MIDLANDS STATE UNIVERSITY

FACULTY OF EDUCATION

DEPARTMENT OF EDUCATIONAL FOUNDATIONS AND CURRICULUM STUDIES

USE OF MODELS IN THE TEACHING AND LEARNING OF SCIENTIFIC CONCEPTS AT EARLY CHILDHOOD EDUCATION LEVEL IN GOKWE NORTH DISTRICT

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF EDUCATIONAL FOUNDATIONS AND CURRICULUM STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE BACHELOR OF EDUCATION DEGREE IN EARLY CHILDHOOD EDUCATION.

GWERU

ZIMBABWE

MAY 2016

APPROVAL FORM

MIDLANDS STATE UNIVERSITY

FACULTY OF EDUCATION

DEPARTMENT OF EDUCATIONAL FOUNDATIONS AND CURRICULUM STUDIES

The undersigned certify that they have read and recommended to the Midlands

State University for acceptance a research project titled: USE OF MODELS IN THE TEACHING AND LEARNING OF SCIENTIFIC CONCEPTS AT EARLY CHILDHOOD EDUCATION LEVEL IN GOKWE-NORTH DISTRICT.

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In partial fulfilment of the requirements of the Bachelor of Education Degree inEarly Childhood Education.

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ACKNOWLEDGEMENTS

I take this opportunity to sincerely thank my supervisor Dr Muguwe for her unwavering support and indispensable guidance throughout the research. She worked relentlessly towards the success of this project. I enjoyed the health discussions and her constructive criticism.

I also wish to extend my acknowledgements to all school heads, TICs and ECD teachers from the sampled schools for the cooperation and assistance they gave me during data collection. Special thanks also go to 2016 BECE final year students for their advice and support. Finally the researcher wishes to extend special thanks to his family for the social and financial support.

DEDICATION

I dedicate this project to my beloved wife Joy and children Tanatswa, Kudzai and Kudakwashe for their social support throughout the course.

ABSTRACT

The study was nessesitated by the need to improve the teaching and learning of scientific concepts at Early Childhood Education level in Gokwe-North, District of the Midlands province through the use of models..A sample of twenty ECD teachers and three TICs from three primary schools was purposively selected from a cluster that was randomly selected from a population of 128 primary schools. The population has 530 ECD teachers and 128 TICs. All the twenty ECD teachers selected completed questionnaires and the three TICs were interviewed. The researcher also used an observation guide to supplement his research findings. Descriptive statistics was used to present quantitative and qualitative data. Quantitative data was presented in form of frequency tables and percentages and all the qualitative data was presented in verbatim. Research findings revealed that ECD teachers in the cluster rarely use models in the teaching and learning of scientific concepts. There is a critical shortage of instructional materials and most ECD teachers in the cluster can not improvise simple learning and teaching materials from locally available materials. As a result they prefer two dimensional media. The few materials available for example the globe are only used for reference. The study recommends that workshops on how to use models should be held at both school and district level and teachers should be encouraged to improvise learning materials from locally available materials. There is need for combined effort between schools and the district office to mobilize resources for the ECE programme. The study further recommends a national in-service programme for all primary school teachers with over five years of teaching experience so that they are reoriented.

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CHAPTER 1 The Problem and Its Context

1.1Introduction

The chapter provides information on the background of the study, statement of the problem, research questions, significance of the study, delimitations of the study, limitations and definitions of key terms in the research question. Science like mathematics is perceived as a difficult subject. Recent researches have shown that it is a defective approach to science teaching at ECD that contributes to this commonly held misconception. An effective use of developmentally appropriate technologies at Early Childhood Education level will help pupils develop a positive attitude towards science learning. Children learn through play therefore the introduction of iconic models in science learning at Early Childhood will help children develop scientific skills necessary for future science learning in middle and upper school.The researcher is going to investigate the use of models in the teaching and learning of scientific concepts at Early Childhood Education level.

1.2Background of the study

The research focused on the use of models in the teaching and learning of scientific concepts at ECE level. Many scholars have researched and explored positive implications of using educational technology. They have also shown that it can be the solution to problems affecting the understanding of scientific concepts by ECE learners. Oakes (1990) claimed that poor science instruction in early childhood contributes to negative attitude and poor performance in

science. This problem persists into the middle and high school years. Mbalula (2001) added that scholars have linked early difficulties in school science to the choice of media used by teachers.

Media selection is not easy. The education reform call "science for all" by the Ministry of Primary and Secondary Education to bridge the science achievement gap is impeded by lack of systematic instructional frame-work in Early Childhood science. Use of unattractive media demotivates learners resulting in poor performance. Student achievement is the yardstick by which media effectiveness is measured. Models are viewed as the solution to challenges affecting the teaching and learning of scientific concepts in primary schools especially in the Early Childhood Education department. Models can be used to enhance instruction giving and concept mastery.

Teaching aided by effective model use arouse pupils' interest towards the subject and content retention. ECD learners learn through play and the most appropriate way to get them learn most is a hands on approach. The approach implies that pupils touch and feel most of the learning materials they interact with in the learning process. When using models pupils get to feel the texture of the models and get to know even the inner details some real objects cannot show. According to Jannsasen (2000) cited in Bell (2010) models are part of educational technology which is an array of tools that might prove helpful in advancing children's learning. Teaching and learning scientific concepts using models make work easier for both the teacher and the pupils respectively.

