

**PRESCHOOL TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE OF PRE-
MATHEMATICS: THE CASE OF SELECTED SCHOOLS IN LUSAKA
PROVINCE OF ZAMBIA.**

BY

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**“A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENT FOR THE MASTER OF EDUCATION IN PRIMARY EDUCATION”**

THE UNIVERSITY OF ZAMBIA

(2016)

TITLE

PRESCHOOL TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE OF PRE-MATHEMATICS: THE CASE OF SELECTED SCHOOLS IN LUSAKA PROVINCE OF ZAMBIA

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This dissertation by Hilda Nthani Zulu has been approved as partial fulfilment for the requirements for the award for the award of the degree of masters in Primary School by the University of Zambia.

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ABSTRACT

Childhood low levels of learning achievement in numeracy at middle primary school have proved to perpetuate into adult life. In order to raise children with mathematical skills, teachers should be appropriately qualified for the task. An exploratory study method was used to collect qualitative data on the Pedagogical Content Knowledge (PCK) of three teachers through lesson observations and interviews. The three elements of PCK explored were knowledge of the subject matter, teaching strategies and teachers' conduct. Data was analysed using manual thematic and constant comparative analysis.

Relating to activities preschool teachers engaged in, three themes emerged namely: developing number awareness, writing skills and having fun. With regard to factors influencing learning of mathematics, themes that emerged included teaching approach, teaching style and using resources. Analysis of the results suggested that the teachers had limited/inadequate subject matter knowledge on some topics and some aspects of teaching strategies. The study also revealed that there are various factors that are important in teaching of pre-mathematics to children and that it all depends on the teachers' perspective and provision of resources.

In conclusion, the study indicated that children needed to relate activities to real life situation in order to bring out the hidden educational value and that the topics should be tailored to the age of the children.

The study recommends that teachers be exposed to workshops, specialization trainings on teaching strategies and knowledge of teachers' conduct on the topic taught at pre-school.

Key words: *Pedagogical Content Knowledge, knowledge of the subject matter, knowledge of teaching strategy, knowledge of teachers' conduct, mathematical skills, numeracy*

DEDICATIONS

This report is dedicated to my husband Allan Zulu, and my children Sharon, Emmanuel and Chisomo Zulu for the sacrifice made. Not forgetting my Mother Christine Nthani and my sisters for their moral support and encouragement.

ACKNOWLEDGMENT

I thank God for showing me thy kindness in the morning, and thy faithfulness every night through the grace he granted me to undergo all challenges experienced. Abundant gratitude goes out to my supervisor Dr. Bentry Nkhata for his thoughtful and tireless guidance. Special mention is made of all those who were of help to me at different stages of the work, especially Ms. Dorothy Nthani and Mr Saidi Mwanamonga for pushing me when I was down. To my niece, Violet Nthani for her invaluable nudge in giving me the encouragement to go on despite all odds. I can still hear her little voice saying “*one day it shall be over*”.

DEFINITIONS OF TERMS

Pedagogical Content Knowledge (PCK): mean an amalgam of (a) specific content knowledge on quadratic functions, (b) knowledge of teaching strategies and application and (c) prior knowledge of learners' conceptions that allow a teacher to transform specific content knowledge in a more conceptually accessible version for the learners.

Subject matter knowledge: (as displayed by the teacher) mean the correct application of mathematical concepts, facts and procedures, the reasons underlying mathematical procedures and the relationship between mathematical concepts during classroom teaching of quadratic functions.

Knowledge of Pedagogy: refers to knowledge of planning and organization of a mathematics lesson and teaching strategies for effective teaching of the particular topic under investigation.

Knowledge of curriculum: refers to knowledge about learning goals for different topics

Procedural knowledge: Procedural knowledge is regarded as knowledge of mathematical rules, algorithms and procedures that a teacher uses to assist learners to learn how to solve mathematical problems quickly and efficiently because it is to some extent automated through drill work and practice.

Misconceptions: refer to pieces of wrong knowledge that may arise as result of learners' prior experience and learning both inside and outside of the classroom and effective mathematics teachers should have knowledge to diagnose and eliminate such wrong knowledge.

Teaching Strategies: refers to methods used by teachers to create learning environments and to specify the nature of the activities in which the teacher and learners will be involved during the lesson to ensure that the sequence or delivery of the lesson helps learners to understand the topic taught.

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ABBREVIATIONS AND ACRONYMS

CPD	Continuous Professional Development
ECCED	Early Childhood Care, Education and Development/
MoE	Ministry of Education
NCTM	National Council for Teachers of Mathematics
NCSM	National Council of Supervisors of Mathematics
PCK	Pedagogical Content Knowledge
PK	Pedagogical knowledge
SSI	Semi-Structured Interviews
SACMEQ	Southern African Consortium for Monitoring Education Quality
UNESCO	United Nations Educational Scientific and Cultural Organization
ZPD	Zone of Proximal Development

CHAPTER ONE: INTRODUCTION

1.0. Introduction

This chapter presents the problem under investigation, the purpose, objectives, research questions, significance of the study and the theoretical framework within which the study will be understood.

1.1 Background

In order to extend children's knowledge, teachers need to have pedagogical and subject matter knowledge. To be alert to children's content knowledge of mathematics, the researcher claims that teaching and learning of mathematics requires attention in order to extend children's learning. The early childhood learning settings for mathematics have important implications for the child's future. Early childhood teachers who are not well versed with the subject content knowledge may have difficulties to provide full application to children's learning. This is the missing link of early childhood teachers' professional knowledge. Teachers need comprehensive subject knowledge to support children's learning. However, due to lack of data on teachers' content knowledge of mathematics cannot be justified in early childhood education in Zambia.

According to the United Nations Educational Scientific and Cultural Organization (UNESCO, 2008) a person's education is the foundation upon which they build their future. One needs to acquire certain skills in a particular field to be considered educated and be able to exert a mighty influence and knowledge to all those they associate with. Quinn (2011) states that every person needs to be literate and numerate in order to function in this corporate world because without these skills they are bound to be cut off from full participation in many aspects of life. In turn, chances of taking up good jobs and careers are compromised due to the fact that they cannot go further or fully participate in education (schooled). According to Ernest (1991), major aspects of life such as health, education and banking depend on numerical systems. This implies that human activities rely on mathematics. Mathematics education needs to equip children with skills necessary for lifelong learning, achieving aspirations and for attaining personal fulfilment (Kilpatrick, Swafford & Findell, 2001).

Childhood is all about learning and a child is an important part of human development. With proper guidance and support, a child can be assured of a bright future. In this regard, a teacher

needs appropriate skills support and knowledge in order to effectively support their development. The development of the brain is at the heart of every parent or caregivers' interest to enhance a child's learning. The Ministry of Education (MoE, 1996) states that many developing countries have started to raise their target for early childhood education. It acknowledges the important role of early childhood education in the multi-dimensional development of young children and facilitates establishment of programs to reach many children. The MoE has set priority for lower and middle basic education to ensure that children master essential literacy and numeracy skills. In this case, the ministry continues dedicating some of its resources to this level of education through training of pre-school teachers and involving the cooperate world in the monitoring of preschool standards, assist in curriculum formulation and the design of materials and support for the development of policy guidelines.

The objective of creating Zambian citizens who are mathematically grounded can only be achieved if real mathematics teaching and learning starts at pre-school level. Researchers have drawn on an extensive range of intellectual resources to address how effective mathematics teaching and learning can be implemented, which are demonstrated in several dominant approaches in the history of mathematics education research (Peng & Nyroos, 2012). The depth and richness of children's existing prior knowledge is supported by international research which indicates that quality preschool mathematics invites children to experience mathematics as they play, describe and think about their world. Preschool is a good time for children to become interested in counting, sorting, building shapes, finding patterns, measuring and estimating (National Council for Teachers of Mathematics (NCTM, 2001).

1.1. Statement of the problem

The National Assessment Survey Report (1999 and 2012) and Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ III, 2010) statistics indicated that there are low levels of learning achievement among middle primary children in numeracy. This is as a result of in-adequate teaching foundation in mathematics skills. (MoE, 2006). CDE (2004) identified a range of in and out-of-school factors that impact on learner performance in mathematics. In their study of teacher quality, appraisal and development, asserted that factors contributing to poor learner performance in mathematics in developing countries (such as South Africa) include teacher quality, the socio-economic background of learners and their communities, the context of schooling, poor school leadership and poor or under-resourced school

facilities. In addition, Centre for Development and Enterprise (CDE, 2004) research report also point to language of instruction as a factor accounting for the poor performances of learners in Mathematics and Science. Furthermore, Ernest (1991) stated that poor mathematics foundation from early childhood education can have diverse effects on a child's future, limiting children to have a wide scope of taking up good jobs and careers considering the fact that most aspects of people's lives depend on numerical system. However, there is scanty information about how Zambian preschool teachers teach pre-mathematics, including the level of content and attitudes towards mathematics. Based on this, Zambia needs to do more research on the possible causes of poor performance in mathematics among children. Therefore, the aim of this study is to explore preschool teachers' Pedagogical Content Knowledge in mathematics.

1.2. Purpose of the study

The purpose of the study was to explore pedagogical content knowledge of a Zambian preschool teacher teaching pre-mathematics.

1.3. Objectives of the study

The specific objectives were:

1. To examine activities used in the teaching of mathematics in preschool
2. To examine preschool teachers' awareness of factors that foster learning of pre-mathematics.
3. To analyse the importance of a teacher's conduct in the teaching of mathematics.

1.4. Research questions

The following were the research questions employed:

1. What activities do preschool teachers engage in the teaching of mathematics?
2. What factors do preschool teachers consider important in fostering the learning of pre-mathematics?
3. What should be the conduct of pre-school teachers in the teaching of mathematics?

1.5. Theoretical framework

This study was inspired by Vygotsky (1978) whose interest was on the conflict between the individual and society, the effect of social interaction, language and culture on learning. Vygotsky

emphasized that learning is a continual movement from the current intellectual level to a higher level. He saw intellectual abilities as being much more specific to the culture in which the child was reared and this occurred in the so called “Zone of Proximal development” as a result of social interaction. The zone of proximal development is the distance between the actual independent development level and the potential development level under the guidance or in collaboration with peers (Vygotsky, 1978). He believed that human development and learning occur through their interactions with people and the environment. He also noted social interaction is the key factor to the understanding of human thinking and the mechanism of social experience. He recognized the higher psychological functions of humans, especially the distinguishing mental process of signification by which humans assign meanings to arbitrary stimuli and with which human learning is determined by the social and historical context. In addition, Vygotsky emphasized the role of the adult as they negotiated meaning through the learners’ peers as they conversed, questioned and explained.

