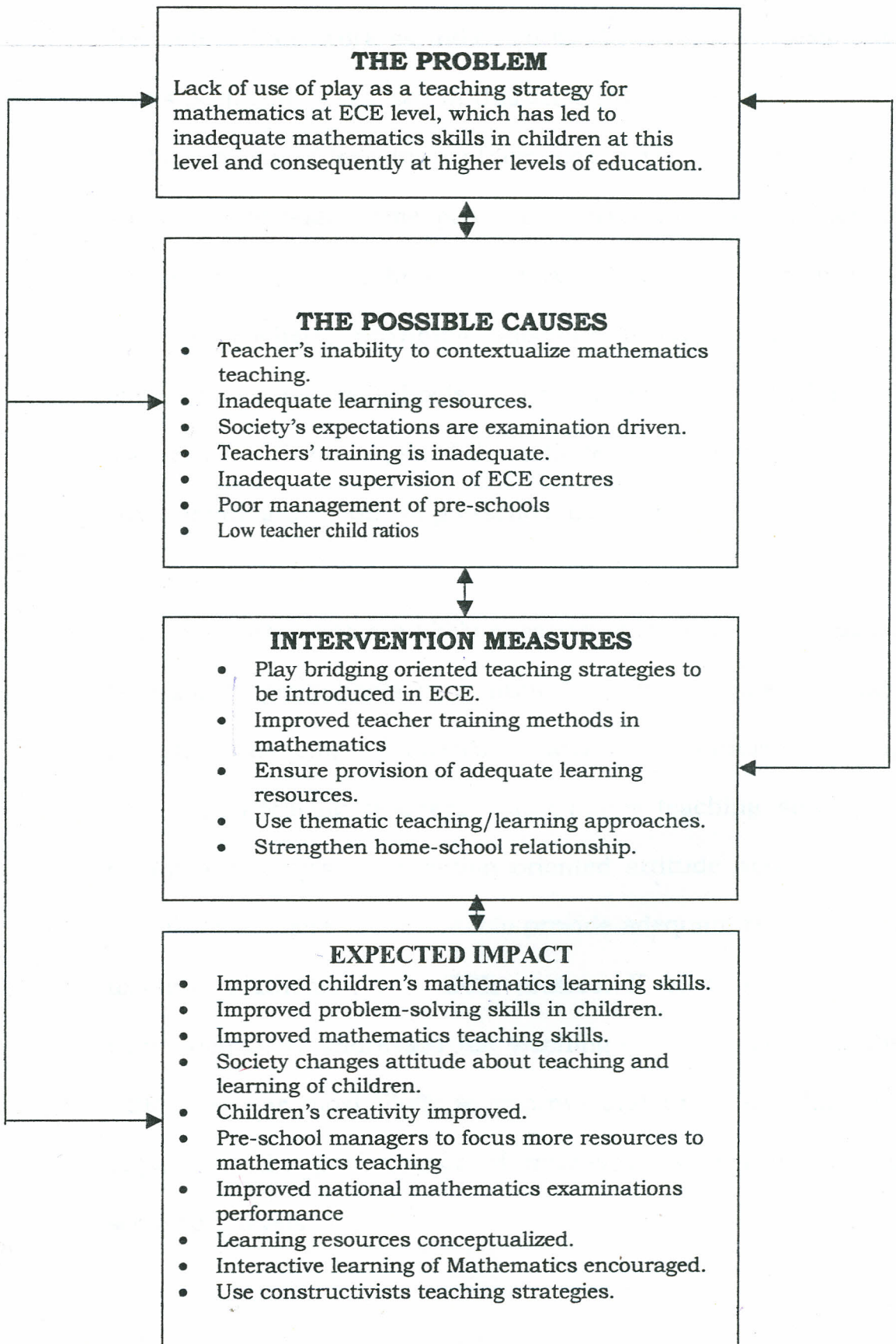


Figure 2.2 shows the interrelationships of the factors of the conceptual framework as indicated by the arrows. For example, it has been conceptualized in this study that the possible causes of the problem of learning mathematics at the ECE level can be addressed through some possible interventions which include the use of play in teaching mathematics, improving the training of ECE teachers, providing adequate teaching material for mathematics in pre-schools, contextualising the teaching of mathematics through use of thematic teaching approaches, and strengthening the skills of pre-school managers.

The above measures are likely expected to improve mathematics learning in pre-schools in a number of ways some of which include enhancing children's creative and problem solving abilities, improving teachers mathematics teaching strategies, changing society's examination oriented attitude and ensuring that the managers of pre-schools provide adequate resources for teaching mathematics in ECE centres. If these interventions were adequately addressed the teaching of mathematics at the ECE level was most likely to improve and this could have an impact on the performance of mathematics at primary and secondary levels.

2.11 Research Hypotheses

From the literature review and the conceptual framework, the following research hypotheses were formulated to guide the process of data collection and testing.

- H₀₁. There is no significant relationship between teacher's use of play bridging teaching strategy in teaching mathematics in pre-schools and children play activities.
- H₀₂. There is no significant relationship between teacher's use of play bridging teaching strategy in teaching mathematics in pre-schools and the use of thematic play activities.
- H₀₃. There is no significant relationship between teacher's use of play bridging teaching strategy in teaching mathematics in pre-schools and the teachers' use of play objects/materials.
- H₀₄. There is no significant relationship between teacher's use of play bridging teaching strategy in teaching mathematics in pre-schools and the teacher's experience.
- H₀₅. There is no significant relationship between teacher's use of play bridging teaching strategy in teaching mathematics in pre-schools and the size of classrooms.
- H₀₆. There is no significant relationship between teacher's use of play bridging teaching strategy in teaching mathematics in pre-schools and the number of children in pre-school classrooms.
- H₀₇. There is no significant difference between teacher's use of play bridging teaching strategy in teaching mathematics in pre-schools and the training levels of pre-school teachers.
- H₀₈. There is no significant difference between teacher's use of play bridging teaching strategy in teaching mathematics in pre-schools and teachers' academic levels

2.12 Chapter Summary

This chapter has reviewed literature related to the theories relevant to this study. In addition, studies that have been reviewed show that the importances of play teaching strategies foster learning of mathematics through social interaction. The chapter has also reviewed studies that document the significance of play in stimulating the development of creativity and problem-solving skills in children, which are essential skills for mathematics learning. The chapter ends with the conceptual framework and research hypotheses.

3.0 Introduction

This chapter discusses the main methodology of the study. The chapter begins by a description of the design of the study followed by the population and sampling procedure and lastly a description of the main variables of the study.

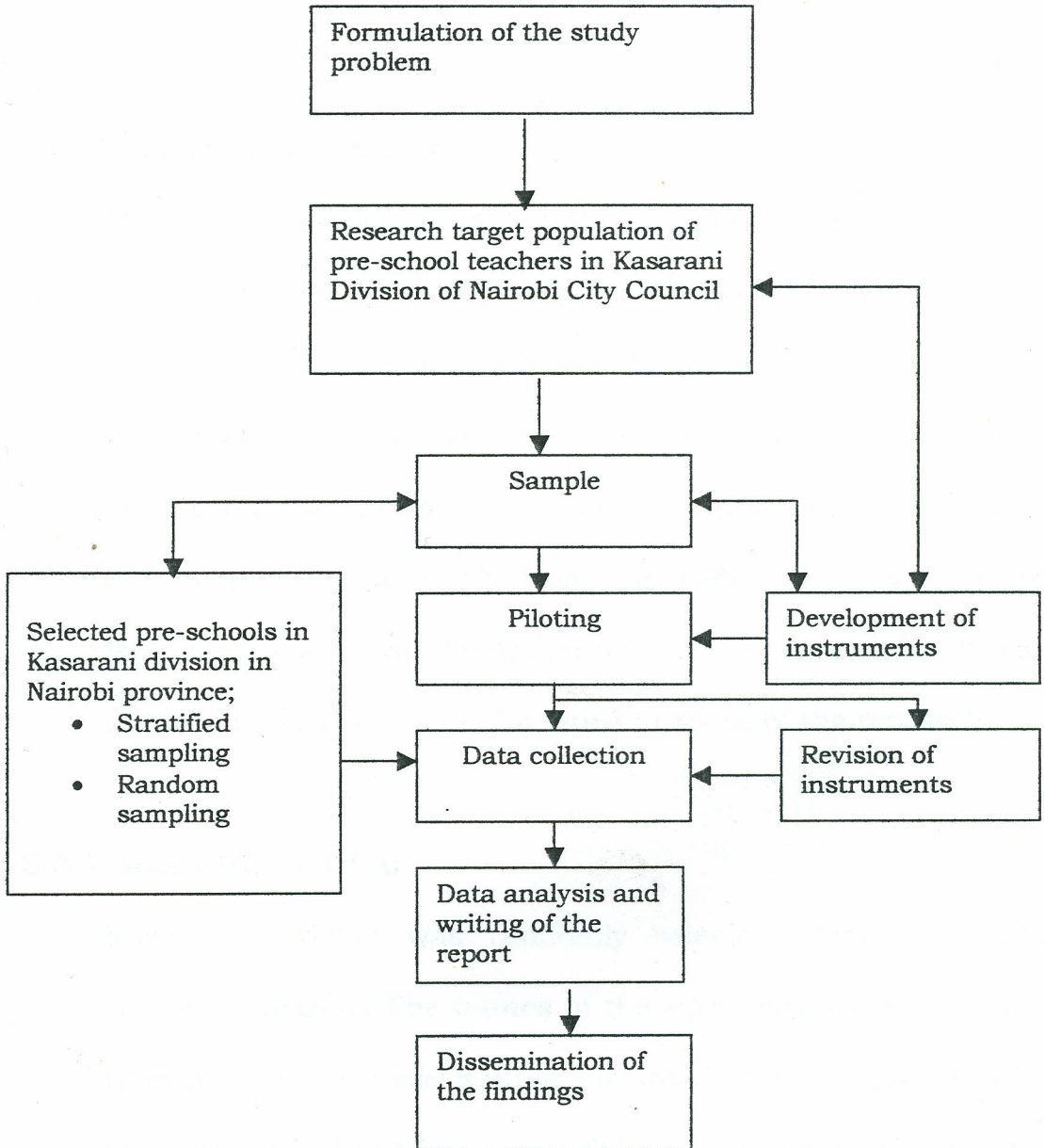
3.1 Design of the Study

The study design selected was an ex post – facto research descriptive survey. An ex post – facto research was suitable because the researcher did not have direct control of independent variables as their manifestations had already occurred. In this design, the researcher would observe play-teaching strategies of pre-school teachers in relation to the various independent variables identified in the study and would be able to establish their relationships. Ex post – facto research design is useful because it allows the researcher to carry out comparison between variables without having to manipulate the independent variables.

The study was designed to be in four phases: Phase I was proposal writing, and development of instruments. Phase II was piloting and validation of the instrument. Data collection was to form Phase III of the study in the sampled pre-schools. Phase IV

involved data analysis leading to the conclusions and recommendations. Figure 3.1 below showed the summary of the design.

Figure 3. 1 Summary of study design



Adapted from Cohen and Manion (1994:89)

3.2 Target Population

This study targeted a population of 184 pre-school teachers teaching in Kasarani division in Nairobi Province. The sample of teachers to participate in the study was selected from this number of teachers.