Gilbert, Osborne and Fenshama (1982) cited in Teaching in America (2007) by Morrison claim that the use of models in science teaching provides a solid foundation for subsequent

development of scientific skills that pupils will use throughout their academic lives. They claim that this foundation helps pupils construct an understanding of key science concepts and allow for future learning of abstract ideas.

In addition to that Eshach and Fried (2005) purport that the use of models in early science experiences in India help pupils develop scientific reasoning, positive attitude towards science and a better foundation for scientific concepts to be studied later in their education. This is supported by a study by Hombo and Mazzeo (2005) on the use of models in science learning and teaching in central African countries. Their work revealed that the use of models in teaching scientific concepts at ECD has helped in addressing achievement gaps in science performance. It also states that although achievement gaps in science have slowly narrowed due to improved use of technologies they still persist across grade levels and time with respect to race /ethnicity, socio economic status and gender.

In trying to emphasise the importance of using three dimensional media Mbamula (2004) asserts that early difficulties in school science is linked to the choice of media by teachers and argued that the use of charts and pictures is not enough to assist pupils understand abstract concepts in science and mathematics. In Zimbabwe the education reform call for science and mathematics for all students by the Nziramasanga commission of (1999) calls for greater improvements in the teaching and learning of science and mathematics starting from ECD up to tertiary education. In addition to this, the vast majority of studies in the field of educational technologies have focused on multi- media, charts, pictures and models as instructional media to be used in the teaching and learning of science and mathematics concepts.

While this has been well documented in literature for over a decade what is absent is an understanding of what is happening at classroom level. This research study was aiming to

address these shortfalls by describing the real classroom practice. Oakes (1990) purports that poor science instruction in early childhood contributes to negative student attitude and performance. It is against this back ground that the researcher decided to research on the use of models in the teaching of science concepts at early childhood level.

1.3 Statement of the problem

The purpose of this study was to provide a comprehensive description of the use of models in the teaching and learning of scientific concepts in ECD classrooms. The study attempted to define reasons for the inclusion of models by ECD teachers in their instruction. A survey administered to (530) ECD teachers and (128) TICs from (128) primary schools in Gokwe North district of Midlands province was designed to collect data on issues pertaining to availability of models, access of models, ability to use models, frequency of using models and reasons for not using them.

A full description of these issues serves as a basis for recommendations. Results from this study may be useful to the Ministry of Primary and Secondary Education in planning for further development of instructional technologies for Early Childhood Education.

1.4Research questions

The research focused on the use of models in the teaching and learning of scientific concepts at ECE. Specific guiding questions were as follows.

1) What are the benefits of using models in the teaching and learning of scientific concepts?

2) What challenges do teachers encounter in accessing models?
3) How knowledgeable are teachers about the use of models in teaching science concepts?
4) What intervention strategies can be put in place to address these challenges?

1.5 Significance of the study

The aim of the research was to provide a basis for effective teaching and learning of scientific concepts at ECD level and the development of media in general. It was hoped that the results of this study would be of great importance to ECD learners, teachers, school heads, parents, the Ministry of Primary and Secondary Education as the regulatory body, student and trainee and graduate teachers in both teacher training colleges and universities, researchers interested in developing education and other stakeholders.

1.6 Delimitation of the study

The study was confined to all primary schools in Gokwe North of the Midlands province. There are (128) primary schools in the district and a target population of about (530) ECE teachers, and (128) TICs. The research sample comprised of (3) TICs and (20) ECE teachers. The study focused on the use of models in the teaching and learning of scientific concepts at Early Childhood Education level. The study focused on one district from a province with (15) districts. It was necessary to delimite because of the short time which was available to carry out this study.

1.7 Limitations of the study

The study was carried out in only one district out of (15) districts in the province which means the results can not be generalised to the whole province. The research survey was affected by a number of constraints the major one being finance to effectively carry out field work. Schools in the district are far away from one another resulting in the researcher incurring huge transport costs in order to cover the defined sample area. In addition to transport costs, a considerable amount of money was also used in preparing research tools. Apart from finance related problems the survey was also disturbed by weather conditions. Most areas in the district are very difficult to access during the rainy season due to a poor road network. Lastly the amount of time given to the data collecting exercise was very short. The researcher had to adjust his programme resulting in limited time with interview participants hence affecting the quality of responses.

1.8 Definition of terms

Science

The Science Council (2016) defines science as a body of knowledge that represents a current understanding of natural systems and processes whereby that body of knowledge has been established following a systematic methodology based on evidence and is being continually expanded, refined, and revised.

Scientific concept

Merriam (1989) defines a scientific concept as an idea or model explaining same natural phenomenon or an abstract or a generic idea generalised from particular instances.

Models

Russell (1993) defines a model is a physical representation of a concept, phenomenon, relationship, structure, system or aspect of the real world. It contains only those features that are of primary importance to the model maker's purpose. Its objectives include facilitating understanding by eliminating unnecessary components. There are three types of models namely iconic, analogous and symbolic. For the purpose of this study the researcher discussed about the iconic model.

Early Childhood Development

UNICEF (2015) defines Early Childhood Development as a comprehensive approach to policies and programmes for children from birth to eight years of age, their parents and caregivers. Its purpose is to protect the child's rights to develop his or her full cognitive, emotional, social and physical potential.