Two themes form the core of Vygotsky's theoretical framework:

1. A reliance on a genetic or developmental method:

Vygotsky (1978) recognized two basic processes operating continuously at every level of human activity: internalization and externalization. He proposed that even though every complex mental function is first an interaction between people, it subsequently becomes a process within individuals. It is the transition from the external operation to internal development which undergoes qualitative changes. This transformation involves the mastery of external means of thinking and learning by using symbols to control and regulate one's thinking.

2. Mediation

Vygotsky claimed that mental processes can be understood only if people understand the tools and signs that mediate them. Changing a stimulus situation in the process of responding to it establishes mediation, e.g. the gesture of pointing could not have been established as a sign without the reaction of the other person. This also implies that any higher mental function necessarily goes through an external stage in its development because it is initially a social function.

1.6. Implications to learning and instruction:

1. Learning in authentic context:

The conception of mediation gives emphasis to the interaction between individuals and the historical and cultural development. The writer argues for the process of situating learners in an authentic context construct learning via dialectical relations among people through acting, the contexts of their activity and the activity itself.

2. Providing Scaffolding: Learning takes place in the social interaction with older, more learned members of the society and it occurs when the individual is prompted to move past levels of performance and develop new abilities. Thus, provide external support from the instructor, peers, experts, artefacts or tools as the learners construct knowledge.

Further, Vygotsky (1978) suggested that in order to ease the transformation of children from drawing things to drawing speeches, there is need to have a preschool curriculum which is well designed. He added that the curriculum should generally challenge and stretch a learner's competence and that it should provide many opportunities to apply previous skills, knowledge and experiences with authentic activities connected to the real-life environment. In addition, he noted that since children learn much through interaction, curricula should be designed to emphasize interaction between learners and their learning tasks. This means that the physical classroom would provide a more conducive environment such as clustered desks and enough work space for peer interaction including collaboration and interactions in small group instructions. Furthermore, Vygotsky stated that both the environment and the instructional design of materials which are there to facilitate learning should be structured in a way to advance and encourage children's interaction and collaboration where classrooms become a community of learning. This would in turn give the opportunity to the teacher to use each child's reasoning ability and suppositions as a starting place to help the child grow to more complex understandings (Vygotsky 1978).

1.7. Significance of the study

Findings from this study will assist education policy makers, educationalists and curriculum developers to formulate responsive policies and programs. The findings will also provide a basis

for the design of continuing professional development activities and transfer of knowledge for preschool teachers.

1.8. Chapter conclusion

This chapter discussed the background of the study which was mainly about pedagogical content knowledge of a pre-mathematics teacher in the Zambian educational system. Various possible factors causing poor performance in pre-mathematics were tabled. The purpose, research questions, significance of the study which emphasised the need to establish PCK were also discussed. The chapter concludes with explaining the importance of studying pedagogical content knowledge of preschool teachers teaching pre-mathematics.

CHAPTER TWO: LITERATURE REVIEW

2.0. Introduction

The chapter presents extracts of literature consulted with regard to the role of teachers in fostering children's learning, the importance of pre-mathematics in the early years and how young children learn. It has been observed that learners are persistently performing poorly in mathematics at all levels. The literature review motivated the researcher to undertake this study to find out why this trend? Some of the basic questions explored were: what is the problem? Where is it coming from? Is the subject difficult for the learners to understand? Do teachers find it difficult to deliver the subject matter?

2.1. Pedagogical Content Knowledge

According to Shulman (1986) Pedagogical Content Knowledge is a blend of the teachers understanding of content within their domain and knowing how to teach specific topics effectively. He emphasized that PCK depends on a teacher's subject matter and knowledge and on how the teacher transforms this knowledge in to various forms that enables learners in different learning environment to understand the subject matter. However, Shulman stressed that PCK is difficult to measure. This led researchers to consider pedagogical as important as the subject matter knowledge.

Shulman further defined Pedagogical Knowledge (PK) as knowledge used in strategies such as instructional and curriculum knowledge, knowledge of educational contexts and purposes and the teaching routines involved in management of a class. In fact, he emphasized much on the way teachers relate to what they know about what they teach and how they process the subject matter. He actually identified three components of PCK: knowledge of a subject; children's existing knowledge/beliefs and effective ways to teach. So, preschool teacher should have both the know-how and the content of the subject. If the teacher is really good in the subject but s/he does not know how to deliver, then there is a problem. In addition, Cullen (1999) reported that early childhood teachers need confidence and an understanding of pedagogical strategies to work with children's knowledge and interest. Perhaps it is not the mathematics content which is difficult, but how teachers put the concepts across to the children which is the problem. Siraj-Blatchford, Sylva, Muttock, DarGilben and Bell (2002) study provided examples of teaching practices where

teachers' content knowledge extended children's knowledge within their environment and at a level appropriate with their understandings of the world they live in. These ideas have much in common with the socio-cultural philosophy and theory that underpin *Te Whāriki*. When the subject knowledge is deeper, teachers are more likely to be confident about integrating curriculum. The teachers are aware of their own knowledge gaps and are more open to children's interests, ideas, contributions, and questions. These are all key beliefs of early childhood pedagogical philosophy which includes an understanding of what makes certain concepts easy or difficult for children to grasp. This is what brings about the difference between the expert teacher in a subject and the subject expert (Ball 2000).

Even if general PCK applies to all teaching subjects, much of it is specific to individual teaching subjects. The teacher using their professional knowledge of the subject to construct meaningful teaching, guides the children from their prior knowledge and experiences towards the children's understanding of their communities. With regard to the teaching of mathematics, Ball (2000) stressed how the depth of a teachers' understanding of mathematics is a major determinant of teachers' choice of examples, explanations, exercises, items and reactions to children's work; more so when children's work relate to what they do in real life situations.

Ball, Thames, and Phelps (2008) conducted a research on content knowledge and pedagogical content knowledge. Their aim was to give a definition to the domain of mathematical knowledge for teaching and refining its sub-domains in establishing teaching as a profession. These researchers hypothesized that content knowledge and PCK can be subdivided into common knowledge and specialized content knowledge. They also elaborated that PCK is closely related to practice. Further analysis revealed that mathematical demands of teaching are substantial and that teaching must be detailed in ways necessary for everyday functioning. In addition, they said teachers need to know features of mathematics that are not suitable for teaching children. Further the study intended to establish the scope of the co-competences within which the teacher operated.

2.2 The role of teachers in fostering children's learning

In the 21st century, one shifting paradigm in education is about teachers' roles and competencies. According to Darling-Hammond (1997:154) research findings on teacher competency reveal that if teachers are to prepare an ever more diverse group of children for much more challenging work such as framing problems, finding, integrating, synthesizing information and working

cooperatively they will need more knowledge and different skills than most now have. Teacher competency in these areas is closely linked to children's thinking, understanding and learning in mathematics education. Grossman, Wilson and Shulman, (1989) states that it is evident that children's achievement in mathematics education requires teachers to have a firm understanding of the subject domain and the framework that guides mathematics education. In addition, they said that teachers need thorough understanding of different kinds of instructional activities that will promote children's achievement. Furthermore, competent mathematics teachers provide a roadmap to guide children to an organized understanding of mathematical concepts, reflective learning, critical thinking, and ultimately mathematical achievement. In acknowledgement, the National policy on Education (2004) affirmed that no education can rise above the quality of its teachers. The single most important learning resources available to children is the teacher. It is therefore important for teachers to possess full knowledge of the subject matter and acquire the necessary skills to transmit their knowledge effectively. The study sought to establish the competence of the pre-mathematics teacher.

2.3 Importance of mathematics in the Early Years

Many studies report that what teachers know and believe about mathematics is directly connected to their instructional choices and procedures (National Council of Teachers of Mathematics, 1989). According to Gilbert (1999: 24) "it is undisputed that the teacher's philosophy of mathematics has a significant influence on the structure of mathematics classes". Teachers need to have skills and knowledge to apply their philosophy of teaching and instructional decisions. Further, Clement and Sarama (2007) noted that the effectiveness of an education system depends heavily on the quality of its teachers as key persons in determining success in meeting the system's goals. In addition, the educational and personal well-being of children in schools hinges crucially on their teacher's competence, commitment and resourcefulness. Preschool is a period when children formally encounter mathematical lessons and research indicated that preschool children have the ability to understand a variety of mathematical concepts even prior to entering kindergarten (Clement & Sarama, 2007). This is why early childhood programmes are increasingly required to implement mathematics instruction in classrooms and allow development of mathematics skills as foundation for later learning (Lee & Ginsburg 2008). In Zambia, the MoE acknowledges the important role of early childhood education in the multi-dimensional development of children and facilitates establishment of programs to reach many children

(Ministry of Education, 1996). In fact, the Ministry of Education Science, Vocational Training and Early education has the important task of sustaining the quality of individual teachers and of the profession as a whole. This will be accomplished by attracting suitable persons to take up teaching as a career, equipping them with initial professional education, and providing for their subsequent in-career development. Running parallel with this, it also has responsibility for rewarding their services and sustaining their morale through satisfactory terms and conditions of service (MoE, 1996).

The study intended to establish how well grounded the teacher in the study were equipped in their subject matter. The outcome should be able to help structure the pre-school curriculum that responds positively to the needs of the pre-school system.

2.4 How young children learn mathematics

Edgar (1994) in his investigations noted that many teachers forget, or are unaware, that learners require psychomotor (motivation and effective) skills. He considered that problems of psychomotor learning are often overlooked by teachers, including preschool teachers. In most cases children are very confident in the things they do and as such it is expected that they will concentrate in whatever they do. Commonwealth of Australia (2009) reported that “children will develop a range of skills and processes such as problem solving and inquiry by developing early understanding about numbers and patterns in real-life situations. In this regard the study sought to establish the activities used in the teaching of pre-mathematics.

Weddy and Catherine (1992) considered several aspects for determining a learner’s performance in a mathematical context including teaching methods employed, syllabus content, the attitude of the parents and teachers, teachers’ innovative and existing knowledge of pedagogy. All these aspects influence a learner’s attitude towards mathematics and its performance. In fact, as preschool teaching becomes formal, the children’s interests, ideas and ability to absorb knowledge should remain at the centre of providing early mathematics education. However, such activities rely upon a teacher’s existing knowledge and previous teaching experiences which in turn guides and influences their teaching practices.