3.3 Location of the Study

The study was located in Nairobi Province in Kasarani Division. Nairobi Province was purposely sampled because of its advanced early childhood activities when compared to rural communities. This made it convenient for the researcher to obtain an appropriate sample for the study. As regards Kasarani Division, it was selected randomly from the eight divisions of Nairobi Province because the researcher felt that any one of the divisions in Nairobi could serve the intended purpose of the research.

3.3.1 Kasarani Division

Kasarani Division was randomly selected using the Lottery sampling method. The names of the eight education divisions of Nairobi Province were written on small pieces of paper, which were folded and put into a tin. The tin was vigorously shaken to mix the content. The researcher closed his eyes, dipped his hand in the tin and picked one of the pieces of paper that happened to bear the name of Kasarani Division.

3.3.2 The Study Area

The division encompassed Mathare and Korogocho slums, Zimmerman, Kahawa West and part of Githurai estates. Consequently, over 50% (Education office report) of the inhabitants live under severe poverty. Kasarani Division comprises Ruaraka and Kahawa educational zones. The Division was headed by an education advisor assisted by two education officers, two advisory center teachers (TAC) and one DICECE officer. The Division had 184 preschools, 25 city council primary schools and 20 private primary schools. There were at least three public secondary schools and a number of private secondary schools.

3.4 Sample Size

A sample size of 132 teachers was sampled from a population of 184 teachers to complete the survey questionnaires. This sample was arrived at using the sampling table developed by Peter, (1994:76). After obtaining the population frame, pre-school teachers were stratified into untrained and trained. The lists of the pre-school teachers were entered in the computer spreadsheet and using the S- Plus statistical package, random numbers were generated for the teachers. This random numbers were used to select the sample of teachers.

Stratified sampling was used to select the categories of trained and untrained pre-school teachers in public and private pre-schools. Random sampling followed this to select preschool teachers needed for the study. This ensures that pre-school teachers selected for the study are fairly distributed (Kerlinger, 1996; Cohen and Manion, 1989). In this study, suitable samples were selected using the Lottery random sampling method and by the use of tables of random numbers (Malim, and Birch, 1997). The sample distribution is presented in table 3.1.

Table 3.1 Distribution of the sampled pre-school teachers for the survey

Population and sample			Actual questionnaires returned		
Type of management	No. of teachers	Initial Sample	No. Trained	No. Untrained	Total
Private	159	107	90	6	96
Public	25	25	5	0	5
Total	184	132	95	6	101

In table 3.1 it should be noted that initially a sample of 132 preschool teachers was envisaged. However, due to inaccessibility of some slum preschools, the researcher was not able to get questionnaires from all the sampled preschool teachers. As a result only 101 questionnaires were finally received for the actual data analysis.

In addition to the survey sample, a further sample size of 31 pre-school teachers for the observational study was randomly sampled from untrained and trained teachers strata. This

management. Observations were used to crosscheck data from Questionnaires.

(b) Observation Checklists (Appendix B)

Observation checklists were used in observing teacher – child, child-to-child and child – objects interaction in a pre-school learning environment. Observation checklist was adapted from the teaching strategies observation differential (TSOD) developed by Anderson, James and Struthers, (1974). This was an example of a an instrument that was designed to provide a measure of the overall teaching strategy used by a teacher in an interactive classroom environment between children and play materials and the teacher.

(c) Explanation of the Teaching Strategies Observation Differential (TSOD) Record Sheet

The teaching strategies used by the teacher are recorded after every one-minute interval. At the end of each one-minute interval, the observer records a rating for that interval by circling the appropriate rating on the ten-point scale shown in table 3.4 below. The teaching strategies targeted have been rated numerically form one to ten (1-10). For example, if the teacher lectures for one minute, the numeral one is circled and if the children are playing with objects freely, it is rated ten. If for half a minute he/she is asking questions requiring specific answers, the numeral two is circled. The doodle space provided in

observation record sheet is used for this working. A segment of the observation record sheet is reproduced below:

Table 3.3 ten-minute observation record sheet

Interval (One minute)	Doodle Space	Rating
1		1 2 3 4 5 6 7 8 9 10
2		1 2 3 4 5 6 7 8 9 10
3		1 2 3 4 5 6 7 8 9 10
4		1 2 3 4 5 6 7 8 9 10
5		1 2 3 4 5 6 7 8 9 10
6		1 2 3 4 5 6 7 8 9 10
7		1 2 3 4 5 6 7 8 9 10
8		1 2 3 4 5 6 7 8 9 10
9		1 2 3 4 5 6 7 8 9 10
10		1 2 3 4 5 6 7 8 9 10

The ten-minute observation record sheet in tale 3.3 consisted of ratings of classroom teacher's behaviours. Table 3.4 below shows the rating of each teacher teaching behaviour (strategy) and the teaching behaviours each represented. The ratings were grouped into two categories according to the teaching strategy they represented. For example, direct teaching strategy was represented by half of the ratings from 1-5. The remaining categories 6-10 represented play bridging teaching strategy. Direct teaching strategy included teacher's teaching behaviours such as giving facts, directing opinion, asking limiting questions, doing demonstrations and giving children exercises. Whereas play-bridging strategy included teacher's teaching behaviours such as teacher's questions, teacher's response, teacher's guidance, teacher's structured investigations, and children's

structured investigations. Tables 3.4 below illustrate these explanations.

Table 3.4 showing the teacher's teaching behaviour and their ratings

Teaching strategies	Ratings of teaching behaviours	Teacher's behaviours
Direct teaching	1	Facts
	2	Directing children's work
	3	Limiting questions
	4	Demonstrations
	5	Children exercises
Direct teaching	6	Teacher's questions
	7	Teacher's response
	8	Teacher's guidance
	9	Teacher's structured investigations
	10	Children's structured investigations

3.5.1 Time Unit Sampling for the Observations

Observations were made for ten-minutes interval followed by five-minute break and another observation of ten minutes. This meant that two observations were done in one thirty-minute pre-school lesson.

The focus of the observations could shift between the teacher and selected children. For example, if the children were working independently in individual tasks or in small groups, the observer shifts his observation to six randomly selected children, each of the six children was observed for one minute in randomly selected order. The observation pattern would keep repeating as long as a particular type of activity continues. The

instrument could successfully be used with video tape recordings if available.

3.6 Piloting of the Research Instruments

The pilot study was conducted in some sampled pre-schools in Ruiru area. 30 teachers were sampled to complete the questionnaire and 12 of them were observed. The data collected were analyzed and the results were found to be consistent with the study. However, some refining was done to the questionnaire and the observation record sheet. The piloting also enabled the researcher to practise with the observation record sheet.

3.7 Validity and Reliability

3.7.1 Validity

Through the training and practise, two observers used the same observation instrument in different pre-schools during piloting and their results correlated. A positive correlation of 0.84 indicated a strong validity of the observation checklists.

3.7.2 Reliability

(a) Split – half test was done to establish the correlation of the scores recorded in the observation during piloting (Malim, et al., 1997). Twelve preschool teachers selected for piloting were divided into two categories. Teachers bearing the odd numbers formed one group of observation and the other group of teachers was formed from even numbers. A correlation of 0.83 was found

indicating a strong consistency of the observation. The correlation was calculated using the Spearman - Brown proficiency formula (Satterly, 1981).

$$r_{ft} = \frac{2r_{\frac{1}{2}t}}{1 + r_{\frac{1}{2}t}}$$

Where r_{ft} and $\frac{1}{2}t$ stand for full test and half - test respectively.

(b) The Internal Consistency Technique

The internal consistency of the data was determined using the Kunder-Richardson (K-R) 20 formulas stated below:

$$KR_{20} = \frac{(K) S^2 - \sum s^2}{(S^2) (K - 1)}$$

Where:

KR_{20} = Reliability coefficient of internal consistency

S^2 = Variance of all scores

K = Number of items used to measure the concept

s^2 = Variance of individual items

(Mugenda and Mugenda, 1999)

The coefficient was high implying that the items correlated highly among themselves indicating consistency among the items in measuring the concept.

3.8 Administration of the Research Instruments

The responses of both the pupils and the teacher were recorded three times in every pre-school visited. One observation during

the indoor free choice activity, one during mathematics activity lesson and one in the outdoor free play. Each activity was observed for twenty minutes with a break of five minutes between each ten-minute observation. In addition, each teacher in the sampled pre-schools filled one questionnaire. The researcher visited all the Preschools physically and issued the teachers with the questionnaires. However, the researcher observed only 31 preschools. Teachers were given 45 minutes to complete the questionnaire.

3.9 Variables

The following were the main variables that were used in the study.

3.9.1 Dependent Variables

Play bridging teaching strategies: These were the average frequencies of teacher's use of teaching strategies such as responding to children, providing guidance, asking open questions, structuring the play activities, and children structured play activities.

3.9.2 Independent Variables

- Pre-school teachers experience
- Pre-school teachers training levels
- Number of children in a class
- Use of thematic play activities
- Mathematical objects/ materials

- Pre-school teacher's academic level

3.10 Ethical Considerations

A permit to conduct the study was obtained from the Permanent Secretary in the Ministry of Education Science and Technology. Further permission was sought from the Director of City Education and the Nairobi Provincial Commissioner. At the divisional level, the researcher obtained permission from the Education Advisor and Kasarani Divisional Officer. The heads of schools and managers were contacted before the teachers were observed and given questionnaires. The purpose of the research was explained thoroughly to the head teachers, managers and teachers. The consent of the respondents especially the pre-school teachers was sought before they were engaged in the study. Hence, the respondents were assured of the confidentiality of the research results.

3.11 Chapter Summary

This chapter has explained in detail the study design and the rationale for the selection of the instruments used. The independent and the dependent variables have been identified and the various methods of data analysis have been identified. The chapter concludes with the ethical considerations in the study.

DATA COLLECTION, ANALYSIS, RESULTS AND DISCUSSIONS

4.0 Introduction

The objective of this study was to find out the extent to which play was used in teaching mathematics in pre-schools. This chapter presents in detail the results and discussions of the results of the study from descriptive and differential statistics. But first the methods of data collection and analysis are discussed.

4.1 Data Collection Procedures

Preschool teachers responses were collection-using questionnaires. The actual number of preschools teachers who filled and returned the questionnaires was 101. Observations of preschool teachers teaching strategies, teaching materials were carried out on 31 teachers.

4.2 Methods of Data Analysis

Descriptive and inferential statistical methods were used to analyse data in this study. Data were systematically coded and organized to facilitate analysis. In descriptive statistics, frequencies and percentages were used to present data from various variables. These included responses of pre-school teachers regarding their academic qualifications, years of experience, use of mathematical objects, training levels, classroom sizes, number of children and their play teaching strategies. These data were then presented for descriptive purposes to explain the various themes of the study.

In inferential data analysis, the study used two main hypothesis testing techniques. These were the Pearson moment correlation (r) analysis technique to test relationships among the variables in hypothesis one to six (H_{01} - H_{06}). One - way Analysis of Variance (ANOVA) to test the differences between variables in hypothesis seven to eight (H_{07} - H_{08}). All hypotheses were tested at alpha significance level of 0.05 ($\alpha = 0.05$). The probability values of the critical t and F values were determined using the SPSS Package. The critical t - value was used to accept or reject the null (H_0) hypothesis at a significant alpha (α) value of 0.05. Presented below are the statistical hypotheses and their corresponding techniques of analysis.