1.9 Summary

This chapter gives an insight into the use of models in the teaching and learning of scientific concepts at Early Childhood Development level in Gokwe North district.The researcher sought to probe into the issue because iconic models as physical manipulations play a crucial role in Early Childhood Education because of their concrete nature. The research also looked at who benefits from the study and how. The chapter gives an outline of geographical boundaries of the study and constraints the researcher encountered during the course of the study. Lastly the chapter looked at definitions of key terms in the research question.

CHAPTER TWO

LITERATURE REVIEW

2.1Introduction

This chapter looked into what authorities say about models, their role in classroom instruction and problems associated with the use of models in the teaching and learning of scientific concepts at Early Childhood Development level. The researcher examined literature related to research questions mentioned in chapter one. According to Russell (1993) cited in Smaldino (2012) a model is a representation of a concept, phenomenon, relationship, structure, system or aspect of the real world. A model contains only those features that are of primary importance to the maker and user, in this case the ECD educator and pupils respectively. There are three types of models, but for the purpose of this study the researcher focused on iconic models only because of their relevance to Early Childhood Development.

2.2Theoretical framework

The research borrowed heavily from constructivism. According to Newby et-al (2011) Constructivism is a term used to represent a collection of theories. These include generative learning (Wittrock 1990), discovery learning (Bruner1961) and situated learning (Brown, Collins and Duguid 1989) among others. Duffy, Lowyck and Jonassen (1993) pointed out that the common thread among these theories is the idea that pupils actually construct knowledge by working to solve realistic problems usually in collaboration with others. The use of models promote active and collaborative learning stressed in the statement above.

According to Driver (1983) and Osborne and Freyberg (1985) the constructivist view of learning in science suggests that learners can only make sense of new situations in terms of their existing understanding. This implies that prior knowledge is used by learners to interpret observations. Scott (1987) added that observations can only be authentic when pupils are involved in manipulation of various scientific models. Meaning is constructed by individuals in a process of adding to or modifying their existing ideas.This position is also supported by Piaget in his theory of assimulation and accommodation. At ECD meanings are easily constructed when the experience are supported by meaningful models. The constructivist perspective have had a significant impact on recent research in science education. Recent researches in education have been concerned with finding out ideas learners typically hold in order to inform teaching.

Many teacher training institutions in Zimbabwe are persuaded of the value of constructivism. It is now commonplace to find that ECD teachers have been exposed to constructivist ideas. Teachers have a commitment to constructivist principles and are modifying their practice to take these principles into account. The most important aspect of constructivist is that the learner's ideas should be taken into account in planning suitable restructuring activities. This implies that the ECD educator should establish what pupils already know before planning learning activities. However the problem comes with the sheer practicality of attempting to do that with a class of 30 or even 40 or more pupils. Even if the teacher has adequate information about the learner's initial ideas, attempting to respond to their individual ideas is not possible because of the abnormal teacher pupil ratios in our schools.

The constructivist perspective describes learning as a change in meaning constructed from experiences. For early childhood learners these experiences are worthwhile when supported by models and toys. Day to day manipulation of scientific models enriches pupils' experiences and

promotes the development of process skills such as analysing, classifying, observing and recording. Driscoll (2005) stresses the idea that knowledge is constructed through social collaboration. This point is also stressed in the theories of Piaget, Bruner and Vygotsky.

Construction of meanings can be enhanced through interaction with real objects or models working in apprenticeship. The above statement brings in the idea of scaffolding propounded by Vygotsky. The apprenticeship element requires the Early Childhood Development teacher to be knowledgeable in the construction and use of models. This is the focus of this research study. Newby (2011) added that the use of technology has allowed students more readily access to models of specific types of behaviours and skills. In addition to the above, constructivists believe meaningful learning occurs most effectively when students are engaged in authentic tasks that relate to meaningful content and argues that the role of instruction is to provide students with ways to assemble knowledge rather than to dispense facts.

2.3 What are the benefits of using models in the teaching and learning of scientific concepts in ECE?

A research by Russell and Sorge (1998) at an American school in Virginia cited in Pitler, Hubbell, Kuhn and Kin (2007) shows that the use of technologies such as models gives pupils control over their own learning. It facilitates analytical and critical thinking among learners. The use of models encourages collaborative learning propounded by Vygotsky (1936) in the constructivist approach to education. Using models in classroom instruction move classrooms from teacher dominated environments to ones that are more student centred.

Richmond (1993) purports that interactive models are physical representations of systems that can easily be seen and manipulated. Interactive models have characteristics similar to key

features of more complex systems in the real world. Richmond (1993) added that the use of models in classroom instruction offers pupils the opportunity to manipulate them at their convenience until they comprehend the concept. To allow this the ECD teacher should be knowledgeable about the use of models for instructional purposes. Models play a crucial role in science practice. One justification for their inclusion in science teaching is that they contribute to an authentic science education. Models can also provide an environment for interactive student engagement. Evidence from science education research shows that worthwhile learning gains are achieved when students participate in collaborative engagement activities.