2.5 The curriculum

A curriculum consists of educational objectives and values which include content, structure and processes of teaching and learning which help mould children’s understanding of their

environment. This curriculum is provided by the school to guide and help the teacher to be focused in their teaching processes. According to MoE (2014) early childhood education centre is a social environment in which children learn about their surroundings and how to play with peers. The goal for learning is for it to happen naturally through real-life experience at the child's own pace. Children need freedom to explore on their own and not to be forced to do something. The teacher is supposed to provide an interesting environment with a variety of activities on a regular basis. As such a curriculum should be designed in such a way that it is not fragmented into rigid subjects. Therefore, the curriculum should respond to the child's unified outlook on life by itself being integrated. In addition the MoE (1996) states that the child at this stage has not acquired the analytical capabilities of separating the world of experience, which is combined and integrated, into clearly defined categories. The following is an extract of pre-mathematics topics which need to be covered at this level.

- (i) Classification and its sub-topics are matching, patterns and grouping.
- (ii) Numbers and its sub-topics it's counting and pre-writing
- (iii) Plane shapes and its sub-topics are lines and shapes
- (iv) Measurement and its sub-topics are length, width and time.
- (v) Commercial Arithmetic and its sub-topic is money.
- (vi) Addition
- (vii) Subtraction

2.6 Chapter conclusion

In this chapter, the notion of pedagogical content knowledge was discussed. Shulman (1987) identified PCK as one of the most important knowledge that teachers should have to effectively teach. Ball, Thames and Phelps (2008) conducted a research on content knowledge and pedagogical content knowledge with the aim of defining the domain of mathematical knowledge for teaching and refining its sub-domains. The results of each aspect selected by the researchers encouraged the researcher to use theoretical framework which was designed by Vygotsky and it was used for both the collection and analysis of the data.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter provides insights into methods and approaches employed to collect data. It covers the research design, target population, sample size and sampling techniques, research instruments, data collection and analysis procedures. In addition, the chapter considers how the collected data was analysed to help with interpretation to enable meaningful discourse.

3.1 Research Design

The researcher used a qualitative exploratory study design to allow in-depth understanding of PCK of preschool teachers from selected preschools in Lusaka. The research utilized non-numerical data collected through semi-structured interviews (appendix 1) and class observations (appendix 2). The enquiry was systematic, planned and documented using a voice recorder so that all information is not lost or distorted and for better transcription later. The interview process was based on Neuman's (2000) open questioning procedure which allowed the teachers to voice their opinions, perceptions and experiences. The in-depth interviews aimed at understanding how issues were defined without imposing pre-formulated and rigid questions. According to Wilson (1993:114) qualitative research relies on first-hand knowledge under natural conditions and on unstructured data collection method in which the researcher is the primary instrument or tool for data collection. This allowed the study to have the richness, texture and feeling of raw data in the teachers own words. The interviews were carried out in a relaxed, non-formal manner.

3.2 Study site

Three preschools; A, B and C were selected in the Kabwata Constituency of Lusaka District. The procedure used for the selection was purposive convenient sampling. All the schools were located within reach of each other. For this reason, it was economical to carry out the research as the travelling costs were minimal. However, note that these pre-schools may not be representative.

3.3 Study Population

Neuman (2000) defines a population as a group of individuals, objects or items. Three pre-school teachers were selected each from a different school for the purpose of the study.

3.3.1 Sample size and sampling procedure

The study used purposive sampling because the characteristic of the participants was well defined and these were three pre-school teachers. According to Neuman (2000) a sample is defined as a piece or segment which is representative of a whole.

3.3.2 Pilot Study

Interview guide and observational checklists were pilot tested at D and E pre-schools in Kabwata constituency in Lusaka. This was done as a trial phase to test the research procedure especially in consideration of how to use open ended questions. At each school, only one teacher responsible for the pre-school grade was picked as the respondent to attend to the researcher's request. One week was accorded to utilize for the pilot phase.

The pilot study helped to find the right balance between use of open-ended questions, the danger of asking leading questions and its consequences, failure to listen closely and probe where necessary, failure to judge answers and asking vague or insensitive questions. Observations of the gaps and logical flow of the questions were made, repeating questions were removed and irregularities were corrected in ensuing checklists.

3.4 Data Collection Method

Data was collected through in-depth semi-structured interviews and observations (lesson and classroom) on the selected pre-school teachers in their respective schools. Employment of a multiplicity of methods enabled the researcher to capitalize on strengths of one method to compensate for weaknesses of another in the overall research design thereby ensuring collection of valid data and avoiding biases and reliance on single perspectives.

3.4.1 Lesson observation

During classroom observation, the researcher sat in class and observed the lessons using a guiding checklist. Observation also included taking note of the environment, both outside and inside the classroom. Of interest was the layout of the available facilities and how these were engaged in the teaching process. The aspect of "talking walls" was of particular interest with regard to the type of wall charts and pictures. In addition, the colours of tables and chairs including toys and other teaching aids provided features of interest. After the session was completed clarity was sought from the teacher on issues that needed more explanation.

3.5 Data analysis procedures

Data was analysed using thematic analysis and the recordings were transcribed. Themes were identified and manual coding was used. Another method that was used to analyse data was constant comparative method which involved on-going analysis of similarities and differences. The comparisons were used to check the consistency and accuracy of the application of the codes and themes used during the research.

Practical procedures and techniques that could help with interpretation of the findings assumed five key phases undertaken in a linear fashion allowing all data to be collected before analysis begun. The stages included organizing the data, familiarizing oneself with the data, generating categories and themes, coding the data and interpreting.

3.5.1 Organizing the data

After the interviews, the researcher transcribed the recorded interviews and observational classroom notes, read repeatedly the transcript for internalization and allowing themes to evolve as more text became apparent. This involved typing out the interviews, rather like a play script as analysis focused on identifying meaningful discourse and symbolic interaction found in the respondent's use of language and expression. Having a typed transcript was convenient for constant comparisons to be made as a way of getting to grips with details of such discourses. Minor editing was done generally to “clean up” what seemed overwhelming and unmanageable. This cleaning up was very important as it created a more complete record, saved on time and stimulated analytic thinking. It was important to make sure that interview transcripts were dated and identifications on who was interviewed when recorded.

3.5.2 Familiarizing oneself with the data

Familiarization involved repeated reading through the transcripts and asking someone else to read through for editing purposes and co-ordinated grammar. Whole transcripts and reading of observation notes from each respondent was done, each time identifying categories and emerging themes then refining during subsequent stages. A common activity in data analysis involved making comparisons of text passages and events the respondents talked about, their themes and topics, phenomena discussed, mode of expression or form of words used with those in other passages.

3.5.3 Generating categories and themes

Rossmann and Rallis (2003) defined coding as “a word or short phrase that captures and signals what is going on a piece of data.” Further, they agree that this phase of data analysis was the most

difficult, complex, though uncertain, creative and also fun. Thoughtful analysis demanded a sensitive awareness of the data and openness to the indirect application of PCK for the pre-school teachers.

3.5.4 Coding the data

Transcribing and coding the data was a time-consuming task although it proved exciting and challenging. Rossman and Rallis (2003) explain that coding was the formal representation of analytic thinking. After transcribing and coding, the researcher arranged a meeting with the research supervisor to reach a consensus on the themes and categories emerging from the transcribed data.

When coding data there was need to be clear on what words or phrases illustrate and elaborate each concept. This coding process (associating labels with text) demanded for close reading of the text, combing data for themes, ideas/concepts, terms or phrases, keywords and categories and then marking similar passages of text with a “code label” so that they could easily be retrieved at a later stage for further comparison and analysis based on relevance to the set objectives. Coding made data search easier to make comparisons and identify any patterns that required further investigation.

Codes were given meaningful names that gave an indication of the idea behind the theme or category. If a theme was identified from the data that did not quite fit codes already existing, a new code was created. As the researcher read through the data set, a number of codes evolved and grew as more themes became apparent and helped to identify issues contained in the data. Mostly when coding, the researcher had some codes already in mind but also looked for other ideas arising out of the data.

3.5.5. Scope and limitations of the study

Seemingly the school managers were hesitant to allow the researcher to conduct the research for fear of it being investigated from the Ministry of Education or the police. It took a lot of explaining to convince them that this was purely for academic purposes.

3.5.6. Chapter conclusion

This chapter described the research design and methodology in detail. The researcher developed a semi-structured guide and observation checklist as the data-collection instruments designed to produce responses relevant and essential to the research problem. The researcher collected all the information in person and confidentiality was maintained throughout the study.

CHAPTER FOUR: FINDINGS

4.0 Introduction

This chapter presents findings of the study. In this section, the researcher presented the findings obtained in the field using the objectives of the study. The following were the three objectives that guided the study.

Research objectives were as follows:

- To examine the activities used in the teaching of mathematics in selected preschools
- To analyse preschool teachers' awareness of factors that foster learning of pre-mathematics.
- To analyse the importance of a teacher's conduct in the teaching of mathematics

4.1 Activities preschool teachers engage in the teaching of mathematics

This is the first objective which sought to identify activities pre-school teachers engage in the teaching of mathematics. As pertaining to this objective, three major themes emerged namely developing number awareness, developing writing skills and having fun.

4.1.1 Developing number awareness: this came in to play as a result of the sub-theme namely counting and consolidating numbers.

4.1.1.1 Counting

In relation to counting further sub - themes were established namely counting numbers, counting some objects (e.g. bottle tops, stones) and singing counting songs.

4.1.1.1.1 Counting number

All participants had a different way of introducing a mathematics lesson.

Teacher A orally counted with the children numbers from 1 up to 20 by pointing at the wall chart and the children were shouting the numbers as she pointed at a number. As for Teacher C, she first started by showing the children a chart with 50 digits on it then showed the children flash cards with a digit on it from number zero to number nine. Then she started showing them the flash cards. Children were instructed to shout the numbers as she pointed at them. Below are some excerpts:

Teacher A: Children look at the chart and tell me the numbers when I point

Children: Ok teacher!

Teacher: what is this number?

Children: Number 1

Teacher: What is this number?

Children: Number 2

Teacher: And this one

Children: Number 3

Teacher: Number

Children: Number 4

Teacher: Number what?