- H₀1. Pearson moment correlation formula was used to test the statistical hypothesis: There is no significant correlation between the frequencies of teacher's use of play bridging teaching strategies in teaching mathematics in pre-schools and the frequencies of children's play activities.
- H₀2. Pearson moment correlation formula was used to test the statistical hypothesis: There is no significant correlation between the frequencies of teacher's use of play bridging teaching strategies in teaching mathematics in pre-schools and the frequencies of use of thematic play activities.
- H₀3. Pearson moment correlation formula was used to test the statistical hypothesis: There is no significant correlation between the frequencies of teacher's use of play bridging teaching strategies in teaching mathematics in pre-schools and the teachers' use of play objects/materials.
- H₀4. Pearson moment correlation formula was used to test the statistical hypothesis: There is no significant correlation between the frequencies of teacher's use of play bridging teaching strategies in teaching mathematics in pre-schools and the frequencies of teacher's experience.
- H₀5. Pearson moment correlation formula was used to test the statistical hypothesis: There is no significant correlation between the frequencies of teacher's use of play bridging teaching strategies in teaching mathematics in pre-schools and the frequencies of the sizes of classrooms.
- H₀6. Pearson moment correlation formula was used to test the statistical hypothesis: There is no significant correlation between the frequencies of teacher's use of play bridging teaching strategies in teaching mathematics in pre-schools and the frequencies of the number of children in pre-school classrooms.
- H₀7. One - way ANOVA was used to test the statistical hypothesis: There is no significant difference between frequencies of teacher's use of play bridging teaching strategies in teaching mathematics in pre-schools and the frequencies of training levels of pre-school teachers.
- H₀8. One - way ANOVA was used to test the statistical hypothesis: There is no significant difference between frequencies of teacher's use of play bridging teaching

4.3 Results and Discussions

In this section, the results of the study are presented using both descriptive and inferential statistics thematically. This are followed with discussions of the findings. But first descriptive statistics are presented.

4.4 Descriptive Statistics

This section discusses preschool teachers responses to various questions presented to them by the researcher using descriptive statistics.

4.4.1 Play as a Teaching Strategy for Pre-School Mathematics

The use of play as a medium for bridging mathematics experiences in pre-schools was observed in 31 pre-school teachers using the teaching strategies observation differential (TSOD) observation schedule. One pre-school teacher was observed three times and this brought the total number of observations to ninety-three (N=93). The results of the observation are shown in table 4.1.

Table 4.1 Pre-school teachers' use of play in teaching mathematics

Teaching strategies	TSOD	No of observations	Percentage
Direct teaching strategies	Directing opinion	15	16.1%
	Closed questions	18	19.4%
	Demonstrations	3	3.2%
	Exercises	18	19.4%
Play bridging strategies	Teacher structured activities	9	10%
	Child structured activities	30	32%

The teaching strategies observation differential (TSOD) indicated that pre-school teachers used only 10% of their teaching strategies to bridge mathematics concepts during children's play activities. Most children's play activities (32%) in indoors and outdoors were not structured by the teachers to stimulate mathematical concepts to children. This meant that pre-school teachers did not regard children's play ideas as important in stimulating learning. As a result knowledge constructed by the children from play objects is not used to stimulate pre-school children's mathematical knowledge. This is against ideas of constructivism approaches to teaching, which embrace interactive learning between children, teachers and mathematical play objects.

4.4.2 Use of Play Activities in Teaching Mathematics

When pre-school teachers were asked the question, which children's play activities they used in bridging mathematics, their responses were as shown in the table 4.2 below;

Table 4.2 Pre-school teachers use of play activities in teaching mathematics

Play activities	No. of teachers	Percentage out of 101
Home corner	28	27.7%
Water play	51	50.5%
Sand play	48	47.5%
Brick piling	50	49.5%
Dressing up	24	23.8%
Sewing	8	7.9%
Cooking	12	11.9%
Playground games	47	46%
Construction	69	68%

The PTQ results (N=101) suggested that the most frequently used play activities were construction 68%, water 50.5%, sand play 47.5%, brick play 49.5% and playground games 46%. However, these results did not agree with actual observations of play activities available in pre-schools. Observation records showed very insignificant use of play activities in pre-schools. If teachers were practical then activities such as home corner, cooking and dressing up which do not require much resource would have been used more than any of those activities they have mentioned. Observations indicated that sand is used only in very few schools. In most pre-schools children use plasticine for making shapes, letters and numbers. This therefore rules out

the use of water activities even though pre-school teachers said they use them.

4.4.3 Use of Thematic Play Activities in Teaching Mathematics

Pre-school teachers' responses from PTQ regarding their use of thematic activities in teaching mathematics (N=101) were as shown in table 4.3.

Table 4.3 Use of thematic activities

Thematic activities	No. of teachers using thematic activities	Percentage (Out of 101)
Creative corner	55	54.5
Block area	28	27.7
Shop corner	70	69.3
House hold corner	32	31.7
Nature centre	36	35.6
Books corner	10	9.9
Music corner	2	2.0
Animals corner	2	2.0

The results from the table show that thematic activities used by teachers to bridge mathematical concepts to children are mostly shop corner 69.3%, creative corner 54.5%, nature corner 35.6%, and household corner 31.7%. However, results from the observations (n=93) were not in agreement with what the pre-school teachers reported in table 4.3. The observation results from TSOD are shown in table 4.4.

Table 4.4 Thematic centers observed in the pre-schools

Thematic activities	No. of teachers observed	No. of pre-schools with Thematic learning centres	Percentages
Construction activities	31	None	0%
Sand play	31	3	10%
Water play area	31	None	0%
Household corner	31	None	0%
Shop corner	31	3	10%
Cooking corner	31	None	0%
Block play	31	None	0%
Creative area	31	2	7%

The TSOD reported very few thematic activities used by pre-school teachers (sand play 10%, shop corner 10% and creative 7%). However, teachers' own reports in table 4.2 indicated that construction was used in 68% and sand play in 48 of the schools.

Further responses of the pre-school teachers (N=101) regarding their use of thematic approach in teaching mathematics in pre-schools remained very inconsistent. The table below shows the teachers' views on their use of thematic teaching approach in teaching mathematics as reported in PTQ as reported in table 4.5

Table 4.5 Teaching approaches

Teaching approaches	No of teachers	Percentage
Thematic	72	73.5%
Montessori	4	4.1%
Play	1	1.0%
DICECE	21	21.4%

From table 4.5, 74% of teachers interviewed showed they were using thematic approach in teaching mathematics in ECE. When asked to recommend the best method of teaching mathematics 52% of pre-school teachers indicated their support for thematic approach. In another question, 77% of pre-school teachers indicated they are comfortable with thematic approach in teaching mathematics. But observation results indicate that only 3.4% of pre-school teachers observed have thematic lesson plans. There appears to be a mismatch between what pre-school teachers say they do and what they practise in their teaching methods.

There was also the question of the time taken by children in thematic play activities during mathematics lessons. When the pre-school teachers (N=101) were asked to indicate the time children spend in thematic learning centres, their responses were as shown in table 4.6 below:

Table 4.6 Time spent by a child in a thematic corner

Time spent in a centre	No of teachers	Percentages
10 minutes	48	52.7%
15 minutes	1	1.1%
20 minutes	29	31.9%
30 minutes	12	13.2%
40 minutes	1	1.1%

Table 4.6 shows that teachers allocated 10 – 20 minutes in thematic play activities. In another question, 69% of pre-school teachers said 10 minutes were adequate for a child to be in a thematic learning centre. Does this time justify the 73.5% teachers' response in support for thematic teaching approach? In practice, the children in the learning centres should use as much time available in thematic play activities. Children require unlimited time to manipulate, explore and discover the properties of a play object. Thus, when teachers said they used thematic approach and at the same time allocated a third of the time to thematic corners of interest then there appear to be some inconsistency. Consequently, it is not logically possible to conclude that teachers actually used thematic approach in teaching mathematics in ECE.

4.4.4 Use of Mathematical Play Objects

Teachers reported use of mathematical play objects was also inconsistent with observation results. Pre-school teachers' responses based on the PTQ are shown in table 4.7.

Table 4.7 Pre-school teachers' use of mathematical objects

Materials	No. of schools	% Out Of 101
Beads	61	60%
Boxes	47	46.5%
Buckets	28	27.7%
Scoops	11	10.9%
Sieves	10	9.9%
Funnels	18	17.8%
Tins	49	48.5%
Dice	39	6.6%
Playing cards	62	61.4%
Flash cards	81	80.2%
Seeds	85	84.2%
Blocks	74	73.3%
Bottle tops	98	97%
Small stones	11	10.9%
Leaves	4	4%
Charts	5	5%
Bricks	42	41.6%
Sticks	88	87.1%

Table 4.7 shows that pre-school teachers used bottle tops (97%), sticks (87%), seeds (84.2%), Flashcards (80.2%), Blocks (73.3%) and to some extent playing cards (61.4%) and beads (60%). However, saying you use the material might be different from actual practice. Table 4.8 presents observation results of 31 randomly sampled pre-school teachers.

Table 4.8 Observed uses of mathematical objects in pre-schools.

Learning resource	No. Pre-schools	Percentage of use
Blackboard	30	98.7%
Chalk	30	98.7%
Furniture	1	3.2%
Books	30	98.7%
Maize Cobs	2	6.5%
Pencils	30	98.3%
Charts	5	16%
Bottle tops	8	25.8%
Plasticine	28	89.6%
Rulers	1	3.2%
Straws	1	3.2%
Blocks	2	6.5%
Sticks	1	3.2%
Seeds	2	6.5%

The observed results indicated that most pre-schools used blackboard (98.7%), chalk (98.7%), exercise books (98.7%), pencils (98.3%) and plasticine (89.6%). The observations like the PTQ also indicated the use of bottle tops, sticks and seeds. However, unlike the PTQ, observation results indicated that these materials although present in many schools were rarely used in teaching mathematics.

Observations further reveal that the teaching in pre-schools was highly academic. Emphasis was on written homework (93.3%) and marking (96.8%). Thematic lesson plan was only observed in 3.4% of the teachers. The emphasis on use of exercises and homework affected teachers' creative use of materials in

introducing varied mathematical concepts and skills to young children.

4.4.5 Conceptualization of Mathematical Concepts

Pre-school teachers were asked to indicate mathematical concepts they teach to children in pre-schools. The table below shows mathematical concepts taught in schools by pre-school teachers.

Table 4.9 Mathematical concepts emphasized in preschools

Skills/concepts	No. of teachers	Percentage of emphasis out 101 responses
Size	51	50.5%
Length	44	43.6%
Weight	42	41.6%
Volume	36	35.6%
One-one correspondence	35	34.7%
Ordering	68	67.3%
Flotation	35	24.8%
Matching	79	78.2%
Time	52	51.2%
Area	37	36.6%
Number recognition	89	88.1%
Number counting	93	92.1%
Addition	68	67.3%
Subtraction	52	51.5%
Multiplication	12	11.9%
Division	8	7.9%
Shapes	78	72.3%

Table 4.10 shows that the main concepts/skills emphasized in pre-schools were number counting (92.1%), number recognition (88.1%), shapes (72.3%), matching (78.2%), ordering (67.3%), addition (67.3%), subtraction (51.5%) and size (50.5%). This was typical of mathematical activities in most pre-schools. However,

the concern was the strategies used by teachers to teach these concepts. Results from TSOD indicated that 58% of the teaching strategies used by teachers in the 31 schools observed were direct teaching. As indicated in table 4.10, the emphasis on number operations of addition and subtraction was quite significant. Although pre-school teachers indicated in the questionnaires that they teach a variety of mathematics skills to children, observation showed that most of the time the emphasis was on addition and subtraction.