Apart from the advantages explained above models allow learners to use all their senses. Children can see, hear, smell, touch and even taste the models before them. By so doing they will be learning. Roblyer (2010) asserts that models bring the outside world into the classroom.and make possible learning with visualisation and manipulation. This implies that they are anything that can help one visualise how a world system works. According to Doering and Roblyer (2010) physical manipulations are a mainstay of ECD classrooms because they help pupils bridge the conceptual distance between concrete and abstract scientific concepts. Inaddition to the advantages mentioned above Newby et-al (2011) purports that models provide hands-on learning and emphasize real world applications. The authority goes on to say since models come in many shapes, sizes and styles it is important to emphasize that a model is not the real world but merely a human construct to help us better understand real world systems.

Research has shown that properly planned lessons start with the arousal of students' interest and then move on to presentation of new material. The use of models help arouse pupils' interest. They enable ECD teachers to keep their learners motivated and explain scientific concepts clearly, resulting in improved understanding of the concept being taught. According to

Alesandrini (1981) pupils who study a model before a lesson may recall 57% more on questions concerning conceptual information. In a survey to find factors that facilitate teacher skills, teacher morale and perceived pupil learning in technology using classrooms, Baylor and Ritchie (2002) found that teachers valued the use of models in class and that it had an impact on pupils' content acquisition and added to class performance.

Baylor and Ritchie (2002) go on to say "…. many educators are stating the need to prepare pupils for a life that will be drastically different …a life that will need pupils to become creative problem solvers, able to analyse a wealth of information and to draw valid conclusions." This type of learning is more likely to take place when models are used during instruction. A report by the Child Development Institute (2015) states that models allow for hands on experiences. They give pupils opportunities to have fun while practising the things they are learning in school. This increases their retention of those things. Good models stimulate interest for continued play thereby reinforcing the things they have learned.

Schacter and fagnano (1999) cited in Pitler et-al (2007) argued that models when applied effectively do not only increase pupil learning, understanding and achievement but also augment motivation to learn and supports the development of critical thinking and problem solving skills. A report by the Child Development Institute (2015) states that models when properly engaged become props for cooperative play and thus encouraging collaborative learning. Good models engage a child's senses, spark their imagination and encourage them to interact with others.

ECD pupil are generally curious about the word around them. They enjoy toys such as farm animals and automobile models. Such models develop scientific thinking in pupils. Models and toys invite pupils to create and use their imagination. ECD teachers are therefore encouraged to

start many playtime activities with let's pretend models so that they stimulate creativity and imagination in their pupils.

ECD teachers who use models effectively will obviously raise the quality of learning experiences for their pupils. Russell (1993) purports that through the use of models ECD teachers can explain scientific concepts that would be difficult to elaborate orally. Russell (1993) goes on to say when ECD pupils see the model, its mechanism and its function, the ECD educator is saved the hard explanations and pupils easily understand what the teacher is talking about. In addition to that Majed (1996) claimes that models and other instructional technologies help pupils acquire observational skills. Observational skills help pupils understand scientific concepts. Majed (1996) further purports that the use of instructional technologies makes possible increased individualised instructional opportunities. ECD teachers are therefore edged to dedicate a lot of time to preparation of instruction technologies that will meet the needs of learners.

Spector (2012) asserts that models can provide learning experiences many real things cannot provide. The authority further argues that some models are assembled to provide interior views not possible with real objects and are the most recommended media when realism is essential for learning, especially with concepts that require identification by size, shape or colour and hands on. Models of complex devices or processes help to highlight essential elements and eliminate distracting details.

Models assist the development of both cognitive and psychomotor skills. Children need to be actively involved in manipulation of models or real things in order to develop their muscles and minds. Children gain self- confidence as they play with models. A research by Heinich (1993) at a school in Nigeria cited in Spector (2012) shows that plastic model kits appeal to children of all ages and can stimulate inquiry and discovery. Russell (1993) claimed that models allow pupils to

manipulate them at their own convenience working with the subject until they comprehend it. Models of electrical gadgets give pupils a head-start by introducing them to things they will be learning in school. ECD centres in low income areas with a poor material culture are therefore encouraged to use models as a way of giving their pupils a head start necessary for formal learning.

According to the constructivist perspective meaningful and purposeful learning occurs in environments that resemble the real world. However the real world is often a very complex environment. Finding such an environment that is conducive to the needs of learners is often difficult if not impossible. Therefore ECD teachers should be innovative and create replicas of such complex environments. For example teaching ECD pupils crossing busy roads is dangerous but models can meet such learning needs. Models such as simulations allow learners to experience the important aspects of a real life process without the risk. According to Bruer (1993) a constructivist proponent cited in Newby (2011) learners must rise above the rote, factual level to begin to think critically and creatively. This can only be achieved if we begin to expose our learners to models at ECD.

Models assist pupils acquire high order skills since they emphasize on knowledge transfer more than other forms of media. According to Gagne (1985) there is no meaningful learning when learners cannot apply what they have learnt to real life situations to solve day to day problems. The relationship between models and real objects makes it possible for learners to transfer learning to real life situations.

Apart from the merits outlined above, models allow pupils to learn about objects from foreign cultures and other times. Newby (2011) claims that models make cultures come alive. Pupils can learn about what is happening in other cultures and what used to happen long ago through the

use of models.Models add relevance for pupils and generate interest and enthusiasm for topics. According to the constructivist perspective interaction with models and working within apprenticeships help learners construct meanings from what they will be doing.