Children: Number 5

Teacher: And number what?

Children: Number 6

Teacher: Children

Children: Number 7

Teacher: Number what?

Children: Number 8

Teacher: And just pointed

Children: Number 9

Teacher: And the last One!

Children: Number 10

For teacher B, she started by asking the children to name the days in a week

Teacher: Children let us name days of the week

Children: Monday, Tuesday.....

Teacher: Ask the children to name the days in good order.

Children: Sunday Monday, Tuesday Wednesdays, Thursday Friday, Saturday

Teacher: Introduced the song, Sunday, Monday, Tuesday.....

Children & Teacher sang the song together, Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, and Saturday.

Teacher: How many days are in a week?

Children: There are seven days in a week.

Teacher: what is today?

Children: Monday

Teacher: Yes today is Monday.

Teacher: Children, what was yesterday?

Children: Sunday!

As for Teacher C she first started by showing the children a chart with 50 digits on it. Then she started showing them flash cards in sequential manner one after another. Children were instructed to shout out the numbers

Teacher: Children tell me!

Children: Number zero

Teacher: What can you see

Children: Number one

Teacher: Number what?

Children: Number two

Teacher: What number is this?

Children: Number three

Teacher: Number?

Children: Number four

Teacher: What number is this Children?

Children: Number five

Teacher: How can you write number five?

Children: Showing signs like this and this!

Teacher: Ok and what number is this?

Children: Number six

Teacher: what number is this?

Children: Number seven

Teacher: Number what?

Children: Number eight

Teacher: Number what?

Children: Number nine

Teacher: How can we write number ten?

Children: Write a one and zero

Teacher: Putting number one and zero on the flash cards together

children: Yes, teacher

Teacher: Show the children real objects (pencils) – and stress that there are ten pencils

Teacher: Ask the Children to count the pencils

Children: Count from number one to ten

Teacher: Show the children the numeral 10 on the board and read it with them

Teacher: Children now write number one up to 10 in your books

4.1.1.1.2 Counting some objects

Teacher used body parts to count objects. Teacher A together with the children counted number from 1 up to 10.

Teacher: Shouted number 1 and showed the children a card which had 1.

Children: Raised one of their fingers to show the teacher.

Teacher: showed a card with number 2 to the children

Children: Raised two fingers to show their teacher.

Teacher: showed a card with number 2 to the children

Children: Raised two fingers to show their teacher.

Teacher: Ask the children to mention how many items they see on the flash card as she showed them.

Children: Raised their fingers and shouted the number according to the numeral they see on the card.

This went on till when all the ten cards were finished.

Teacher B showed first number 1 up to 20 to the children on flash cards. Then she told the children that they were going to learn about number sixteen.

Teacher: Ask the children to write numbers in the air first from 1 to sixteen.

Children: Write imaginative numbers in the air

Teacher: Tell the Children to write number sixteen

Children: Raised their fingers and imagine to write number sixteen in the air.

Teacher: Gave the books to the children and asked them to trace out number sixteen in their books.

Children: Started tracing out number sixteen in their books.

In the follow up interviews, research revealed that teachers started their lessons in pre-mathematics with nursery rhymes and the following were typical examples of what transpired in Teacher A and teacher C's classroom.

4.1.1.1.3 Singing counting songs

Both Teacher A and C introduced the concept of counting by singing the counting rhymes when it was time for pre-mathematics. As for teacher B she did not do any singing of rhymes when starting to teach pre-mathematics. The activities which happened in teacher A and Teacher C's class were the researcher observed the two teachers singing with their children the songs went as follows:

Teacher A's class:

Teacher: Finger one, finger one where are you?

Children: Here I am, here I am ... How do you do?

Teacher: Finger two, finger two where are you?

Pupil: Here I am, here I am ...How do you do?

Teacher: Finger three, finger three where are you?

Pupil: Here I am, here I am ... How do you do?

Teacher C's class

Teacher: 1,2,3,4,5

Children: Once I caught a fish alive

Teacher :6,7,8,9,10

Children; Then I let it go away

Teacher: Why did you let it go

Children: Because he bit my finger so

Teacher: Which finger did it bite?

Children: This little finger on my right!!

4.1.1.2 Consolidating on number

Similarly, in relation to consolidating numbers, further sub-themes were established namely: going through the numbers, knowing numbers and measuring scoops of sands.

4.1.1.2.1 Going through the numbers

Two out of three participants did this activity in a similar way. A typical example is that of teacher B and teacher C. While teacher A just instructed the children to count with her the

numbers. Teacher B introduced the concept of counting by point at the number chart which was stack on the wall in the classroom. She was pointing at the numbers in ascending order, and when she points at a number children were made to shout the number in question.

As for the interview when teachers were asked to mention the activities that took place in their respective classes. They all had similar answers apart from teacher C. The following were their responses:

Teacher A

(paused)....in the morning we start by going through the charts on the walls, for the children to be ready for the lessons because we can't just start teaching whilst (paused) they haven't prepared for the lesson, so we have to go through the numbers, the letters on the walls for the, for the preparation of the mind of the children.

Teacher B

Pointing at the number chart which was stack on the wall in the classroom.

Children: Shouting the numbers as the teacher points at them.

Teacher C

Said "we are preparing them to go to grade 1 most of the activities are pre-writing and pre-reading. Writing are activities that you do to help them to know how to write up while reading are activities that you help them to know how to read. There is also numeracy. We call it pre-mathematics. This is where learners do the counting adding using real objects and subtracting using real objects.

4.1.1.2.2 Knowing numbers

Similarly, in relation to consolidating numbers under the theme "knowing numbers", the responses were similar from all the 3 participants A, B & C. The only difference was the numbers which they were instructing their children to count and trace.

Teacher A's class

Teacher: showing the children a chart with eleven objects

Teacher: Children can you mention the items on the flash cards

Children: A banana, an orange, a hammer, a boat, an aeroplane, a cup, a plate, a ball, a clock and a bird.

Teacher then stressed that there are eleven objects and she did mention the objects.

Teacher: count the items with me children

Children: One, two, three, four, five, six, seven, eight, nine, ten & eleven.

Teacher: Write the numeral nine on the board

Children: Looking at the board to see number nine

Teacher: Children say number nine

Children: Number nine

Teacher: Again say it and you shout

Children: Number nine

Teacher: showing the numeral nine on the board and read it with them.

Children: some were looking at the board to see the numeral nine.

Teacher: Showing the children how to write nine in the air.

Children: Demonstrating how to write number nine in the air.

Teacher: Giving the books to the children and instructing them to write number nine in their books.

Teacher: Telling some children to trace the numeral nine in their books.

Children: Tracing number nine in their books

Teacher: Going around checking what children are doing and helping them where they need be.

Teacher B she shows first number 1 up to 20 to the children on flash cards. Then she told the children that they were going to learn about number sixteen.

Teacher: Ask the children to write numbers in the air first from 1 to sixteen.

Children: Write imaginative numbers in the air

Teacher: Tell the Children to write number sixteen

Children: Raised their fingers and imagine to write number sixteen in the air.

Teacher: Gave the books to the children and asked them to trace out number sixteen in their books.

Children: Started tracing out number sixteen in their books.

Teacher C's class also had a similar activity.

Teacher: showing children 5 objects, number 1, number 2, number 3, number 4 and number 5 in form of building blocks.

Children: Looking at the building block

Teacher: Instructing children to say the numbers as she showed them.

Children: counted up to number 5 as teacher was showing them one number at a time

Teacher: Telling children that they were going to learn about number five.

Teacher: instructed the children to write number five in the air.

Children: Imagining writing number five in the air.

Teacher: Telling children to write number five in their books

Children: Started writing number five in their books.

4.1.1.2.3 Measuring Scoops of sand

Research finding revealed another activity which was supposed to take place in these classes.

All the 3 participants, A, B & C did not engage in this activity.

Teacher C in the follow-up interviews openly said that going out to play with sand made her very tired.

The other two participants did not say anything on this activity.

Table 1: Activities preschool teachers engage in the teaching of mathematics

Codes	Category	Theme
<ul style="list-style-type: none"> - Counting numbers - Counting some objects (e.g. bottle tops, stones) - Singing counting songs 	Counting	Developing number awareness
<ul style="list-style-type: none"> - Going through the numbers - Knowing numbers - Measuring scoops of sand 	Consolidating on number	
<ul style="list-style-type: none"> - Learning writing letters through sight - Going through letter charts on the wall - Knowing how to write letters - Identify letters on cards 	Identifying letters	Developing writing skills
<ul style="list-style-type: none"> - Drawing pictures - Drawing real objects - Doing the printing - Painting objects 	Creating images	
<ul style="list-style-type: none"> - Going for outside activities - Preparing graduation ceremony - Enjoying outside play - Out-door games tiring 	Playing out doors	Having fun
<ul style="list-style-type: none"> - Imitating real life - Narrating the story - Playing games - Going through science activities - Distributing of toys in class 	Imaginative play	
<ul style="list-style-type: none"> - Singing songs [examples: <i>i.</i> a, b, c, d; <i>ii.</i> finger 1 finger 1 where are you? Here I am, here I am how do you do? <i>iii.</i> One man and a dog walking to Lusaka....] - Dancing 	Singing and dancing	
<ul style="list-style-type: none"> - Going for break - Ending the lesson (Finishing, Ending at 12.30) - Breaking for the day 	Relaxing the mind	

4.2 Factors considered important for a successful mathematics lesson

This is the second objective which sought to identify the factors that foster the learning and teaching of pre-mathematics. Pertaining to this objective, three major themes emerged namely teaching approach, teaching style and using resources.

4.2.1 Teaching approach: In relation to this theme, further sub-theme were established, namely facilitating learning and encouraging learning.

4.2.1.1 Facilitating learning

In relation to facilitating learning, the respondents further raised sub-themes established namely helping children to develop mentally, engaging children in creative activities that help them to

learn, constant practice enabling children to learn how to write more quicker and helping children to know their language.

4.2.1.1.1 Helping children develop mentally

All participants had their own way of describing how children were supposed to be helped in order to develop mentally.

Teacher A had this to say;

“To put the children in the mood of mathematics lesson, we start by singing the counting songs and count some objects for the mind to be prepared”. After that, the teacher said that they would introduce the learners to the numbers.

Teacher B had this to say;

She would help them to identify numbers from one up to 20 for the children to develop mentally. Being the teachers’s responsibility of teaching them how to write she said that she did so and also helped them how to draw. It is therefore very important for them to start at an early age with these activities that they are taught.