Actual classroom observations revealed that even though the ECD classes were divided into nursery and pre-unit, the mathematical skills taught to the two groups of children were similar. For example, at nursery level, the type of mathematical concepts observed were as shown below:

$$5 + 4 =, 3 + \square = 4 \text{ and}$$

$$\begin{array}{r} 5 \\ + 5 \\ \hline \end{array}$$

In pre-unit the operations remain the same, however the magnitude of number increase as shown below;

$$13 + 9, 16 + \square = 24,$$

$$\begin{array}{r} 20 \\ + 25 \\ \hline \end{array} \quad \begin{array}{r} 30 \\ + 20 \\ \hline \end{array} \quad \text{and}$$

$$60 - 20$$

The skills were basically those taught using Primary Mathematics Pupils Book Two (MoE, 1981). Are these children going to learn the same concepts in primary? What will be the effect of repeating these concepts in primary on children's motivation? Is the ECE curriculum being followed in pre-schools? At baby class, emphasis also continues to be on number operations and symbols and less on use of play objects. The questions then arise; when would children get the opportunity to conceptualize mathematical concepts through objects? If the same mathematical concepts would be taught in standard one and two why teach them in ECE level?

This was not in agreement with Piaget's findings that children can only carry out number operations with concrete objects after age seven (Copeland, 1984, Schminke, 1973 and Dawes, 1977, Swadworth, 1978 and Kamii, 1982). According to Piaget, skills of one to one correspondence and ordering are necessary precondition for understanding number operations. This meant that at pre-school age, this is the mathematics children are capable of mastering in addition to simple conservation of length, mass and area.

4.4.6 English Language and Learning of Mathematical Concepts

Results from PTQ indicated that 64% of the sampled pre-school teachers used English in teaching mathematics. 27% of the teachers used Kiswahili and only a mere 4% integrated mother tongue (Kikuyu, Luo, Meru, Kamba and other vernaculars) in English and Kiswahili in teaching mathematical concepts. It was evident from the teaching observations that children's participation in class work activities was limited due to their inadequate skills in English language. For example a child, who is called to the blackboard to solve a problem for others, would in most cases say a brief thing and would not continue.

Pre-school teachers insisted that children speak to others in English and this was not easy to children especially those in baby classes and nursery. Even the older pre unit (5-6 years) children would be hesitant and not quite confident when explaining mathematical ideas in English. These findings agreed with the study by Njubi (1993) that difficulty in language could make children deficient in articulating concepts. Researches seem to support the view that the teaching of concepts in mathematics and science should be done in the language most familiar to the child (Hendricks, 1980; Whitaker, 1995; and Jackman, 1997).

It should be emphasized that English plays an important role in teaching and learning the traditional examination subjects of the 8-4-4 curriculum in primary and other higher levels of education. But the concern is the manner in which it is taught to pre-school children. What we would like to appeal to pre-school teachers is to follow developmentally appropriate teaching methodology in introducing a second or even a third language such as English to young children which recognizes the values of a first language as a basis for teaching other languages. Pre-school teachers should pick up the process of the child's language development from where the family reached. For example, children who are fluent in mother tongue can learn to speak in English very quickly as long as their first language is appreciated by pre-school teachers and used to integrate the skills of English.

4.5 Inferential Statistics

The study used inferential statistics to test various variables which included use of play activities, use of thematic activities, teachers' academic levels, teacher's experience, teachers training, use of play objects, use of play space and number of children. These variables were correlated with the results of the TSOD. Pearson product moment was used to test relationships and ANOVA was used to test differences between variables.

4.5.1 Pre-school Teachers' use of Play Activities

The relationships between teachers' play-bridging teaching strategies and play activities of children were tested using Pearson moment correlation (r) using the hypothesis below;

H₀₁ There was no significant correlation between pre-school teachers' play-bridging teaching strategy and mathematics play activities of children

The results indicated a very insignificant negative correlation ($r = -0.298$) with a probability ($p=0.322$). On the basis of this results the null hypothesis was accepted at alpha value ($\alpha = 0.05$) and ($p=0.322$; $p > \alpha$). Although teachers reported use of play in teaching mathematics to children in PTQ, when their reports were correlated with the TSOD, the correlation was not significant. This was demonstrated by the fact that teachers used only 10% of children's play to bridge mathematical concepts to children. In table 4.2, the use of play activities as reported by pre-school teachers was not reflecting everyday life activities of children. For example a home corner, a cooking activity, dressing and sewing are simple play activities that children can initiate from their own creativities. In Nairobi, sand can be very expensive and it is not most likely that many pre-schools can access it to children as demonstrated by observation results of table 4.4. The use of water has been minimized

through the use of bought plasticine and so children no longer use natural moulded clay made from the mixture of water.

The PTQ results in table 4.2 showed that the most frequently used play activities were construction (68%), water (51%), sand play (47%), brick play (50%) and playground games (46%). When teachers were asked if they prefer play or DICECE approach in teaching mathematics concepts, 1% supported play and 21% indicated they use DICECE and 74% said they use thematic approach. In another question, 62% of the teachers said they guide children during play. If 99% of the pre-school teachers were not in favour of play how possible was it for the same teachers to provide 62% guidance to children? It appears teachers want to present in the questionnaire a good impression of themselves and not actually the practical situation of their teaching strategies.

When observed playing in the indoor and outdoor areas, children imitated and explored adult roles such as cooking, building bridges, setting a dining table, sewing, construction using blocks, transportation, and various family and community activities. These activities were very mathematical and should have been the basis on which various concepts of number would be introduced to young children. The findings do not support

Vygotsky's ideas on the Zone of Proximal Development (ZPD) and constructivists' approaches (Whitebread, 1996; Bruce, 1990) that the teaching of mathematical concepts makes sense to children if done in a meaningful context.

The role of pre-school teacher or caregiver was to use children play activities to draw children's attention to the concepts of mathematics. The teacher was expected to challenge children in their play to count, to measure, pair, match, sort and group objects. Mathematical concepts such as shapes, measurements, length, area, classification and others were not bridged in play activities of children through questioning, guiding and responding to their questions. Teachers were not closer to children to listen, observe, reinforce and respond to children's mathematical ideas besides even providing safety.

4.5.2 Use of Thematic Play Activities in Teaching Mathematics

The use of thematic activities in teaching mathematics by pre-school teachers was correlated with their play-bridging strategy and tested with Pearson correlation formula (r). The hypothesis below was used to demonstrate this relationship.

Vygotsky's ideas on the Zone of Proximal Development (ZPD) and constructivists' approaches (Whitebread, 1996; Bruce, 1990) that the teaching of mathematical concepts makes sense to children if done in a meaningful context.

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The use of thematic activities in teaching mathematics by pre-school teachers was correlated with their play-bridging strategy and tested with Pearson correlation formula (r). The hypothesis below was used to demonstrate this relationship.

H₀₂ There is no significant correlation between pre-school teachers' play-bridging teaching strategy and thematic mathematics play activities of children.

Pearson moment formula gave a negative correlation of ($r = -0.166$). The correlation was very insignificant indicating no relationship between teachers' use of thematic activities and play-bridging strategies of teachers. In view of these results the hypothesis was accepted at alpha significant level of ($\alpha = 0.05$) and ($p = 0.588$; where $p > \alpha$). This confirms the observation results reported in table 4.4. However, preschool teachers' reports in table 4.3 show that they use the following thematic activities: shop corner (69%), nature corner (36%), household corner (32%) and others. In addition, 74% of pre-school teachers reported in the questionnaires that they use thematic and integrated learning approach in teaching mathematics. Reports from pre-school teachers are inconsistent with their actual practices in their classrooms and this is demonstrated by the observation results indicated in table 4.4.

4.5.3 Teachers' use of Mathematical Objects in Teaching Mathematics

This study also investigated pre-school teachers use of mathematical objects in teaching mathematics. The hypothesis below was used to test the relationship between teachers'

bridging teaching strategy and their use of play objects in teaching mathematics concepts to young children.

H₀₃ There is no significant correlation between pre-school teachers' play-bridging teaching strategy and use of mathematical play objects

Pearson moment correlation formula gave a negative correlation of ($r = -0.279$) and a probability value of $p = 0.356$. In view of these results the null hypothesis was accepted at ($\alpha = 0.05$) where ($p = 0.356$; $p > \alpha$). Observation results in table 4.8 showed that most pre-schools used the traditional teaching resources like the blackboard (98.7%), chalk (98.7%), exercise books (98.7%), pencils (98.3%), plasticine (89.6%) and others in teaching mathematics. Locally found materials such as seeds, sticks, bottle tops, wooden blocks and others were rarely used in pre-school teaching even though teachers had made adequate collections of these materials in their pre-schools as shown by their responses in table 4.7. Observation indicate that teaching in pre-schools continues to be highly academic emphasizing written exercises and homework.

The teaching in pre-schools always centred on the manipulation of abstract numbers worked out on the blackboard. An example of this type of working is illustrated below.

$$\begin{array}{ccc} 4 & + & 3 & = & 7 \\ \begin{array}{cc} \circ & \circ \\ \circ & \circ \end{array} & & \begin{array}{cc} \circ & \\ \circ & \circ \end{array} & & \begin{array}{ccc} \circ & \circ & \\ \circ & \circ & \circ \\ \circ & \circ & \end{array} \end{array}$$

In the above working the pre-school teacher used the circles or balls drawn on the blackboard to represent concrete objects. This approach to solving mathematical calculations was common in most pre-schools visited (N=31). The pre-school teachers preferred direct teaching without use of objects. The statement below made by one pre-school teacher illustrates this manner of teaching:

We do not use materials in Pre-Unit because children have already seen them in Nursery (Pre-school teacher).

The pre-school teachers used the circles in the above example to represent concrete objects. Teachers did not realize that all that was written on the blackboard or on a piece of paper was symbolic and can have little meaning conceptually to children without the use of real objects. For example, what was the difference in meaning to children of numbers 3,4, and 7 and the circles 000, 0000,0000000? Are these not symbols whether they are numerals or groups of circles? According to Piaget

(Wadsworth, 1978), even if children were matching pictures of groups of objects to numbers, the activities were still symbolic. In the perception of pre-school children, Piaget argues that circles and the numerals are all symbols. They only look concrete but to the mind of the child they are very abstract. This is matching symbols and numbers, which is meaningless to the child (Wadsworth, 1978). This tendency of teaching using symbols was further illustrated by the comment of one of the teachers indicated below;

Here we do not use materials a lot instead we go straight to teach the subjects. We teach the Jua Kali way the DICECE way (pre-school teacher).

Observations further showed that most calculations ended on the blackboard without children hardly touching objects. The teacher's demonstrations were as brief as just one addition or subtraction problem on the blackboard and then the lesson was concluded with exercises. For example within a thirty-minute pre-school period children were given the operations illustrated below as exercises;

$$16 + \square = 18, 14 + \square = 19, 8 + \square = 16$$

Before children are given such complex operations to solve, teachers needed to ask themselves; have children encountered adequate opportunities to play freely with as many mathematical

objects as possible? And second, have children been given adequate opportunities to learn the meaning of symbols and their relationships to objects? For example, what does the operations +, = and \square mean to children aged 2 ½ - 6 years? And third what is the relationship between these mathematical equations and everyday life experiences of children?