Reynolds and Walberg (1991) cited in Cohen, Manion and Morrison (2011) claim that developmentally appropriate engagement with quality science learning models is vital to help pupils understand the world, collect and organise information, apply and test ideas and develop a positive attitude toward science. The use of models helps pupils to construct an understanding of key scientific concepts and allow for future learning of abstract ideas.

Ravanis and Bagakis (1998) cited in Leftwich, et-al (2011) suggest that engaging models in science learning allow for the development of scientific thinking. A research by Hombo, Mazzeo and Lee (1998) cited in Smaldino et-al (2012) shows that engaging models in science learning and teaching at ECD is very crucial for preparing the child for future science learning. This implies that Early Childhood Development teachers in rural areas should try by all means to use models to assist the already disadvantaged pupils.

Models allow pupils to ask questions. A good model helps pupils interpret the representation observed through questions. Models lead to new discoveries as they provide pupils with new ways to conceive hypothetical ideas and relations. Mortensia (1972) claimed that any model when studied casually should offer an insight. This implies that models create a condition suitable for discovery learning.

Boblyer (1990) cited in Doering (2013) purports that models are well suited for content for which discovery learning is preferred, especially in science and mathematics for example in a unit on magnetism in science. They are important when encountering a subject for which pupils

have had little direct experiences for example in cities when teaching the topic types of toilets. The ECD teacher can use a blair toilet model to explain important scientific concepts and in rural areas when teaching the same topic the teacher can use the model of a flash toilet. They are also important when building a foundation for understanding abstract concepts or content.

The use of models in teaching and learning is not new. Technology in education is an area prone to what Boblyer (1990) cited in Doering (2013) called the glitz factor. Teachers sometimes throw out methods that had potential but were just subject to unrealistic expectations. Boblyer (2013) claims that the past has shown that teachers must be careful, analytical consumers of technological innovations, looking to what has worked in the past to guide their decisions and measure their expectations in the present. Educational practice tends to move in cycles and new methods are often old methods in new guise.

2.4What challenges do teachers encounter in accessing and using models?

Science is largely viewed as a difficult subject mainly because of the way scientific concepts are taught at ECD level. The damage done at this level will have effects in future science learning. Learners need instructional media close to reality. They need media that is appealing to their senses and is capable of promoting learning through sensory experiences. Effective media must provide for tactile, auditory and visual learners. According to Foskett and Lumby (2003) instructional technologies are crucial in that they are the means by which the processes of education may be operationalized. Models like all other technologies assist ECD managers in the achievement of goals.The use of models in teaching and learning scientific concepts helps pupils

understand the world, collect information, apply and test ideas as well as developing a positive attitude towards science learning.

For ECD teachers to use models, they must first of all be available. Hope (1997) reiterated that for technology to be exploited in the environment, it must first exist. Unfortunately, just as Majed (1996) remarked decision makers in schools do not emphasize the importance of instructional media. Due to tight budgets instructional media does not come into their priorities. Such lack of emphasis is unfortunate given that research in educational trends demonstrate the positive impact technology has on learning.

Models come in different forms. Some are easy whilst others are very difficult to construct and need high technical expertise especially those that are electrical. In most rural schools in Zimbabwe there is no electricity making the problem more compound. This entails that different support systems have to be put in place before we begin to talk of meaningful technology integration in most rural schools. Hope (1997) observes that leadership must foster an environment where teachers are encouraged to be creative. Without a visionary leadership technology integration remains a pipe dream for most rural schools. Smaldino et-al (2012) asserts that some models are often more expensive such that schools cannot buy them for their ECD classes.

It must also be noted that availability and accessibility are slightly different because sometimes models may be available at a school, for example commercially made models such as globes but kept under strict rules. Bruce and Roberts (1996) recommend a check-out system that makes instructional technologies available and accessible any time. Such accessibility enhances lesson preparation and delivery as well as eliminating the frustrations that teachers may have if they cannot access a particular technology that they have planned to use. In most rural schools media

organisation is the sole responsibility of teachers with the schools providing stationery only. Teachers are encouraged to be innovative. However this cannot be possible looking at how much they earn.

Sammons (1994) observes that teachers who already have too much class work and school responsibilities may find that models require additional time to learn and to prepare .Teachers may feel that they have on extra time to spare for making models. Kadzera (2006) suggested that ECD teachers should be exempted from other co-curricular activities that time is created for preparing teaching and learning media. In most rural schools teachers are not allowed to use commercially produced schemes of work. This results in them spending alot of time on scheming and records preparation at the expense of preparing media. The teacher's job description has turned more clerical than teaching.

Research has also revealed that minimal or lack of incentives for teachers who sacrifice their time to integrate technology in their classes contributes significantly to teachers' reluctance to use models. A research by Spodark (2003) at Hollins University on obstacles to technology integration showed that 70% of respondents reported that there were no outside incentives given to initiate these changes. Hope (1997) asserted that, recognising and rewarding teachers will enhance technology integration in the teaching and learning process. This implies that ECD teachers need to be recognised and rewarded for them to commit themselves fully.

The department of teacher education in both colleges and universities is making efforts to equip both trainee teachers and graduate teachers with skills on how to make models so that they have a collection of these items for use when they get back to schools, but they cannot do it for all concepts done in the school. Russell et-al (2012) claims that in Europe and America models of almost anything from airplanes to zebras can be purchased from shops for classroom use. This

entails that schools should provide instructional media. More resources should be channelled towards procurement of instructional media. This idea is supported by Levacic (1989) who purports that effective allocation and management of resources is critical to effective school management and should relate to the needs of learners. This is why School Development Associations are now mandated to involve a Pupils' Representative Board when planning.