Teacher C had this to say;

In order to help the learners, the teacher said she used real objects unlike just explaining in abstract terms so that the learners can get the concepts right.

4.2.1.1.2 Engaging children in creative activities that help them to learn

All 3 participants A, B & C had their own way of expressing this theme respectively and the following were their responses:

It helps their muscle because finger muscle of children, they know how to write quicker than those who have not gone through creative activities even the muscle

These activities which I have mentioned are important to the children because they help in the growing of the mind of the children they help in that area like creative activity, it helps their muscle finger muscle of children to be quicker in terms of writing than those who have not gone through creative activities

These activities help learners to know how to write and read. they also improve their vocabulary. They also improve children’s fluency

4.2.1.2 Encouraging Children

In relation to encouraging Children, the respondents suggested that asking children questions and getting their responses put children in the right frame of mind as they paid particular attention to each child

4.2.1.2.1 Asking children' questions

Generally, all the respondents had a similar way of conducting this activity, for instance one of the teachers conducted this typical example;

Teacher displayed various items on the table and started asking the children to identify them

Teacher: what can you see on the table?

Pupil A: Pencil

Pupil B: Pens

Pupil C: Sticks

Pupil D: Books

Teacher: How many pencils are on the table?

Pupil A: (Started counting the pencils and shouted) 7

Pupil B: (Counted the pens and shouted) 3

Pupil C: (Shouted out after counting) 11

Pupil D: (She counted and said) 5

Teacher: Children, put the items in order of size starting with the smallest.

According to the teachers this activity is used to put the children in their right frame of mind.

4.2.2 Teaching style

In regard to this theme, two sub-themes were generated namely guiding learning activities and varying learning activities. These also spring in to other smaller units. Under guiding learning activities those that pertained to the teaching of mathematics, were the following: Starting day with singing, starting teaching letters, starting with topic news and teaching the topic. Then under varying activities there are the following units: Painting objects, Instructing Children to bring learning materials to class e.g. Crayons, bottle tops, stones, grass stalks, Giving children specific instructions in class.

4.2.3 Using resources

As for this theme, again two sub-themes emerged namely Concrete objects and semi-concrete objects were generated by the respondents. Under each sub-theme, several units were generated. Under Concrete objects were stones, bottle tops, Crayons, paints, paper, water, lemon and other real objects. As for semi-concrete objects, there are wallpapers, flow charts and flash chart. One of the participants commented that one cannot just mention a number without children seeing it.

Table 2: Factors considered important by preschool teachers

Code	Category	Theme
<ul style="list-style-type: none"> - Helping children to develop mentally - Engaging children in creative activities that help them to learn - Constant practice enabling children to learn how to write more quicker - Helping children to know about their environment. - Helping children to know their language 	Facilitating learning	Teaching approach
Asking the children questions <ul style="list-style-type: none"> - Answer the question asked Putting children in the right frame of mind Paying particular attention to each child	Encouraging children	
Starting day with singing Starting teaching the letter Starting with topic news <ul style="list-style-type: none"> - Teaching the topic 	Guiding learning activities	Teaching style
<ul style="list-style-type: none"> - Painting objects - Instructing children to bring learning materials to class e.g. crayons, bottle tops, stones, grass stalks - Giving children specific instruction in class 	Varying learning activities	
<ul style="list-style-type: none"> - Stones and bottle tops - Crayons, paints, paper and water - Lemon and other real objects 	Concrete objects	Using resources
<ul style="list-style-type: none"> - Wallpapers - Flow Charts - Flash Cards 	Semi-Concrete objects	

4.3 Teachers' conduct in teaching of Pre-mathematics

Three major themes emerged under this objective namely fostering learning, inhibiting learning and developing child's mind.

4.3.1 Fostering learning

Research finding showed a number of issues that were revealed under two sub-themes namely being good to the children and being supportive. The 3 Participants had this to say:

Teacher A: One is not supposed to be harsh to the children, then not to shout at them, but rather listen and understand them.

Teacher B: When handling little ones, one must be very patient and interested in them, as they are different from the big ones.

Teacher C: One should avoid beating and insulting the children

Table 3: Teachers' conduct in teaching of mathematics

Code	Category	Theme
<ul style="list-style-type: none"> - Being a humble person - Being understanding - Being friendly - Having a kind heart - Listening to the children 	Being good to the children	Fostering learning
<ul style="list-style-type: none"> - Having interest - Needing more patience - Having self-confidence 	Being supportive	
<ul style="list-style-type: none"> - Being harsh - Shouting at the children - Going to demoralize them - Using abusive language 	Being unsupportive	Inhibiting learning
<ul style="list-style-type: none"> - Giving clear instructions - Requiring the children to pay attention - Asking the children to bring learning resources - Telling the children to do lesson activities. 	Teacher instructions	Developing child's mind

4.3.2. Chapter conclusion

This chapter presents the findings on the three teachers' knowledge of the subject matter; knowledge of teaching strategies and knowledge of teachers' conduct. The findings revealed that all the teachers were lacking in one way or the other in the way they handled the lessons concerning the subject matter. They had insufficient knowledge of teaching strategies and knowledge about learners' misconceptions and learners' difficulties on how they handled certain topics.

Of the three participating teachers, no one had an opportunity of attending any continuous professional development workshops opportunity which could in a way help them to improve or develop knowledge about the content and teaching strategies/approaches.

CHAPTER FIVE: DISCUSSION

5.0 Introduction

The purpose of the study was to establish Pedagogical Content Knowledge of a Zambian preschool teacher of pre-mathematics. The study was guided by the following research questions:

- a. What activities do preschool teachers engage in the teaching of mathematics?
- b. What factors do preschool teachers consider important in fostering the learning of pre-mathematics?
- c. What should be the conduct of preschool teachers in the teaching of mathematics?

To answer these research questions, the researcher employed a qualitative explorative study design. Three preschool teachers in Lusaka participated in the study. Data were collected using lesson observation checklists and semi-structured interviews using an interview guide. Data analysis was done using a process of constant comparison which gave rise to codes, categories and themes. Themes formed the basis of the answers to each research question. The discussion that follows will consider each research question in turn.

5.1 Activities used in the teaching of preschool mathematics

The first research question was on activities used in the teaching of preschool mathematics. Analysis of interview transcripts, lesson observation notes, codes, and categories in relation to this research question culminated into three themes namely: *developing number awareness*, *skills developing writing skills* and *having fun*.

5.1.1 Developing number awareness

Relating to developing number awareness, a number of statements made by participants showed that a lot of activities done with the children related to the development of number awareness. For example, as pointed out in Chapter 4, **Participant A** started her mornings by *going through charts* on the walls for the children to be ready for the lessons because “*we can’t just start teaching whilst they haven’t prepared for the lesson, so we have to go through the numbers*”. **Participant A** further said that her mathematics lessons started with singing the counting songs and counting objects “*for the mind to prepare*”. **Participant B** also employed a number chart to make the children aware that when its mathematics time then it’s to deal with numbers. She consolidated the concept of number accord+ by pointing to the numbers on the chart and asking children to sing the nursery rhyme which involved shouting out numbers. **Participant C**

instructed children to draw the numbers in the air. This showed that developing number awareness was regarded as an important activity.

All the participants started their lessons with an activity on counting. According to Aubrey (1997:104) stated that Counting is a pre-requisite to other activities in mathematics for the early years of learning. In the lessons the researcher observed, *Participant A* engaged the children in singing counting nursery rhymes accompanied by actions in which children were showing the number of fingers in ascending order according to the lines in the rhyme. In line with the theoretical framework which guided the study that children need to be guided and with continuous practice, the concept would have developed and be cemented in their right framework of mind.

The rhyme went on until the children could count up to ten. However, Participant A did not appear to pay sufficient attention to children's actions with the number being counted to the number of fingers being shown. For example, some of the children were showing actions that were contrary to the number being shouted out while others were playing and not concentrating to what was happening around them. Some of the children were not able to relate the singing to the counting implied in the rhyme and so the learning intended was not wholly achieved, and yet the teacher did not seem to notice. Had she noticed, she would have corrected the situation immediately. Showing actions which did not match with the words of the song should have signalled to the teacher that the words of the song probably did not have meaning yet to the children. Good mathematical knowledge for teaching number sense should have alerted the teacher that children needed to relate what they were doing to real life situation, a possible learning gap that needed to be attended to. For example, the teacher could have responded by using concrete objects which the children were familiar with. In agreement with the notion Dewey (1987) suggested that experience was the cornerstone from which new knowledge is created, promoting authentic, meaningful experience that foster knowledge growth. In supporting this concept, Aubrey (1997:104) stated that children relied heavily on counting and number knowledge to solve simple arithmetic problems in concrete situations. Observations revealed that the children were enjoying the lesson by shouting and jumping when giving out the answers.

In another lesson, after the singing of the rhyme 'Once I Caught a Fish Alive' *Participant A* introduced multiplication. The teacher used dots to illustrate the concept. However, the children had difficulties and failed to group the dots drawn on the board. Teacher then tried to use the date

of 18th in the example from the exercise given above. She picked on question C which had the product 18 and asked the children what date it was. In unison, they shouted the number 18; the date on that particular day. Then she requested the children to collect 18 sticks and group them in threes, and asked how many groups the sticks were making? Some Children managed to come up with 6 groups while others failed to group the sticks accordingly. Even this real-life concept did not seem to achieve the intended purpose. Only some of the children seemed to understand the concept while some did not fully participate in the learning activity. Moreover, this topic of multiplication was at an advanced stage for the pre-grade because it is only taught to grades and not at pre-grade. This is in agreement with the curriculum which has no topic on multiplication at this level. The topics go up to subtraction and not multiplication. So from this the researcher concluded that the teacher was teaching from her head and not referring to the required content which was supposed to be taught.

Although the participants carried out many wonderful activities that support early childhood development of number awareness, some of the activities were not age appropriate. This was evident from what ***Participant A*** portrayed. Some topics taught at pre-grade include “Count Numbers/Objects Orally”, “Match and Trace Numbers”, “Group Familiar Objects according to their Size, Colour and Shape”, “Identify Zambian Coins”, “Make patterns using different objects etc.”