4.5.4 Teaching Experience of Pre-school Teachers

This study was interested in the extent to which teacher's experiences improve their play teaching strategies. The hypothesis below was used to establish the level of relationships between teachers' experience and their play teaching strategy.

H₀₄ There was no significant correlation between pre-school teachers play-bridging teaching strategy and their teaching experience.

Pearson moment correlation formula was used to test this hypothesis. The results gave a correlation of $r=0.292$ and probability value of ($p=0.333$). Based on these results the null hypothesis was accepted at alpha (α) level of 0.05 and ($p > \alpha$).

The correlation was very insignificant confirming that experience was not a factor in improving the teaching strategies of teachers. This is contrary to what we know from research regarding the value of experience in teaching in early childhood. The result of the hypothesis confirms the observation reports that the

teaching in most pre-schools emphasizes direct teaching using the blackboard, chalk, exercises and homework. Pre-school teachers in pre-schools teach to sustain their own survival rather than to enhance the quality of learning of children. The teaching was not guided by pre-school teachers' professional experience. Although over 55% of pre-school teachers had four years experience and above, this does not improve their teaching skills. Instead, pre-school teachers turned this valuable experience into survival teaching strategies. The following DECECE trained teacher's comment can provide a useful illustration;

Although I am DICECE trained I am forced to ignore what my training taught me and teach according to what is happening in the environment (DICECE pre-school teacher).

The teaching of mathematics in pre-schools continued to reflect the teaching in primary characterized by heavy marking of written exercises (97%) and homework (93%). Teachers depended on marked homework and exercises for assessment records and proof of pupils' progress to parents and administration. The teaching in pre-schools was mainly geared to pleasing the parents, the management and the primary school teachers. The pre-school teachers were merely survivors and mainly taught to keep their jobs and not to professionally

develop the children. These findings were also supported by studies by Swedener, et al, (2000) and Gakuru, (1979).

Although 77% of the teachers reported and actually presented schemes of work to the researcher, this did not mean that they used these schemes for teaching. In most cases, the schemes were kept at the head teachers or at the manager's office for official and administrative purposes during the inspection by DICECE officers and education officials. Whether teachers were DICECE, Montessori or KHA, they all tend to practice "teaching for survival" once they left their respective training. The "teaching for survival" is the practise in which pre-school teachers teach to the approval of parents, primary teachers and pre-school managers in order to protect their teaching career.

4.5.5 Teaching Space in Pre-school Classrooms

This study also investigated the relationship between pre-school classroom sizes and the use of play teaching strategies by pre-school teachers. The hypothesis below was used to test this relationship.

H₀₅ There was no significant correlation between Pre-school teachers' play-bridging teaching strategy and the sizes of the classrooms.

The results of Pearson moment correlation indicated a negative strong correlation of $r=-0.699$ and a probability value of

$p=0.011$, showing that ($p<\alpha$). In view of these results the null hypothesis was rejected at alpha level of 0.05. Most pre-school classrooms were less congested even though they were small (5 metres square). For example, 80% of the pre-school teachers were satisfied with their classroom sizes. Although teachers were generally directive (58%) in their teaching, large classrooms tended to encourage interactive teaching and use of mathematical objects such as plasticine, bottle tops and a few other displays. However, the average sizes of 70% of the pre-schools were five square metres. This was far less the national recommended average of eight square metres (GoK, 1999). Although congestion was evident in most slum pre-schools over 50% of the academies had spacious classrooms. In general, most pre-schools operate in plots sandwiched in residential areas. Most pre-schools are converted residential houses and in this way, they lacked adequate play space in the outdoor areas.

4.5.6 Number of Children in Pre-school Classrooms

This study was also concerned with the effect of the number of pre-school children in teacher's use of play in teaching mathematics. The hypothesis below was used to test the relationships between the number of children in pre-school classes and teacher's use of play bridging strategies in teaching mathematics.

H₀₆ There was no significant correlation between pre-school teachers' play-bridging teaching strategy and the number of children in their classrooms

The Pearson correlation test gave a correlation of $r=-0.163$ and a probability of $p= 0.594$. So the null hypothesis was accepted at alpha value of 0.05. The correlation was very insignificant indicating no relationships between the number of children and teachers' play teaching strategies.

The observations indicated that teachers used direct teaching even with a small number of children in their classrooms. The data from the TSOD and PTQ indicated the average number of children in the sampled pre-schools to be twenty. The Ministry of Education recommends a pre-school classroom population of twenty five to thirty children per teacher (GoK, 1999). This meant that the numbers of children handled by the pre-school teachers in the sampled schools in Kasarani were manageable by the teachers and play-bridging teaching strategy should have been effectively used. Further, 82% of the teachers indicated in PTQ that they were comfortable with the numbers of children they were teaching. However teachers' reports from the questionnaires were always inconsistent with actual observations of their teaching practices.

4.5.7 Pre-school Teacher's Training

Teachers' responses from the PTQs indicated various types of pre-school teacher's training, which included DICECE, Montessori, and KHA and others. This study was interested in establishing the difference the type of training would have on play teaching strategy and ANOVA testing technique was used to test the hypothesis below;

H₀₇ There was no significant difference between pre-school teachers' play-bridging teaching strategy and their type of training.

The ANOVA analysis of the differences of pre-school teacher's play bridging strategies and their type of training are shown in table 4.10

Table 4.10 Teachers' play teaching strategies and training

		ANOVA				
		Sum of Squares	df	Mean Square	F	Sig.
OBSFIH	Between Groups	.211	2	.106	.428	.663
	Within Groups	2.471	10	.247		
	Total	2.683	12			

The ANOVA test in table 4.10 gives a significant value of 0.663 and F value of 0.428. Although the significance is relatively strong, the F value is still greater than the alpha value 0.05. Consequently, the null hypothesis was accepted at alpha value

of 0.05 and the alternative hypothesis rejected. The results from the study indicated that 84% pre-school teachers were DICECE trained, 5% were Montessori trained and another 5% were untrained. These results show that the training does not significantly improve play-teaching strategies of pre-school teachers. Despite the fact that the majority of pre-school teachers were trained in child development, this was not demonstrated in their teaching strategies. This study seems to suggest that the DICECE training was not play oriented. Pre-school teachers did not demonstrate confidence in child development knowledge even though the majority of them were trained in early childhood education. Pre-school teachers were not practically able to demonstrate skills in the use of play in teaching mathematics to young children.

Pre-school teachers' responses to questions on teaching methodologies further confirm the teachers' lack of clarity regarding their teaching approaches. For example when teachers were asked to indicate the type of approach they used in teaching mathematics to young children, their responses were varied besides being inconsistent. Some of these responses were as follows; 74% said they used thematic, 21% used DICECE, 1% used play and 4% indicated they used Montessori. As seen from these responses, teachers treated thematic, DECECE and play

as different teaching approaches. Why? What were the pre-school teachers, understanding of thematic, DICECE and play teaching approaches? How different are they? Trained teachers in child centred methodologies should be able to demonstrate that the three approaches were closely related. It appears from the pre-school teachers' responses that they were not conversant with the ECE philosophy. This then raises questions regarding the quality of training in ECE. The challenge we are faced with is whether the ECE training is adequate enough to develop the confidence and change in attitude in pre-school teachers that is required from them as ECE professionals. There are great disparities between observations and pre-school teachers' responses in terms of what they say they do and their actual practices in teaching. Pre-school teachers demonstrate lack of confidence, professional integrity and honesty.

A major inconsistency was the teachers' belief that thematic was slower when used in teaching mathematics than DICECE approach. What is the difference between thematic and DICECE approaches? Like the DECECE teachers, Montessori teachers also thought their approach was too slow in teaching mathematics. However, the Montessori trained teachers preferred to integrate DICECE approach in their teaching to

make their Montessori method faster as illustrated by the comment below of one of the Montessori teachers;

When DICECE method is used children get more than when they use Montessori. You have to mix the methods (Montessori and DICECE) for the sake of the examination and parents. Parents look at the bookwork. They don't care about the use of the materials. They want to see if children can subtract or add from their work in the exercise book (Montessori teacher).

Pre-school teachers preferred to teach concepts directly using the blackboard to conceptual learning using mathematical objects. To them learning is not a construction of the mind from play objects but a direct activity from the teacher to the child. This is the only way they can guarantee parental confidence in what they teach. Pre-school teachers prefer accelerated teaching, which Piaget disapproves, by arguing that children should be ready according to their timing of development before they can advance to the next level of learning (Copeland, 1984).

It was observed in all pre-schools visited (N=31) that the teaching was predictable and always followed the same methodology, which is illustrated by the steps below;

- i) An addition or a subtraction operation written on the blackboard
- ii) An explanation of how the operation is performed by the teacher usually by drawing counting sticks or small circles (balls) on the blackboard

- iii) One or two children being asked to come to the board one at a time to work out the problem for others following the teachers, method
- iv) Ten to twenty similar operations written on the blackboard as exercises for children
- v) Teacher sits on her table to wait for children to finish the exercises.
- vi) The books are collected for marking

Pre-school teachers carried children through these steps for ten to fifteen minutes of the full time of the mathematical activity. Slightly close to 50% of the pre-schools observed allocated one hour for mathematics and language activity. The same style of teaching was used in the baby class, nursery class and pre-unit classes. Whether pre-schools were in slums or in high cost academies, the teaching strategy continued to be direct and followed the six steps described above. The children remained seated during the lesson while the teacher did the explanations as she/he stood next to the blackboard in front of the children. Pre-school teachers most likely were copying the style of teaching used by their counterparts at the lower primary level. Thus confirming Gakuru's study (1979) that pre-schools were treated by pre-school teachers as extensions of primary schools.

4.5.8 Academic Qualifications

The objective of this study was also to establish whether academic qualifications improve play-teaching strategies of pre-school teachers. ANOVA testing technique was used to test if any differences in academic levels of teachers can improve teacher's play bridging teaching strategies. The hypothesis below was used to test this relationship.

Ho8 There was no significant difference between pre-school teachers' play-bridging teaching strategy and their academic qualifications

The results of the above hypothesis are shown in table 4.9.

Table 4.11 Teachers' play teaching strategies and Academic qualifications

		ANOVA				
		Sum of Squares	df	Mean Square	F	Sig.
OBSFIH	Between Groups	8.540E-02	1	8.540E-02	.362	.560
	Within Groups	2.597	11	.236		
	Total	2.683	12			

The ANOVA results from table 4.11 gives a significance value of 0.560 and $F = 0.362$. Since F value is greater than 0.05, the null hypothesis was accepted. Consequently, the academic qualifications did not improve pre-school teachers play bridging teaching strategies. Although 83% of the pre-school teachers interviewed had Kenya certificate of secondary education (KCSE), this did not improve their play teaching. The high

academic qualification of teachers would be attributed to the fact that 95% of pre-school education in the division was under private management. Private managers were in favour of employing qualified teachers to teach in their pre-schools and academies. This also explained the high number (85%) of trained teachers in the division. But it was a weakness of this study to fail to determine the actual grades of pre-school teachers.