Apart from availability, accessibility and adequacy using models in the classroom to explain ideas comes with its own set of challenges as the model needs to explain the behaviour as understood by pupils at a particular stage in learning. According to the Department of Education GCSE Subject Programme of Study (2013) as the pupils' experience of macroscopic phenomena expands, the model needs to become more complex as well. For example the model of an automobile as understood by pre-five pupils will explain most of the phenomena met at this stage but a more complex model is needed later. This does not invalidate the usefulness of the simple model at that stage, but pupils need to be aware of the progression so that they do not dismiss earlier ideas as incorrect but see them as part of development. This implies that at ECD teachers must choose age appropriate models and the models must be used in a developmental series.

According to Warren (2016) models are human inventions based on an incomplete understanding of how things work. They concentrate attention on specific aspects. By using something that is similar as a simile to explain or describe something that is not familiar. As a result most models are limited or wrong in some key aspects. Ogunniyi (1982) asserts that the use of models can create learning problems especially if pupils take a different meaning from the model than that intended by the teacher. ECD learners can mix up aspects of two different models and can also find it difficult to apply the model in different contexts. This implies that the Early Childhood educator should plan adequately for the use of models otherwise no meaningful learning can take

place. As teachers, it is important that we are aware of commonly held misconceptions and we are ready to challenge students' ideas. We must also critically review the resources students have access to including animations and simulations when planning to use a model. It is important to review it before use by asking the following questions.

- What learning outcomes does the model meet?
- How does it support student learning?
- What are the strengths and limitations of the model?
- With whom and how would you use this model?

Using models require thorough planning. Nutbrown (2006) warns that misuse of models in science teaching can lead to misunderstanding by students of both the model and their embodied concepts and can contribute to later academic failure.Poorly planned use of models can result in pupils learning the model rather than the concept it is meant to illustrate. This is very common with ECD pupils. This implies that the Early Childhood educator must plan thoroughly. ECD pupils can fail to distinguish between a mental image and a concrete model being shown. They also lack awareness of the boundary between the model and the reality the model is representing.

In addition to the challenges outlined above, a 2006 Ministerial report by the NewZealand government pointed out that pupils can miss some key aspects of a model and misunderstand its purpose. Early Childhood Education learners lack the necessary visual imagery to understand models. This implies that models should be simplified to overcome such problems. However oversimplification of models results in the ECD teacher's continued use of the least sophisticated models even if there are more advanced ones for them to use.

The Texas Education Agency (2007) stresses that in trying to make models simplistic enough some accuracy is lost. The report goes on to say if the teacher cannot recreate certain properties the model will be incomplete or not accurate. This entails that teachers can only have models they are able to make. Such a condition does not promote learning. Early Childhood educators must therefore have an in-depth understanding of models, how they are made and used in order to overcome such challenges.

2.5 How knowledgeable are teachers about the use of models in the teaching of scientific concepts?

The use of models has an impact on pupils' content acquisition and adds to their performance. However Beggs (2000) cited in Russell et-al (2012) claimes that researches have shown that it is not only the technology that is important but also how it is used that improves and increases pupils' interest and motivation. Russell et-al (2012) added that models can distort learning when not properly used. ECD teachers are therefore encouraged to have an in-depth knowledge of how models they plan to use in lessons work. This implies that they should familiarise with the models first before engaging them.

According to Pettitt (1995) familiarisation means the ECD teacher needs to have an understanding of how the model works if it is a working one. The ECD teacher should talk about how the model is like? What would really be happening and where the model differs from the real object, event or pattern? This is crucial because it helps pupils understand that they are interacting with a model not the real object. Also of importance is that ECD teachers should help pupils identify positive and negative features of the model so that they understand the concept being explained by the model.

The ECD practitioner should also identify neutral features or those aspects of the model that are ignored or not commented on during the lesson. Pettitt (1995) asserts that the teacher has to be able to direct pupils towards what has been planned otherwise pupils will get carried away by other features of the model not in question. A clear outline of model features and its uses enables the ECD practitioner to use even the most advanced models available. It also enables pupils to have a wide range of concepts covered and promotes understanding.

Beggs (2000) purports that the Early Childhood Development teacher needs to introduce what the model intends to show and find out what ideas pupils already have about the event or pattern being introduced. Learners are not blank slates, they know something. This is what the teacher should establish first. According to the constructivist perspective learning is attaching new information to what pupils already have.

Russell (2012) asserts that if the model is a working one, be sure you know how it works. This implies that the Early Childhood Development teacher must practise using the model before the lesson it is planned for. The teacher should be able to connect the model to the content. If the model is not connected to the content it is therefore not serving any purpose. In addition to that the teacher must make sure the model is large enough to be seen. The size of the model helps pupils to be able to understand the underlined features of the model. Since a model is a replica of the actual object it is necessary that the features are big enough and clearly seen. According to Smaldino et-al (2012) the size of models is essential to enable pupils manipulate them easily. This is mainly because Early Childhood Education pupils learn most through manipulation.