The next day ***Participant A*** changed the topic from multiplication to matching of simple numbers. This involved writing random numbers on the board and then placing subsequent dots against them in a random manner. It was evident that ***Participant A*** changed the topic because she noticed the difficulties the children were having in understanding the intended concept. The children were then asked to copy the work and match dots to corresponding numbers in their exercise books. This activity showed the teacher’s commitment to developing number awareness. Her strategies of switching between teaching styles/ topics showed that she was merely experimenting on what would work for the lesson and not equipped with skills necessary for teaching pre-school mathematics. Sound mathematical knowledge/curriculum for teaching requires that a teacher matches what she is teaching to the level of the children she is handling. This knowledge gap, if left unattended, renders the children to suffer the consequences in future.

Following a foregoing, the conclusion is that the concept which Participant A was trying to teach the children was too advanced for children's cognitive assimilation. In agreement with Wadsworth (1989) the children were able to integrate new perceptual, motor or conceptual matter into existing schemata patterns of behaviour.

On the other hand, *Participant B* employed a numbers chart as a teaching aid for counting. She pointed out to various numbers which the children shouted in unison. This approach seemed beneficial to the lesson's intended objective as the children's responses were overwhelming. They quickly mastered the numbers and were able to participate in the shouting out of natural numbers. The activity was reinforced by showing flash cards with numbers written on them. Children were instructed to shout out the relevant numbers as she pointed them out.

Apart from this, *Participant B* also had well prepared expected objectives outlined thus: if (i) the children were matching items correctly and (ii) if children were able to count correctly. In addition, *Participant B* also used teaching aids including stones, pencils, flash cards, lollipop sticks and wall charts for teaching counting. This was in line with Aubrey (1997:104), who stated that "children learn better when they use concrete objects". Use of concrete objects allows the children to develop concepts within a real-life context; allowing them to bridge the gap between the concrete and abstract. Mathematics becomes abstract too early for children, in fact, using stones did not seem to be safe teaching aids for learners of that age. Inquiring from *Participant B* whether she realised that stones were dangerous for children, in response she said for as long as they were guided on what to do with the stones then, they were not dangerous. *Participant B* explained that she was trying to be resourceful so that even in the absence of building blocks she was still able to teach and an added advantage was that stones were readily available. Stones and sticks were easily accessible while building blocks needed funds to purchase them. This provided evidence that *Participant B* knew the importance of counting as an activity and had a proper know how of how to impart the required concept in the children. She understood that judging from just shouting the numbers could give her a wrong picture, thus she realized that for the children to understand the concept clearly there was need to be resourceful in the absence of building blocks as children at this stage mastered the concept by use of concrete items. So she used a variety of activities concerning counting before she could finally conclude that the objectives had been achieved. However, some of the activities were not age appropriate, unless

under close supervision. The following day *Participant B* went through the same work activity just to make sure that the intended concept was internalised.

As for *Participant C*, the first activity was counting numbers orally up to 20 in unison with the children. She then collected some exercise books from her table to represent teaching aids and instructed children to be counting in unison by shouting numbers as she put the books back, one at a time. *Participant C* then instructed the children to write numbers in the air starting from number one to twenty. Thereafter, she informed the children that they were going to learn about number 16 and reinforced the learning by instructing them to write the number in the air several times. Then templates with number 16 were given to some children to trace, while others were instructed to draw the number 16 in their books. When the researcher tried to inquire as to why the variation, Participant C said that they were at different levels in-terms of grasping concepts. Basing on this activity, the researcher deduced the theme of number awareness. All the participants had the knowledge about numbers; the only problem was how to put the intended objective across

5.1.2 Developing writing skills

Teachers and parents should encourage writing skills in the children as this will make a big difference in developing their writing skills. A child with proper guidance and support can be assured of a better future. Suffice to note that mathematics education equips children with skills necessary for lifelong learning, achieving aspirations and for attaining personal fulfilment (Kilpatrick, Swafford, & Findell, 2001). From the foregoing, it appears that a teacher needs appropriate skills, support and knowledge in order to effectively facilitate development. Ball (2000) emphasize how teachers' Pedagogical Content Knowledge is a major determinant of teachers' choice of examples, explanations, exercises, items, and reactions to children's work. Teachers need to be equipped with appropriate skills to enable them know how to adjust once faced with a situation like the one which Participant A was entangled in. As children were singing the rhyme which participant A instructed them, they were also playing.

According to the Curriculum Development Centre (2014) play is defined as children's work; and it's important because it is linked to learning, growth, and development. Aubrey (1997) acknowledges that there is a strong link between play and learning for young children, especially in the areas of problem solving, language acquisition, literacy, numeracy and social skills. The

people children socialize with and the games engaged in at home build on play. Ultimately, play is considered as the process that supports development of a child as a whole.

Play was particularly evident at break time. Although claim was made that time was set aside for the children to play, they displayed irregular organized play. The researcher did not see organised play happening in all the three schools visited. Note was made that it was easy for a child to understand what was being done using familiar objects because then learning would be meaningful. The teacher's method of instruction should accommodate the natural thought processes of the child through play by involving them in practical activities and allowing them discover things for themselves through drawing, sorting, classifying, measuring and investigating; challenging their existing level of thought. In every lesson, children should be given the opportunity to do, talk about what they are doing since in this there is a skill which they gain as they talk about what they do or draw.

Engagement in a lot of activities in the teaching of mathematics such as matching, sorting, classifying and identifying of numbers was mentioned. However, in the lessons observed, the children were mostly taught in abstract; without using any concrete objectives allowing the children to relate. As a result, they were making a lot of noise, in keeping themselves occupied. Observation was made that when it was time for mathematics, children were instructed to count numbers by singing and then the lesson was introduced. Participant A taught without having any form of teaching aid or lesson plan as such it was difficult to keep track of what was being taught let alone the progress the children were making. This finding did not reflect well on the participant. Research findings revealed that lesson planning was the most important factor that contributed to fostering of teaching and learning of pre-mathematics. The researcher did not see any evidence of planned work.

It appeared Participant B also did not understand that out of playing children would grasp the intended concept. Her teaching of only using teaching aids without combining it with play made difficult for the children to develop the concept within a real-life context. Only matching of numbers was taught to the children at the time of the visits. When going for break children were made to match in a single file and wash their hands then come back to eat their food. Participant B was strict with the children in that she even punished one girl by making her sit under the teachers table for almost 30minutes because of playing as she was teaching. She did not know

that planning her work by integrating play in her lessons would have brought the best out of the restless children.

According to Curriculum Development Centre (2014), learning is the process of behaviour change influenced by past and present experiences. It involves children through their five senses to explore and manipulate the world through interaction with others and the environment. If activities and lessons were planned to include play the children were not going to be easily bored while learning. In the context of play, children learn the meaning of words that are confusing, hear new words, and use words in both new and familiar ways. Children need opportunities to engage with their peers in play activities of their own devising sometimes, through which they can express themselves and explore things of special interest to them. Teachers are only supposed to assess what and how children learn through play by observing, documenting, and analysing their observations. They could then stimulate children to create, solve problems, and think critically. Vygotsky (1978) terms scaffolding as children having many opportunities to explore materials and making decisions with the support of an adult who knows how and when to intervene. For example, teachers could acknowledge what the children were doing in order to sustain and extend their interest.

According to the Canadian Ministry of Education (2006), *kindergarten program handbook*, play encourages creativity and allows children to become imaginative or build fantasy, thus the teacher could encourage a child by saying “I see that you have lined all your cars up in a row, what will you do next?.” In agreement, play in this context has been understood as a form of amusement or entertainment for children and a way of keeping children busy.

Seemingly Participant B felt that play was separate from learning and that it was an activity that merely served as time filler for the children and that it was important for the children since they could link it to learning. Children were encouraged to put their heads on the table and keep quite. Play also influences the development of social, intelligence, language development and creativity.

Participant C openly confessed that she did not like teaching the topic on measurement because this required going outside to play with sand; a factor that made her very tired. She did not know how to integrate play in her teaching to bring about learning and its importance. The Curriculum Development Centre (2014) states that a lot of play that the children engage in at home involves numbers. The teacher ought to know how to integrate play making her subject very interesting

and the children would not even know that they were learning mathematics if the teacher designed play so well. **Participant B**, confessed that she enjoyed outside play with the children because that was where they expressed themselves better. She pointed out that when the children were in class, they started making noise, and when stopped it demoralized them.

5.1.3 Having fun

Number statements and codes implied children were having fun in class and this is evident from the results in table 1(chapter 4). Common statements from all participants was the element of fun that the children were having as they played; giving rise to *having fun* as the theme from lessons observed. Most of the time before the teacher started the lesson, she would start by instructing the children to sing a song and they sung joyfully. Participant B even went to an extent of pointing at the letters on a chart where she had numbers written, and instructed the children to shout out the numbers as she pointed at them. She did this at the beginning of a lesson and it was helpful to build the understanding of numbers to children as they were relating what she was pointing at to what they were saying. The children had a chance of relating the symbols to the actual numbers as they shouted them out and looked at them.

From the extract “*we have to introduce Mathematics by starting singing counting songs and counting objects for the mind to prepare*” indicate that Participant A knew what she was doing including the value sought. When the period for mathematics was over Participant A introduced another lesson as creative activity where paints, papers and water was brought out. Participant A added that if required to make lemon print, a real lemon would be obtained for the children to see and be able to relate to real objects. Participant A led the children to sing the song “*one little finger, one little finger, one little finger tap, tap, tap...point to the ceiling, point to the floor and put it in your wrap.....*” The song also served as a mind capture to draw the attention of the children. They were playing as they sung. Here the Participant A tried to cement the concept of numbers in the children’s mind and she knew which songs to sing and the concept being put across for them to have fun as they learn. The songs highlighted some numbers and the children seemed to enjoy undertaking the activity and they did not show signs of boredom as they sang the songs. The researcher observed that in Participant B’s class children were some-how restricted to a certain extent on having fun. This was evident when it was time to go for break; they were made to match in a single file.

From the foregoing, the researcher could tell that the participants were engaging similar activities despite following different sequences and practices. Even if it appeared that the participants seemed to have some knowledge of how to go about the different ideas, there was need for education on how important the various activities were to the children in the learning process. These different activities had hidden educational value which required the teacher with the know how to bring the intended goal in the children.

5.2 Factors considered important for a successful lesson

The second research question was on factors participants considered important for a successful lesson. Data analysis in relation to the factors teachers considered to be important in fostering learning of pre-mathematics led to three themes namely; *teaching approach*, *teaching style*, and *using resources*.