Findings in this study confirm the results by studies by Gakuru (1979), and Swadner et al., (2000) which showed that the majority of pre-school teachers had low academic backgrounds. Until 2002 recruitment to DECECE training colleges was based on grade D plain in KCSE, 15 points in primary certificate or 36 points in KCPE (MOE, 1999). Low academic qualifications are most likely to affect the quality of teaching of pre-school teachers.

4.6 Chapter Summary

In the Chapter, the results of the study were presented using both descriptive and inferential statistics. Discussions of the various themes in the study were articulated to support various findings. The chapter has demonstrated a major inconsistency between descriptive and inferential statistics. This is due to the fact that pre-school teachers' reports do not agree with actual observations of their classroom teaching strategies. In this way, only one hypothesis was rejected and all the others being accepted. For example although teachers indicated in the questionnaires that they use play, thematic teaching approaches, and that they used various mathematical objects, this was not reflected in teaching methods from the observation results.

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter discusses the conclusions, implications and recommendations of the study. But first a summary of the main results of the study is presented.

5.1 Summary of the Findings

The objective of this study was to establish the extent to which pre-school teachers use play as a medium for bridging children's mathematics activities in pre-schools. Presented below is a summary of the main results of the study.

- 1) Observations of mathematics activities of 31 pre-school teachers indicate that play bridging teaching strategies were demonstrated by only 10% of the teachers. Responses from the PTQ (N=101) indicated that only 1% of the pre-school teachers said they used play as a teaching approach for mathematics activities.
- 3) Although 74% of the pre-school teachers indicated in the PTQ that they used thematic teaching approach, only 3.4% of the pre-school teachers observed had thematic lesson plans and over 70% lacked thematic centres of interest in their classrooms.

- 4) Preschool teachers taught according to the instructions of their managers. Emphasizing written work, homework (93%) and marking of pupils' work (97%) with no project activities designed for children. Consequently even though 84% of the teachers were trained in DICECE, they never practiced their professional training.
- 5) Exposure and experience of teachers after training did not make the teachers better in their play teaching strategies. Although 55% of the teachers had over four years of experience, the pre-school teachers continued to teach for survival and emphasis put on use of written work and homework.
- 6) Pre-school teachers continued to teach children using the traditional learning resources such as chalk, blackboard, exercise books and pencils. The use of mathematical objects for children to manipulate and conceptualise mathematical concepts lacked in over 90% of the pre-schools observed.
- 7) Over 80% of the pre-school teachers interviewed had KCSE certificate of education. However, these high qualifications did not improve the play teaching strategies of pre-school teachers.

- 8) Congestion was evident in the majority of pre-schools. However, where there were smaller numbers of children, pre-school teachers continued to direct children's learning of mathematics. But in large classrooms, interactive teaching with play objects especially using plasticine was encouraged.
- 9) Inspection and supervision of preschools was inadequate. The study showed that education officials from MoEST and NACECE had visited 25% and 19% of the pre-schools between 2001 and 2003 respectively.
- 10) Most pre-school teachers used lower primary textbooks for teaching mathematics. Only 45% of the pre-school teachers interviewed said they had the ECD guidelines.
- 11) Preschools admitted children aged 2-3 years without appropriate learning resources for them. These children followed the same mathematics content and methodology as the older children.

The findings demonstrate inadequate use of child centred teaching strategies in stimulating early learning of mathematical concepts. Young children require opportunities to concretise mathematical ideas with real life experiences through play. This will provide children the

foundation for abstract reasoning at higher levels of learning. The findings show that the teaching in the majority of preschools in Kasarani Division is teacher directed. This could lead to inability of children to demonstrate effective reasoning and problem solving skills in the learning of mathematics at primary, secondary and other higher levels of education. Therefore to develop a mathematical Kenyan society, play child centred oriented teaching strategies which are stimulant of cognitive skills in children need to be fostered at the early childhood level.

5.2 Conclusions and Implications

- 1) Pre-school teachers' use of play as a medium of teaching mathematics lacked in many pre-schools. Inadequate skills in play teaching strategies that are children play oriented contributed to teachers' failure in applying these skills in their teaching methods at the ECD centres. This has implication in the training of pre-school teachers. Are teachers trained adequately in appropriate play oriented teaching strategies that embrace learning of concepts through child initiated play activities? Most teaching in pre-schools was teacher directed despite the fact that majority of the teachers were trained in ECE teaching methods.

- 2) Pre-school teachers observed and interviewed had the qualifications, training and experiences needed to enable them perform effectively

in teaching mathematics to young children. However, their teaching strategies continued to be factual, directed and abstract. Based on the preschool teachers' voices and focused group interviews, it was evidently clear that teachers taught for survival to please their employees, parents and primary school teachers. Preschool teachers were exploited by the managers of Private pre-schools for commercial purposes. This demystified the dignity of the teachers, at the same time hampering conceptual learning of mathematical concepts of preschool children.

3) The teaching of mathematics in pre-schools did not emphasise conceptual learning using mathematical play objects. Theme to contextualise mathematical concepts were not used in enhancing the number skills of pre-school children. The implication of this is that thematic and integrated approach to teaching of mathematics skills was not familiar to the teachers, raising questions regarding the teachers' mastery of their teaching strategies at their training institutions.

4) Pre-school teachers were not familiar with innovative problem solving teaching approaches involving constructivist learning strategies such as mediation techniques through bridging of mathematical concepts in an interactive medium with play objects. These teaching approaches

recognize children as potential resources and therefore having the capability to construct for themselves mathematical concepts from objects. This implies that pre-school teachers require training in constructivist teaching approaches.

5) In teaching mathematics, pre-school teachers emphasized abstract calculations with number operations and mathematical symbols. Number addition, subtraction, counting, and number recognition were emphasized in teaching using traditional learning resources such as the blackboard, chalk, and exercise books. According to Piaget pre-school children should master foundational skills of mathematics like seriation, one to one correspondence and ordering before number symbols and operations which should begin when children enter lower primary. The implication of this is that teachers require knowledge in Piaget's ideas regarding number skills of young children.

6) The majority of teachers taught mathematics concepts pre-school children in English, which is either a third or a second language to most Nairobi children. Observations indicate that young children had difficulty interacting with mathematical objects in English. Psychologists are in favour of a first language in teaching science and mathematics concepts to young children. This has implication to language policy issues in ECE.

7) In general, pre-schools in Kasarani seem to follow a curriculum different from that developed by KIE/NACECE. Many pre-school teachers observed do not follow the ECD guideline. Mathematics concepts taught in pre-schools are those taught in standard one and two at the primary level. This implies the need for supervision of pre-school curriculum in ECD centres in Kasarani Division. Among the pre-schools visited, 25% had been visited by an inspector from MoEST and 19% had been visited by NACECE officers between 2001 and 2003.

5.3 Recommendations

Policy makers, inspectorate and NACECE

- 1) This study found that preschool teachers emphasised direct teaching using traditional learning resources such as blackboard, chalk, written homework and marking of exercises. It is recommended that the MoEST should strengthen pre-school inspection with qualified early childhood trained inspectors to ensure curriculum at ECE level is developmentally appropriate.

- 2) The found that preschool teachers in the division continued to teach using direct teaching approaches despite their training and experience. It is therefore recommended that pre-school teachers training needs strengthening to ensure trained pre-school teachers are conversant with constructivists teaching approaches such as

mediation, and thematic teaching which are play oriented teaching strategies.

- 3) It was also observed that preschool teachers taught using lower primary textbooks. It is recommended that the ECD guidelines should be used in all preschools.
- 4) The MOEST should ensure that developmentally appropriate learning resources are provided for young children. Pre-schools that admit babies (2-3 year olds) must provide adequate and suitable facilities for the care of this vulnerable category of children.
- 5) The MoEST should consider supporting pre-schools by employing pre-school teachers to enable them discharge their profession without fear of harassment from parents, managers and the primary school teachers.

Pre-school Teachers

- 1) The teaching of mathematical concepts should be conceptual using play objects applied to relevant and meaningful content. Thematic teaching approaches should be practised by all pre-school teachers.

- 2) Pre-school teachers should teach mathematical concepts using familiar environment, which include experiences of child's family, the community and the school. Children should be able to apply mathematical concepts they learn in pre-school to their everyday life situations, for example in the family and in the neighbourhood.
- 3) Mathematics should be taught in the language that is most familiar to the child. Pre-school teachers should encourage children's confidence in talking without being concerned with the mastery of English. The teaching of English to young children should be done on the basis of the context of another language, which is usually the child's first language.

Pre-school Managers

- 1) The managers of pre-schools should provide adequate space in indoor and outdoor, and appropriate learning resources for pre-school children.

5.4 Suggestions for Further Research

- 1) This study was carried out only in one division of Nairobi Province. There is therefore need for a similar study to be conducted in other divisions of Nairobi and pre-schools in rural areas to establish if the same findings also apply to these areas.

- 2) Since this study was only interested in establishing the extent to which play is used in pre-schools, a longitudinal study should be done to find out the use of thematic and play teaching approaches in enhancing the cognitive skills of children
- 3) This study did not establish the academic grades of teachers to be able to effectively find a correlation between their academic performances and play teaching strategies. Another study is recommended to establish the relationship between the teacher's academic performance in mathematics and their ability to use play in teaching mathematics.
- 4) A study should be done to find out the relationship between parents' academic expectations of their children and the level of mathematics skills learnt in pre-school. This is necessary in establishing the role of parents in determining their children academic learning.
- 5) Although pre-schools admit babies, there are no facilities for this age of children (2-3 year olds) in these academies. There is therefore need for a study to establish the effect of inadequate learning resources to children aged 2-4 years.

5.5 Future Projection

The strategies children use to learn mathematics will influence how they can manipulate their environment in making intelligent decisions socially and economically as adults. Applying mathematical skills in solving every day life problems can be developed in children if teachers relate the subject to real life experiences. This will be achieved if teachers embrace the understanding that mathematics is all that is surrounding them, the children and the community. In this way teachers can teach mathematics as a body of knowledge integrated in human life and not as an abstract ideas found in textbooks in the form of symbols and formulas. This means that children from objects in the environment can construct the content of mathematics, which they can then use as a tool to solve technological and social problems confronting them in the society. This concept can be summarised as shown below:

- ❖ Child and teacher manipulate play object in the environment
- ❖ Object is transformed mentally to mathematical knowledge
- ❖ Mathematical knowledge become tools for socio-economic advancement

BIBLIOGRAPHY

- Almy, M. (1975). *The early childhood education at work*. New York: McGraw-Hill Book Company.
- Almy, M. (1970). *Logical thinking in second grade*: Columbia: Teacher College Press.
- Anderson, R.D. Struthers, J. A. and James, H.H., (1974). "The Teaching Strategies Observation Differential". In Stanford, G (ed.). *Human interaction in education* (pp 274-280). Boston: Allyn and Bacon.
- Anderson, J.E. (1957). *Dynamics of development: system in process. The concept of development*. Minneapolis: University of Minnesota Press.
- Aspy, D. N. (1972). *Toward a technology of human education*. Illinois: Research Press Company
- Bredekamp, S. (ed.) (1987). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8*. Washington, DC: NAEYC.
- Bruce, T. (1991). *Time to play in early childhood education*. London: Hodder and Stoughton.
- Chirchir, J. K. (1983). "A survey of the instructional practices in upper primary mathematics" Unpublished M.Ed Thesis. Nairobi: Kenyatta University.
- Clermont, A. N. (1980). *Social interaction and cognitive development in children*. London: Academic Press.
- Cohen, L. and Manion, L (1994). *Research methods in education, 4th edition*. London: Routledge.
- Copeland, R. W. (1984) (4th edition). *How children learn mathematics. teaching implications of Piaget's research*. New York: Macmillan Publishing Company.
- David, T., (1993). *Educating our youngest children: European Perspectives*. London: Paul Chapman
- Dawes, C.C. (1977). *Early math*. London: Longman