For pupils to benefits from the use of models teachers should be able to indicate the actual size, colour, and shape represented by the model. Russell (2012) stressed that the teacher should make sure pupils do not get wrong impression of the size, shape or colour of the real object, if the

model differs from it in these respects. This implies that the teacher must be well versed with both models and the real objects they represent. This demands a lot of research by the teacher. It entails that the ECD teacher should have knowledge of a number of objects in order to craft their representations.

Newby et-al (2011) purports that the storage of models can also be a problem for classroom practitioners. Poor storage can result in pupils seeing models before intended lessons. Seeing media prior to intended lessons results in lowering the interest and enthusiasm of learners. One of the most crucial roles of the ECD teacher is to keep the learners' interest and motivation high all times. Low levels of interest result in less chances of learning.

2.6 What intervention strategies can be put in place to address these challenges?

The policy context in which teachers work encourages professional development in order to ensure quality service delivery. Professional development aspects include the need to improve subject, pedagogical knowledge and instructional technologies. Wang, X. Wang, T. (2002) purport that knowing how much teachers understand about instructional technologies and how to use them in classroom is essential for staff development programmes.This will help planners deliver effective in-service programmes. District and provincial education offices should organise symposiums on how to make and use models. Workshops are crucial in that they help to reorient teachers.

In-service workshops go a long way in equipping ECD teachers with the expertise required. These workshops should be thoroughly planned and facilitated by experts in educational media from universities and colleges. Ndawi and Peasuh (2005) argue that, though appropriately trained

educators are equipped to produce desired educational outcomes there is need for in-service training. Gilbert and Osborne (2007) likened in-servicing to oiling a running plant in order to maximise efficiency.

Schools should plan and carry out staff development programmes on how to make and use models in classroom instruction. Osborne (2007) stresses that the programmes should be carried out at department levels so that more focus will be on issues affecting lesson delivery at department level. These sessions should be followed by demonstrations to consolidate what would have been learnt. The demonstration lessons will cater for the practical aspect that is how models are used in lesson delivery. The demonstration lessons should be followed by supervision. The visits should be objective and serve as reinforcement on aspects ECD educators would have learnt in workshops.

Geber (2003) purports that the current pre-service training has a limited preparation component for actual in-service practice therefore there is need for mentoring.Through mentoring new and in-experienced ECE teachers can be equipped with skills to make and use models. The school can engage experienced educators to offer mentoring for new members. Coleman (2001) argues that in many instances, new employees entering a school are left to sink or swim. Schools like any other organisations need orientation and mentoring for new members. Fourie and Meyer (2004) define mentoring as a dynamic and reciprocal relationship in a work environment whereby a more advanced and wise career incumbent (mentor) helps a less experienced person usually not a direct subordinate who has developed potential (mentee) in some specialised capacity.

Learning is enhanced by in-service activities that demonstrate respect, trust and concern for the learner. Adults prefer to learn in an informal learning situation and will resist learning situations

which they believe to be an attack on their competence. Mentorship is a sustained relationship between the two persons and can be used to improve practice and performance, share new challenges and build staff moral and collegiality (Schreuder, Du Toit, Roesch and Shah (1993).

Weller (1996) asserts that ECD teachers can be assisted by fellow teachers on how to make and use models. School administrators can organise class visits at both grade and department levels which are then followed by discussions. These formal arrangements should leave out department heads to facilitate free discussions and rule out the element of supervision. Teachers can use this opportunity to assist each other on how to improve their classrooms.

Beggs (2000) purports that peers can make experiences easier. Peer support can be one of the easiest and most reliable ways ECD educators can get help. However, it calls for collaboration with members where those who are able are also willing to render their support. Such is possible where members of staff work as a team and have a common goal. Beggs (2000) added that this collegial bond allows for free and open exchange of experiences and knowledge among teachers.

Teachers can utilise knowledge gained from peer collaboration activities in making models and other instructional technologies. They can involve their pupils in this exercise. This is important in that it facilitates the development of fine motor skills in pupils. Models can be made from clay, paper marchie, wax and plasticine. Pupils are interested in playing with these materials. Teachers should utilise this opportunity and use them productively. The Early Childhood educator can divide the class into groups and assign them to mould different articles that will be used as media at a later stage.

Inaddition to ways suggested above Kadzera (2006) asserts that teachers who are given incentives commit themselves to their work more than those who are not. Therefore schools can

encourage ECD teachers to make and use models in their teaching by simply working out an incentive package based on classroom presentation. Such developments will go a long way in motivating Early Childhood Development teachers to use models in their teaching.

Lastly Kadzera (2006) argues that teacher education should focus more on use of models particulary those that can be made from locally available materials. Improvising instructional materials from local resources is cost effective and does not strain the budgetary allocation for the department. Kadzera goes on to say models and toys are essential in Early Childhood Development.

2.7 Summary

In this chapter the reasons for using models were explored. Literature has shown that pupils can benefit a lot if teachers resort to using three dimensional media instead of using charts, pictures and other two dimensional instructional media. Despite models helping to capture pupils' attention and explaining concepts, literature has also shown that it takes the willingness and ability of teachers to adapt to change in using instructional technologies in their teaching. However for those teachers who are ready to use models literature reports that they face challenges of lack of adequate training in how to make models, availability, accessibility, and support from peers and administrators.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines research methodology used in the study. Research methodology refers to a systematic way of gathering data from a given population so as to understand a phenomenon and to generalise facts obtained from a population. The chapter examines research tools used in collecting data and the data analysis plan followed. It explains why the descriptive survey was used. The chapter describes and gives justification to the population, sample and the sampling procedure used. It also justifies the use of the questionnaire, the interview and the observation as data collecting instruments employed in the study.