5.2.1 Teaching approach

The concepts of *teaching method* and *teaching style* share some common but different attributes. According to the 2U Incorporation from the University of Southern Aubreyina (2009), the term *teaching method or approach* refers to the general principles, pedagogy and management strategies used for classroom instruction. The choice of teaching method depends on what fits the educational philosophy, classroom demographic, subject area(s) and school mission statement. In this context teaching approach gives rise to methods, the way of teaching something, which use classroom activities or techniques to help learners learn. Whereas *teaching style* is “a set of attitudes and actions that open a formal and informal world of learning to the student by the teacher’s instructional activities and it shapes the learning-teaching experience” (Butler cited in Mohanna, Chambers & Wall 2007).

Teachers may teach new concepts from different perspectives by various approaches so that children can grasp the ideas through meaningful and repeated illustrations. Teachers should encourage children’s active participation by more frequent use of teaching aids, games and activities. They can also make use of information technology and all the teaching resources available to help children understand the main points. *Participant A* pointed out that the teacher’s approach towards the planned work schedule and the use of designed teaching aids were important factors in the discourse of a mathematics lesson.

Throughout the teaching process, teachers should encourage the children to develop their generic skills, including interpersonal relationships, communication, problem-solving, self-management, self-learning, independent thinking, creativity and the use of information technology. Such training can lay the foundation for their life-long learning, help them develop positive attitudes and values as well as prepare them for future studies and careers. It is this backdrop that clearly indicates that a teacher's approach towards the teaching of mathematics is an important factor.

Therefore, it can be deduced that a well-organized work plan is a very important factor in the teaching of mathematics. According to Clark and Peterson (1986) planning is an important and often underappreciated aspect of teaching practice which ultimately impact students' opportunities to learn and planning is the time teachers spend preparing and designing activities for the children. From tasks and activities to instructional practices employed during lessons, teachers need to consider a variety of aspects of their instruction before the children even enter the classroom. Kilpatrick, Swafford and Findell (2001: 337) stated that "effective teachers need to pay careful attention to designing their lessons as teaching requires a considerable effort at design. Such design is often termed planning, which many teachers think of as a core routine of teaching." Clark & Peterson, (1986) argue for reviews of teacher planning and decision-making further emphasizing the centrality of planning processes in teachers' practice. Despite this general agreement about the importance of planning, few researchers have explicitly examined the precise ways in which teachers plan for mathematics instruction. The findings of this study are an important revelation of the importance of planning and should be used to inform policy on the need to invest in this technique.

The results of the data analysis show that the three participants had different viewpoints in explaining what factors were important for a successful mathematics lesson. In general, for example, when asked what factors were important for a successful mathematics lesson, ***Participant A*** said that it was important for a teacher to carefully plan his/her work and develop a comprehensive teaching aid so as to facilitate learning in a classroom. She further added that teachers should give concrete examples before proceeding to abstract concepts by way of simple and easy steps at a pace in line with the learning abilities of the children. In the class of participant B, the researcher observed that some children were given books with already traced numbers for them to trace where she made marks while others were told just to write number 16

in their books. When the researcher inquired why the difference, she was told that the children were at different levels of grasping the concept. This showed that teachers engaged in planning for all categories of children in her class.

In addition, *Participant A* also mentioned the need to have well-designed and comprehensive teaching aids. Each child has differences in terms of learning abilities, academic standards, classroom learning and academic performances and each has his own pace in learning. The aim of teaching aids is to provide learning support to children who lag far behind their counterparts in school performance.

By adapting school curricula and teaching strategies, teachers can provide learning activities and practical experiences to children according to their abilities and needs. They can also design individualized educational programs with intensive remedial support to help children consolidate their basic knowledge in different subjects, master the learning methods, strengthen their confidence and enhance the effectiveness of learning (Clark & Petersen, 1986).

5.2.3 Teaching Style

Participant B responded that using teaching style to teach children was important for them to understand what they were being taught. Like *Participant A*, she also mentioned that a successful lesson had to employ the use of comprehensive teaching and learning aids to guide the lesson though she emphasized importance on the teaching style when teaching mathematics. This has long been known but usually overlooked by most in the teaching profession. An effective teaching style engages children in the learning process and helps them develop critical thinking skills. No two teachers are alike, and any teacher with classroom teaching experience will agree that their style of teaching is uniquely their own. This is why traditional teaching styles have evolved with the advent of differentiated instruction, prompting teachers to adjust their styles toward children's learning needs.

Selecting a style that addresses the needs of diverse children at different learning levels begins with a personal inventory — a self-evaluation — of the teacher's strengths and weaknesses. Eric Grill (2013) noted that although it is not the teacher's job to entertain children, it is vital to engage them in the learning process. As teachers develop their teaching styles and integrate them with effective classroom management skills, they learn what works best for their personalities

and plan successful lessons that breed future learners. Since children have different characteristics in learning, teachers must devise different learning activities with the same teaching objective to develop children varied abilities and skills in problem solving. It is more effective for teachers to adopt a series of relevant and simple teaching activities than assigning one long teaching activity since children may acquire the required knowledge and skills through diversified activities.

5.2.4 Using Resources

Finally, *the use of resources* emerged as one of the important factors in the successful delivery of a mathematics lesson to children. Participant C, mentioned that a teacher has to be organized in their work and even use toys or other helpful resources in teaching such as stones, sand, paint or crayons. It was noted that the use of resources was helpful. Even though the researcher also supported the suggestion by Participant B of the teacher's style of teaching, she further added that in delivering a lesson to children, it was important to make the children use object resources around them in order to clearly make them understand some examples. The use of resources is meant to manipulate the children's minds so as to engage them in the classroom learning. This was an intriguing discovery as it helped the researcher have a broader perspective on the various factors that are available to teachers in order to produce a successful lesson. In most literature, this is referred to as the use of '*Manipulatives*' to teach.

According to Sutton and Krueger (2002) the use of manipulatives in teaching mathematics has a long tradition and solid research history. They note that manipulatives not only allow children to construct their own cognitive models for abstract mathematical ideas and processes, they also provide a common language with which to communicate these models to the teacher and other children. In addition, manipulatives have the additional advantage of engaging the children and increasing both in interest and enjoyment of mathematics. Sutton and Krueger further add that children presented with the opportunity to use manipulatives report to be more interested in mathematics. Long-term interest in mathematics translates to increased mathematical ability.

The importance of this finding from *Participant C* cannot be over emphasized. In fact, the National Council of Supervisors of Mathematics (NCSM, 2013) issued a position statement on the use of manipulatives in classroom instruction to improve student achievement thus "*in order to develop every child's mathematical proficiency, leaders and teachers must systematically*

integrate the use of concrete and virtual manipulatives into classroom instruction at all grade levels.” This position is based on research supporting the use of manipulatives in classroom instruction. In fact, Ruzic and O’Connell (2001) stated that long-term use of manipulatives has a positive effect on children’s achievement by allowing children to use concrete objects to observe, model, and internalize abstract concepts.

The above discussion shows that there are various factors that are important in the teaching of mathematics to children. A teacher is presented with an array of choice to employ and it is up to the teacher to understand what really connects with the classroom. A teacher has to understand the children both individually and collectively to be able to successfully communicate the lesson to them. Whether it is the teacher’s approach towards the teaching process, the style or method of teaching or the use of manipulatives and other learning aids, the goal was to communicate mathematics to pre-school children.

5.3 Importance of the teacher’s conduct in the teaching of mathematics

The third research question addressed what the participants considered to be of importance in the teacher’s conduct in the classroom. Findings on this research question centred around three themes, namely; *Fostering learning, inhibiting learning and developing the child’s mind.*

5.3.1 Fostering learning

This means the way the teacher conducts themselves or relates with the children can either foster learning in the classroom, inhibit learning and/or develop the child’s mind in the learning of mathematics.

Asked what a pre-school mathematics teacher’s attitude should be, Participant A responded that when teaching or giving instructions to children, a pre-school teacher is supposed to be humble, understanding and have interest in teaching pre-school children. She added that without interest in teaching, a teacher would be impatient and would therefore not manage to teach them. Participant A further said that a teacher should not be harsh or shout at the children but rather listen and understand them.

Participant B responded by saying that anyone that wanted to teach pre-school children should have a kind heart and care for the children. She further stressed that it was important for a pre-school teacher to be patient and have self confidence in teaching the children. She also added that

a pre-school teacher should not have a bad temper as this would hinder the children from understanding the lesson.

Participant C responded that a teacher needed to love and create friendship with the children and further treat them as his/her own children. She further stressed that the pre-school teacher should neither beat nor insult the children in a classroom.

From these findings, it is evident that all the participants were in consensus on the need to have a good attitude or conduct in the classroom. Other responses drawn out were the need for humility, kindness, self-confidence, having an interest in the class and children individually, being patient with their learning capabilities and creating a friendly learning environment. Most of these sentiments communicate two very important aspects of a pre-school teacher i.e. a teacher needs to be good to the children and offer as much support to them in all their learning activities both individually and collectively.

The teacher's attitude is very important in fostering learning. A teacher's presence in the classroom is supposed to foster an effective learning culture in the young minds so as to effectively communicate the subject to them. For example, if the children felt comfortable and free to express themselves in the classroom, they would be free to ask questions where not clear. By showing interest in the children and being supportive of their efforts, a teacher gains the necessary tools required to effectively teach the class.

5.3.2 Inhibiting learning

The opposite is also very true. Bad or unsupportive teacher's conduct in the classroom can inhibit the learning of the subject matter. All the participants in this study agreed that it was important to avoid being harsh in a class, practicing unnecessary shouting and yelling at the children, the use of abusive language or merely demoralizing the children. These were deemed unsupportive teaching practices and could negatively affect learning in the classroom. Children are supposed to be loved, nurtured and treated in a way which opens up their inner curious minds to knowledge and understanding. This certainly cannot be achieved with a bad teaching conduct in the learning environment.