- Donaldson, M. (1996). *Human minds: an exploration*. Harmondsworth: Penguin.
- Dongo B. O. (1999). *A study of relationship between attitude and achievement in mathematics of form iv students in Ukwala division of Siaya District, Kenya*. M.Ed Thesis. Nairobi: Kenyatta University.
- Eshiwani, G.S. (1983). *Research into methods of teaching mathematics: some results from Kenya*. Nairobi: BERC, Kenyatta University.
- Eshiwani, G.S. (1982). *The system of education in Kenya*. Nairobi. BERC, Kenyatta University.
- Fein, G. and Rivkin, M. (1986). *The young child at play*. Reviews of Research vol. 4. Washington D.C: NAEYC.
- FEMSA, (1997). *Teachers' attitudes to the study of science, mathematics and technological subjects by girls in secondary schools. the experience of the pilot phase*. Dissemination Report No. 7. Nairobi: FAWE.
- Fuglesang, A. and Chandler, D. (ed) (1990). *Early childhood development*. Harare: Redd Barna.
- Gakuru, O. N. (1979). "Pre-schools education and access to educational opportunities in Nairobi." Nairobi: Unpublished Med. Thesis. University of Nairobi.
- Gardner, D. B. (1971). The child as an open system; conference summary and implications. In *Play: The child strives towards self-realization*. Washington, D.C: NAEYEC.
- GoK. (1999). *Guidelines for early childhood development in Kenya*. Nairobi: KIE/NACECE
- Haywood, H.C. Brooks, P., Burns, S., (1992). *Bright start: a cognitive curriculum for young children. Introduction and implementation*. Watertown, MA: Charlesbridge Publishers.
- Hendrick, J. (1980). *The whole child. New trends in early childhood Education*. London: The V.V. Mosby Company

- Hodgkin, R. A. (1985). *Playing and exploiting education though the discovery of order*. London: Methueu.
- Hohn, R. L. (1995). *Classroom learning and teaching*. New York: Longman Publishers, USA
- Jackman, H. L. (1997). *Early education curriculum: a child's connection to the world*. New York: Delmar Publishers.
- Kamii, C. (1982). *Number in pre-school and kindergarten*. Washington D.C: NAEYC.
- Kamunge, J. M. (1988). *Report of the presidential working party on education and human power training for the next decade and beyond*. Nairobi: Government Printer.
- Kavanagh, J.F. (Ed.) (1991). *The language continuum*. Sydney: Ashton Scholastic.
- Kerlinger, F. N. (1996). *Foundations of behaviour research, 3rd Edition*. New York: Rinehart and Winston.
- KIE, (1984). *Guidelines for pre-school education in Kenya*. Nairobi: Jomo Kenyatta Foundation
- Kigotho, W. (2001). Poor Mathematics, Science Grades Worry Experts. *The east African standard*, 3rd March 2001. Pg. 15 – 16. Coln. 1-3, Nairobi:
- Kiswili, P. D. M. (1993). *“Mathematics across the curriculum a case study of the applications of mathematics in selected kenya secondary school subjects.”* Nairobi: Unpublished M.Ed Thesis. Kenyatta University.
- Koech, D. K. (1999). *Totally integrated quality education and training (TIQET). Report of the commission of inquiry into the education systems of Kenya*. Nairobi: Government Printer.
- Lee, V., (1980). *Children's learning in school*. London: Hodder and Stoughton.
- Malim, T. and Birch, A. (1997). *Research methods and statistics*. Hong Kong: Macmillan Press Ltd

- MoE. (1981). *Primary mathematics. Pupils book two*. Nairobi: Jomo Kenyatta Foundation
- MoE. (1981). *Primary mathematics. Pupils book one*. Nairobi: Jomo Kenyatta Foundation
- MoEHRD/UNICEF, (1999). *Developing alternative, complementary approaches for survival, growth and development*. Nairobi: MOEHRD/UNICEF
- Moyles, J. and Adams, S. (2000). *Too busy to play ...? A framework for playful teaching*. Buckingham: Open University.
- Moyles, J. (1989). *Just playing? The role and status of play in dearly childhood education*. Milton Keynes: Open University Press.
- Mugenda, O. M. and Mugenda, A. G. (1999). *Research methods: qualitative and quantitative approaches*. Nairobi: Acts Press.
- Muhandi, K. G. M. (1982). "A survey of the problems encountered by teachers and pupils in the teaching and learning of mathematics in the primary schools." Nairobi: Unpublished M.Ed Thesis. Kenyatta University.
- Munguti, B. K. (1984). "A survey of factors affecting the teaching and learning of mathematics in primary schools in Mbooni educational division in Machakos District in Kenya." Nairobi: Unpublished M.Ed Thesis. Kenyatta University.
- Murithi, I. G. (1990). "A study of some of the problems that teachers trainers in primary teachers training colleges in the eastern province of Kenya face in preparing trainees to teach mathematics." Nairobi: Unpublished M.Ed. Thesis. Kenyatta University.
- NAEYC. (1988). Position Statement on Standardized Testing of Young Children Through 8 Years of Age. *Young children*, (43) 3, 42-47. Washington D.C: NAYEC.
- NCTM. (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: NCTM.

- Njumbi, N. G. (1993). *“Children’s performance on Piagetian tasks of conservation. Effects of presenting tasks in Kikuyu and or English language”*. Nairobi: Unpublished M. Ed Thesis. Kenyatta University.
- Nyangayo, J. A. O. (1986). *“A study of factors that affect primary school teachers achievement in mathematics: Kenya”*. Nairobi: Unpublished M.Ed Thesis. Kenyatta University.
- Obbayi, A. A. (1983). *“A study of the teacher’s perception on how children learn mathematics.”* Nairobi: Unpublished M.Ed Thesis. Kenyatta University.
- Ogola, P. A. (1997). *“An investigation of generic errors committed by students in algebraic equations: a case study of Migori District.”* Nairobi: Unpublished M.Ed Thesis. Kenyatta University.
- Piaget, J. (1962). *Play, dreams, and imitation in childhood*. New York: Norton.
- Peter, C.B. (1994). *A Guide to academic writing*. Eldoret: Zapt chancery.
- Read, K.; Gardner, P. and Mahler, B.C. (1993). *Early childhood programs. Human relations and learning*. New York: Harcourt Brace College Publishers.
- Rukangu, S. M. (2000). *“Pupils development of spatial ability in mathematics: An issue of learning environment in selected secondary schools in Kenya.”* Nairobi: Unpublished Ph.D Thesis. Kenyatta University.
- Satterly, D. (1981). *Assessment in schools: Theory and practice in education*. New York: Basil Blackwell, Inc.
- Schminke , C. W. (1973). *Teaching the Child Mathematics*. Illinois: The Dryden Press Inc,
- Seefeldt, C. Barbour, N. (1994). *Early childhood education: An introduction (3rd edition)*. New York: Macmillan Publishing Company.

- Seefeldt, C. (1980). *Teaching young children*. New Jersey: Prentice Hall, Inc.
- Seefeldt, C. (1976). *Curriculum for the pre-school – primary child. a review of the research*. Columbus, Ohio: Charles E. Merrill Publishing.
- Smilanky, S. (1968). *The effect of socio dramatic play on disadvantaged children*. New York: John Wiley and sons Inc.
- Swadener , B.B., Kabiru, M. and Njenga, A. (2000). *Does the village still raise the child? A collaborative study of child rearing and early education in kenya*. New York: State University of New York Press, Albany.
- Tobin, K. & Tippins, D. (1993). Constructivism as a Referent for Teaching and Learning. In: K. Tobin (Ed). *The practice of constructivism in science education*, pp 3-21, Lawrence-Erlbaum,
- Tumbo, M. M. (1991). "A study of the attitudes of pre-service towards mathematics in some primary teachers colleges." Nairobi: Unpublished M.Ed Thesis. Kenyatta University.
- UNESCO, (1984). *Educational building digest*. Bangkok: UNESCO.
- Von Glasersfeld, E. (1990). An Exposition of Constructivism: Why Some Like it Radical. In R.B.Davis, C.A. Maher and N. Noddings (Eds), *Constructivist views on the teaching and learning of mathematics*_(pp 19-29). Reston, Virginia: NCTM.
- Vygotsky, L. S. (1978). *Mind and society: The development of higher mental processes*. Combridge, M. A: Havard University Press.
- Wadsworth, B. J. (1978). *Piaget for the classroom teacher*. New York: Longman.
- Wamani, W. N. (1980). "A study of mathematics abilities among the primary school children in Nyeri, Kenya." Unpublished M.Ed. Thesis. Nairobi: Kenyatta University.

Wando, D. H. (1992). "A study of the relationship between teachers attitudes towards mathematics and pupils performance of mock examinations among standard eight pupils." Nairobi: Unpublished M.Ed Thesis. Kenyatta University.

Whitaker, P. (1995). *Managing to learn. aspects of reflective and experiential learning in schools.* New York: Cassell Villiers House

Whitebread, D. (1996). (ed.) *Teaching and learning in the early years.* London: Routledge.

Williams, M and Burden, R.L. (1997). *Psychology for language teachers. A social constructivist approach.* London: Cambridge University Press

APPENDIXES

APPENDIX A: PRE-SCHOOL TEACHER'S QUESTIONNAIRE (PTQ)

The purpose of this questionnaire is to establish the role of play in bridging mathematics experiences of pre-school children. The results of this study will be instrumental in improving the teacher's skills in teaching mathematics and thus improve pupil's performance in mathematics. The information you provide will be accepted unanimously and treated with strict confidentiality. It will be used only for the purposes of the study and in no way against you. You are kindly requested to answer the following questions honestly.

Instruction. Tick (✓) or complete where appropriate.

PART I: TEACHER'S PERSONAL INFORMATION

1. Gender

Male []
Female []

2. Age _____ years

3. Your teaching experience (years) in ECE

1 []
2 []
3 []
4 []
5 []

Others Specify _____

4. Your Academic qualification:

- i) Number of years spent in primary _____
- ii) Number of years spent in secondary _____
- iii) Number of years in university _____
- iv) Others specify _____

iv) Certificate obtained:

CPE []
KCPE []
KJSE []
Graduate []

Others Specify _____

5. ECE Training attended

- i) Number of years in ECE training in DICECE _____
 - ii) Number of years in ECE training in KHA _____
 - iii) Number years in ECE training in Montessori _____
 - iv) Number of years in ECE training in University _____
- Others (specify) _____

v) Certificate obtained

DICECE []

KHA []

Montessori []

Graduate []

Others Specify _____

6. How has your training improved your teaching skills in mathematics using play?

Very adequately []

Adequately []

Inadequate []

Very Inadequate []

Give reason for your answer _____

(II) Teacher's information about his/her Pre-school

7. Name of school _____

Category

Public []

Private []

8. No. of children by gender and age in class

Enter the number of children against the appropriate ages shown in the table below.

Ages in years	2	3	4	5	6	7	8	9	Total
Number of boys									
Number of girls									
Total									

9. Do you find this class size suitable to teach mathematics using Play?

Yes _____ No _____

If No, Why _____

III) Teaching Information

10. Which of these approaches do you use in teaching mathematics to ECE children?

Thematic []

Montessori []

Frobelian []

DICECE []

Others (specify) _____

11. Do you have a problem in using thematic approach in teaching mathematics to pre-school children?

Yes _____ No _____

If Yes, Why? _____

12. How do you find teaching mathematics in pre-school?

Interesting	[]
Very interesting	[]
Difficult	[]
Very difficult	[]

Give reasons for your answer _____

13. How do you find the size of your classroom?

Very adequate	[]
Adequate	[]
Inadequate	[]
Very inadequate	[]

14. Which of these learning corners are you able to have with this class size?

Creative	[]
Block area	[]
Shop corner	[]
Household corner	[]
Nature	[]

Others (specify) _____

15. How much time do children use in each learning corner during mathematics activities every day

10 min	[]
20 min	[]
30 min	[]

Other specify _____

16. Do you find this time adequate?

Yes	[]
No	[]

If NO, why? _____

17. Which of the problems listed below are commonly experienced by children when using learning corners during mathematics time?

Lack of space	[]
Number of children	[]
Lack of corner	[]

Others (specify) _____

18. Which of these are common teachers problems in teaching mathematics in ECE?

- | | | |
|--------------------------------|---|---|
| Lack of space | [|] |
| Lack of materials | [|] |
| Large number of children | [|] |
| Lack of administration support | [|] |

19. Which of the activities below do you use play in teaching?

- | | | |
|-------------|---|---|
| Language | [|] |
| Mathematics | [|] |
| Outdoor | [|] |
| Creative | [|] |
| Science | [|] |

Give reason for your answer _____

20. Do you prefer any type of play game in teaching the find play useful in teaching mathematics to your children?

- | | | |
|-----|---|---|
| Yes | [|] |
| No | [|] |

If YES list them _____

21. What do you do when children are playing?

- | | | |
|---------------------------|---|---|
| Observe the children | [|] |
| Guide the children | [|] |
| Discuss with them | [|] |
| Ask them questions | [|] |
| Join them in play | [|] |
| Let them play undisturbed | [|] |
| Others (specify) _____ | | |

22. Which of these activities do children use to stimulate their mathematics ideas in the pre-school?

- | | | |
|-------------------|---|---|
| Home corner | [|] |
| Brick | [|] |
| Water | [|] |
| Sand | [|] |
| Dressing up | [|] |
| Sewing | [|] |
| General classroom | [|] |
| Cooking | [|] |
| Playground | [|] |
| Construction sets | [|] |

23. Which of the following mathematics concepts are emphasized in your mathematics lessons?

Size	[]
Length	[]
Weight	[]
Volume	[]
Order Seriation	[]
Floation	[]
One to one correspondence	[]
Matching	[]
Time	[]
Shape	[]
Area	[]
Number recognition	[]
Number counting	[]
Addition	[]
Subtraction	[]
Multiplication	[]
Division	[]
Others Specify _____		

24. Which of the following materials do you use in teaching mathematics?

Beads	[]
Bricks	[]
Boxes	[]
Buckets	[]
Cups	[]
Scoops	[]
Sieves	[]
Funnels	[]
Tins	[]
Dice	[]
Playing cards	[]
Flash cards	[]
Seeds	[]
Blocks	[]
Sticks	[]
Bottle tops	[]
Others Specify _____		

25. Which of these activities do you teach during the outdoor sessions?

- | | | |
|-------------|---|---|
| Language | [|] |
| Mathematics | [|] |
| Outdoor | [|] |
| Creative | [|] |
| Science | [|] |

26. Which of these outdoor activities do you use to teach mathematics?

- | | | |
|----------------------|---|---|
| Water play | [|] |
| Sand play | [|] |
| Climbing frames | [|] |
| Others Specify _____ | | |

27. Which of these games do you use in teaching mathematics activities?

- | | | |
|----------------------|---|---|
| Play cards | [|] |
| Hiding game | [|] |
| Musical chairs | [|] |
| Skittle games | [|] |
| Guessing | [|] |
| Others Specify _____ | | |

29. Pre-school children's outdoor play area in a school is:

- | | | |
|-----------------|---|---|
| Very adequate | [|] |
| Adequate | [|] |
| Inadequate | [|] |
| Very inadequate | [|] |

30. Pre-school children's outdoor play area in the school has:

- | | | |
|-----------------------------|---|---|
| More than enough facilities | [|] |
| Enough facilities | [|] |
| Less than enough facilities | [|] |
| No facilities at all | [|] |

31. What language do you use when teaching mathematics?

- | | | |
|------------------------|---|---|
| English | [|] |
| Kiswahili | [|] |
| Others (specify) _____ | | |

32. What language difficulties do children experience in the language you use in teaching mathematics?

33. What do you do to solve the problem? _____

34. What problems do you experience in teaching Mathematics using

Play? _____

35. What method would you recommend for teaching mathematics to pre-school children?
36. Which of the textbooks listed below do you have?
- | | | |
|---|---|---|
| Management and Language activities Book one | [|] |
| Play and creative activities Book Two | [|] |
| Mathematics and Environmental activities Book Three | [|] |
| Guidelines for pre-school education in Kenya | [|] |
| Guideline of Early childhood development in Kenya | [|] |
| Others Specify _____ | | |
37. Which of the difficulties below do you experience in getting mathematics textbooks?
- | | | |
|-------------------------------------|---|---|
| Lack of funds | [|] |
| Lack of books in the market | [|] |
| Lack of information about the books | [|] |
| Others (specify) _____ | | |
38. At what levels do you assess children's mathematical ideas in the pre-school?
- | | | |
|------------------------------|---|---|
| When they come to pre-school | [|] |
| When they are playing | [|] |
| When they are learning | [|] |
| When they do the test | [|] |
| Any (other specify) _____ | | |
39. When were you last given professional guidance by:
- | | |
|-------------------------|--|
| School management _____ | |
| NACECE _____ | |
| Inspectorate _____ | |
41. If you have any other information with regard to the teaching of mathematics in pre-school, please write it in the space provided here _____

**APPENDIX B: CLASSROOM AND OUTDOORS PLAY OBSERVATION
QUESTIONNAIRE**

PART ONE:

1. a) Name of school: _____
- b) Teacher's academics
- i) Qualification: Graduate _____ Diploma _____ DICECE _____
Others specify _____
- ii) Teaching experience _____ years
- c) Teaching preparation:
- i) Schemes of work
Available and up-to-date (AUD) _____
Available but not up-to-date (ANUD) _____
Not available (NA) _____
- ii) Thematic lesson plan Yes _____ No _____
- iii) Pupil's progress records _____
- iv) Teaching resources/ materials _____
- v) Marking of pupils work _____
Regularly done _____
Not regularly done _____
Not done at all _____
- vi) Class assignments given _____
Project work _____
Homework _____
- vii) How does the teacher conclude the lesson? _____
- viii) How long does the teacher take to settle the class? _____
- ix) How does the teacher introduce the lesson? _____
- x) Size of the classroom _____ size of outdoor area _____
- xi) Learning corners/centres: creative _____ block _____ cooking _____
Shop _____ household _____
- xii) Mathematical play areas: water play _____ sand play _____
construction area _____

**PART TWO: TEACHING STRATEGIES OBSERVATIONS
DIFFERENTIALS (TSOD)**

1st ten minutes observations for indoor free choice activities

Interval (one minute)	Working space	Rating
1		1 2 3 4 5 6 7 8 9 10
2		1 2 3 4 5 6 7 8 9 10
3		1 2 3 4 5 6 7 8 9 10
4		1 2 3 4 5 6 7 8 9 10
5		1 2 3 4 5 6 7 8 9 10
6		1 2 3 4 5 6 7 8 9 10
7		1 2 3 4 5 6 7 8 9 10
8		1 2 3 4 5 6 7 8 9 10
9		1 2 3 4 5 6 7 8 9 10
10		1 2 3 4 5 6 7 8 9 10

2nd ten minutes observations for indoor free choice activities

Interval (one minute)	Working space	Rating
1		1 2 3 4 5 6 7 8 9 10
2		1 2 3 4 5 6 7 8 9 10
3		1 2 3 4 5 6 7 8 9 10
4		1 2 3 4 5 6 7 8 9 10
5		1 2 3 4 5 6 7 8 9 10
6		1 2 3 4 5 6 7 8 9 10
7		1 2 3 4 5 6 7 8 9 10
8		1 2 3 4 5 6 7 8 9 10
9		1 2 3 4 5 6 7 8 9 10
10		1 2 3 4 5 6 7 8 9 10

1st ten minutes observations for mathematics activity lessons

Interval (one minute)	Working space	Rating
1		1 2 3 4 5 6 7 8 9 10
2		1 2 3 4 5 6 7 8 9 10
3		1 2 3 4 5 6 7 8 9 10
4		1 2 3 4 5 6 7 8 9 10
5		1 2 3 4 5 6 7 8 9 10
6		1 2 3 4 5 6 7 8 9 10
7		1 2 3 4 5 6 7 8 9 10
8		1 2 3 4 5 6 7 8 9 10
9		1 2 3 4 5 6 7 8 9 10
10		1 2 3 4 5 6 7 8 9 10

2nd ten minutes observations for mathematics activity lessons

Interval (one minute)	Working space	Rating
1		1 2 3 4 5 6 7 8 9 10
2		1 2 3 4 5 6 7 8 9 10
3		1 2 3 4 5 6 7 8 9 10
4		1 2 3 4 5 6 7 8 9 10
5		1 2 3 4 5 6 7 8 9 10
6		1 2 3 4 5 6 7 8 9 10
7		1 2 3 4 5 6 7 8 9 10
8		1 2 3 4 5 6 7 8 9 10
9		1 2 3 4 5 6 7 8 9 10
10		1 2 3 4 5 6 7 8 9 10

1st ten minutes observations for outdoor free choice activities

Interval (one minute)	Working space	Rating
1		1 2 3 4 5 6 7 8 9 10
2		1 2 3 4 5 6 7 8 9 10
3		1 2 3 4 5 6 7 8 9 10
4		1 2 3 4 5 6 7 8 9 10
5		1 2 3 4 5 6 7 8 9 10
6		1 2 3 4 5 6 7 8 9 10
7		1 2 3 4 5 6 7 8 9 10
8		1 2 3 4 5 6 7 8 9 10
9		1 2 3 4 5 6 7 8 9 10
10		1 2 3 4 5 6 7 8 9 10

1st ten minutes observations for outdoor free choice activities

Interval (one minute)	Working space	Rating
1		1 2 3 4 5 6 7 8 9 10
2		1 2 3 4 5 6 7 8 9 10
3		1 2 3 4 5 6 7 8 9 10
4		1 2 3 4 5 6 7 8 9 10
5		1 2 3 4 5 6 7 8 9 10
6		1 2 3 4 5 6 7 8 9 10
7		1 2 3 4 5 6 7 8 9 10
8		1 2 3 4 5 6 7 8 9 10
9		1 2 3 4 5 6 7 8 9 10
10		1 2 3 4 5 6 7 8 9 10

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