Another thematic area that came out clear was that the teacher's conduct had an impact on the development of the child's mind. By giving instructions to the children on a daily basis, the teacher opens up the children's mind to the world of learning and activities. As mentioned in preceding chapters, a teacher could be the child's aid in development, referred to as scaffolding and bridging of the Zone of Proximal Development (ZPD). According to Vygotsky (1978) learning occurs in this zone and believes that the assimilation of these tools lead to higher thinking skills. In line with this, all the participants agreed in one way or the other that when teaching pre-school mathematics, a teacher must give clear instructions and ask the children politely to do lesson activities. Sometimes the teacher may also ask the children to bring learning resources or manipulatives as aids to the learning process such as stones and sticks. Ball (2000) stressed how the depth of teachers' understanding of mathematics was a major determinant of teachers' choice of examples, explanations, exercises, items and reactions to children's work more so when children's work related to what they did in real life situations. His evidence indicated that purposeful teaching and learning occurred when the teacher used appropriate pedagogical strategies during the delivery of the subject matter relating to children's experiences as this helped them to make sense of their experiences with people, places, and objects around them.

5.3.3 Developing Children's mind

The teacher using their professional knowledge of the subject to construct meaningful teaching while guiding the children towards prior knowledge and experiences rewards the children's lives in the contexts of their communities. This clearly shows how important the teacher's conduct is in teaching mathematics. A teacher should strive by all means to exhibit character that fosters learning in the classroom and also help children's minds develop by introducing them to a wide range of learning techniques. The researcher observed this happening in one of the classes when the teacher was showing flashcards to the children and asking them to shout the number on the card. Flashcards were a way of catching children's curiosity to tie their imagination of the number to the actual number and they help the children to enjoy learning from the expression they were making as they shout the numbers on the cards. This was observed in class for participant C where number 16 was shown to the children and they were asked to shout that particular number. As for participant B it was a chart of numbers which the researcher saw being

used in the class. This was used for practice and for the children to master the numbers in their minds.

From the above discussion, one can conclude that both the learning environment and the relationships between teachers and children has a bearing on the child's learning. As such teachers need to create a necessary conducive climate for learning.

5.3.4. Chapter conclusion

The study effectively established preschool teachers' pedagogical content knowledge by three successful teachers whose selection to participate was based on their nature. A qualitative research approach using the case study was used. A framework to guide the study and assist in data collection was identified. The framework that was developed focused on three elements of pedagogical content knowledge as having influence on effective teaching of pre-mathematics. Observation notes and interviews were used to gather data about the teachers' approaches to teaching pre-mathematics as a way of collecting the teachers' pedagogical content knowledge. The data collected was triangulated via one-on-one interviews with the teachers before each of ten lesson presentations, during lesson observations. In addition, the study attempted to find out how the teachers had developed the pedagogical content knowledge that they used in the teaching of pre-mathematics.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

This chapter gives remarks based on the findings of the study. It points out some of the recommendations to be considered if an improvement of PCK in the practices of preschool teachers in Zambia and for further research studies in the same area.

6.0 Conclusion

The study showed that developing number awareness was regarded as an important activity at preschool level. This was evident in that all the participants started with number awareness activity. The findings indicated that activities to be tailored at the age level of the children and the hidden education value should be brought out as children are engaged in these activities. The incident of the difficulties experienced by one of the Participants trying to teach multiplication to the children, and which turned out to be too advanced for children's cognitive assimilation, illustrates the importance of age-appropriate pedagogy. All the participants seemed to be conversant with how to go about the different ideas to foster children's learning. However, there was need for greater awareness of how important the various activities were to the children in the learning process and, therefore, use terms that children could understand; as such needed an expert who could be able to bring the hidden value to simpler terms. Even if it appeared that the participants seemed to have pedagogical content knowledge but to varying extents, there was need for greater awareness of how important the various activities were to the children in the learning process.

Regarding factors, the findings of the study were that planning was essential for successful teaching of pre-school mathematics. For example, it was pointed out that a well-organized work plan is a very important factor in the teaching of mathematics. It was evident that planning was an important and often underappreciated aspect of classroom practice, when teachers make decisions that ultimately impact children's opportunities to learn. Despite this general agreement about the importance of planning, few researchers have explicitly examined the precise ways in which teachers plan for mathematics instruction. The findings of this study are an important revelation of the importance of planning and should be used to inform policy on the need to invest in this technique.

Teaching resources emerged as another important factor in the teaching of preschool children. Participants had a big task of organising different teaching resources in order to deliver their

lessons effectively. However, the study showed there was no coordination in what the teacher taught and what the children knew as some children could not competently co-ordinate what they know and what they observe about numbers. Children needed to relate what they were doing to real life situation, a possible learning gap that needs to be attended to. This implied that some participants were not skilled to offer their services at preschools. If this knowledge gap is left unattended to, it might render the children to suffer the consequences later in future. The weaknesses in the existing body of knowledge to have a curriculum that equips teachers with knowledge and skills necessary to successfully teach mathematics will result in poor mathematics foundation in early childhood education which can have diverse effects on a child's future. With regard to the teaching of mathematics, Ball (2000) emphasized how teachers' understanding of mathematics PCK as a major determinant of teachers' choice of examples, explanations, exercises, items, and reactions to children's work. Though some aspects of teacher Pedagogical Content Knowledge could be inborn, most of this knowledge is acquired through teacher's own education hence worthy of study by mathematics teacher

Finally, the main finding on teachers' conduct was that a teacher needed to be humble, loving, kind towards the children. It occurred to the realisation of the researcher that teacher's conduct provided children with support and enriching environment within which children learn. It was from this protection, love and understanding which inculcated the best learning practices. The implication was that the teacher's conduct had induced the learning environment which had a bearing on the child. Since learning is based on what happens in classroom, teachers' conduct in the classroom had a greater influence on the children's learning.

Furthermore, a teacher needs to be good to the children and offer as much support to them in all their learning activities both individually and collectively. The teacher's attitude is very important in fostering learning in the classroom. A teacher's presence in the classroom is supposed to foster an effective learning culture in the young minds so as to effectively communicate the subject to them. This clearly shows how important the teacher's conduct is in teaching of mathematics.

This study has shown that pedagogy content knowledge is important in the teaching of mathematics to children. A teacher is presented with a vast array of techniques to employ and it

is up to the teacher to understand what really connects with the children in the classroom. A teacher has to understand the children both individually and collectively to be able to successfully communicate the lesson to them. Whether it is the teacher's approach towards the teaching process, the style or method of teaching or the use of teaching and learning aids, the point to remember here is that the teacher's pedagogy content knowledge is paramount and should always be enhanced so as to effectively teach mathematics to pre-school children. The findings revealed that both the teacher's conduct and the learning environment had a great impact on the child's learning.

6.1 Limitation

- The study dealt with only 3 private schools in Lusaka urban, it would have been better if it was conducted also in rural areas. Generalisation would therefore need to be handled with discretion.
- Exploring on the teachers' pedagogical content knowledge is challenging as it reveals itself in many places and ways, such as, in teachers' planning, classroom interactions, explanations, mathematical competency, and so on and a study of only one environment could lead to a limited perspective emerging.
- The sample size was too small and constituted only females.

6.2 Recommendations

The following recommendations were made after considering the findings:

- Mathematical knowledge for teaching in preschool mathematics should be strengthened in the curriculum
- There should be increased opportunities for continuous professional development (CPD) programs among preschools to enhance mathematics knowledge in preschool teaching.
- Teaching resources in preschool should be improved.
- Further research to uncover qualitative aspects of learning that seeks understanding of children should be undertaken.
- There is need for research whose methodology includes a test to assess teachers' pedagogical content knowledge.
- More research targeting a wider variety of contexts such as rural and urban, well-resourced pre-schools and under-resourced schools, and well established stand-alone pre-schools and emerging pre-school classes which are part of regular primary schools should be considered.

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APPENDICES

APPENDIX 1: INTERVIEW GUIDE FOR PRESCHOOL TEACHERS

The following questions give some indication of the things the researcher was particularly interested in.

1. What is the schedule of activities for a full day class?
2. Are there other activities which are expected to be done but are not mentioned?
3. Why do you feel that these activities you have mentioned are important?
4. Out of the activities mentioned which ones do you enjoy most?
5. Which of the activities do you do as a requirement but do not enjoy?
6. Which of the activities do you think you need help to do better?
7. Which ones of the activities do you think children enjoy most?
8. How important do you think mathematical activities are to the children?
9. Why do you think it's important to teach mathematics?
10. What do you find most satisfying in the teaching of mathematics at preschool?
11. What do you think are some of the positive attitudes that you consider important in the teaching of mathematics?
12. What do you think are the most important factors for a successful lesson at preschool?
13. What is the appropriate age for a child to be enrolled at preschool?
14. Do you have all the facilities /resources you consider most important for teaching mathematics activities?
15. Which teaching method do your children like most?
16. What type of teaching /learning aids do you normally use?
17. Do you have a teaching file? (If yes who checks your file and if no why not?)
18. Which aspect of preschool teaching would you like to focus on?
19. Have you had any chance to be enrolled in a training college after you completed your course?
20. IF yes which kind of training?
21. Do you think it was useful for your teaching?
22. What kind of training do you think is necessary for improvement of your teaching at preschool?
23. What do you think are the most important factors influencing preschool mathematics?

APPENDIX 2: OBSERVATION CHECKLIST FOR PRESCHOOL TEACHERS**SCHOOL**
CHILDREN.....**DATE..... NO OF****TIME:****SEX; F/M****TOPIC.....**

Topics	Activity	Specific Outcome	Yes	No	If yes Specify
Classification	Matching objects according to different colour, shape, size. Sort according to colour, size and shape Making pattern using different objects	Match objects according to different properties Sort different objects Make patterns using different objects			
Number and notation	Using concrete objects to count(Employ songs, rhymes, games) Recognizing number values of 1-5 Recognizing of number symbols/numerals 1-5 Using numerals 1-5 to represent quantities of objects Tracing Outlines of given numbers 1-5 in ascending order	Count Orally up to 10 Identify number value 1-5 Use numerals 1-5 to symbolize quantities of objects. Trace numbers from 1-5			

General Observation

1. Are teaching documents marked?

.....

2. How often are they marked?

.....

3. Are exercises books of children marked?

.....

4. Use of appropriate vocabulary while matching sets that are alike (e.g. too many, not enough)

.....

5. Describe or explain what has been

done.....

.....

6. Order s objects in a systematic

manner.....

7. Comparison of opposites (e.g. long/short, big/small etc)

KEY TO CHECKLIST

1. Demonstrate ability to classify objects, counts measure and apply geometrical skills
2. Demonstrates ability to identify Zambian coins
3. Demonstrate knowledge of the concept
4. Demonstrates partial knowledge of the concept
5. Does not demonstrate any kind of knowledge of the concept