3.2Research design

The study used the descriptive survey design. Chiromo (2009) posits that a descriptive survey involves drawing conclusions about a population basing on a sample. This means findings from the sample were used to generalise to the population under study. Cohen and Manion (1994) define a research design as a plan, structure or strategy of investigation concerned with obtaining answers to the research question. Punch (2009) on the other hand defines it as all issues involved in planning and executing a research project. Therefore a research design is a strategy for planning and carrying out a research project.

Punch (2009) further argues that the survey entails studying a limited number of cases with the view of drawing up conclusions that cover the generality of the whole group under study. The descriptive survey was adopted for this research because it permits the researcher to gather data

from a large number of participants and gives him chance to collect first hand data. Ray and Mondal (1999) point out that the major strength of a descriptive survey is its wide scope. Detailed information can be derived from a sample taken from a large population.

This is a non-experimental research based on questionnaires, interviews and observations. Cohen et-al (1994) also refer to it as a survey research.The descriptive survey in this case was used to investigate the use of models in the teaching and learning of scientific concepts at early childhood level in Gokwe North district of the Midlands province. To carry out the study the researcher employed probability sampling technique in order to come up with a more representative sample.

3.3Population and sample

The population for this research study consisted of 128 primary schools, 530 ECD teachers and 128 TICs.Punch (2009) defines a population as a target group usually large about whom we want to develop knowledge, but which we cannot study directly. For the reason above the researcher established a sample in order to make the study feasible. The research sample consisted of three primary schools with 20 ECD teachers and 3 TICs.The sample was established using cluster random sampling.Franklin and Wallen (2009) define a sample as any group from which information is obtained. Tuckman (1994) on the other hand defines it as a subset or a portion of a population that is selected for analysis.

Gokwe North district is too big therefore it is practically impossible to use simple random sampling for the researcher would spend an inordinate amount of time and money travelling about interviewing spaced respondents. For the sample to be more representative the researcher

used cluster sampling. In cluster sampling like in all other probability sampling styles the chances of a member being selected is independent and can be calculated. According to Chiromo (2009) cluster sampling is a type of sampling in which clusters are randomly selected.

Of cause, Cluster sampling is less accurate than simple random sampling but the researcher preferred it because it is less costly. According to Johnson and Christensen (2004) the trade-off between cost and accuracy is prominent in a cluster sampling situation. Often the importance of cost and time out-weighs the loss in accuracy. This sampling technique gives the researcher an opportunity to generalise sample findings on the population under study. Cluster sampling is ideal for populations that are large and widely dispersed. The researcher took extra care to ensure that the chosen sampling style did not build in bias.

All probability sampling techniques have less risk of bias. After establishing a cluster through random sampling. The researcher selected three schools in the area under study using purposive sampling. The researcher interviewed 3 TICs and administered questionnaires for twenty ECD teachers in the three schools and carried out three science lesson observations to augment research findings. The researcher checked on potential barriers to access before committing himself to the cluster. Cohen and Holiday (1996) assert that access may be denied by potential sample participants themselves for very practical reasons, for example a teacher simply might not have the time to spend with a fellow teacher researcher.

However the researcher was very fortunate. All the three administrators for the sampled schools were very supportive. All the twenty ECD teachers and their three supervisors complied very well with the requirements set by the researcher.

3.4Research instruments

For the purpose of this study the researcher used questionnaires, an interview guide and an observation guide to collect research information. The researcher adopted multiple research tools or the triangulation principle to ensure validity and reliability of research data. Research instruments refer to tools a researcher uses to collect data from research respondents. There are a number of data collecting tools a researcher can use depending on the nature of the research one wants to embark on.

A pilot study was conducted at a primary school in Gweru urban district. The researcher also made use of his colleagues who are ECD teachers themselves. The aim of the pilot study was to test the appropriateness of research tools to ascertain their validity and reliability before using them in the study. After carrying out the pilot test, necessary corrections were made before the actual data collecting exercise commenced.

3.4.1Questionnaire for ECE teachers

A questionnaire was deemed most suitable for use in this research. Best and Kahn (2006) purport that a questionnaire is used when factual information is required or when opinions rather than facts are desired like in this study.Wilson and Mclean (1994) cited in Cohen et-al (2011) define a questionnaire as a useful instrument for collecting survey information, providing structured, often numerical data being able to be administered without the presence of the researcher and often being comparatively straight forward to analyse. Chikoko and Mhloyi (1995) on the other hand described a questionnaire as a document containing questions designed to solicit

information appropriate for analysis. Therefore a questionnaire is a set of written down questions prepared for research purposes.

Silverman (1993) cited in Bogdan and Biklen (1992) argues that a questionnaire will always be an intrusion into the life of the respondents, be it in terms of time taken to complete it, the level of threat or sensitivity of the questions or the invasion of privacy. Thus the researcher sought consent from individual participants and guaranteed that the information will be treated with confidentiality. Wilson and Mclean (1994) warn that questionnaire respondents are not passive data providers for researchers. They are subjects not objects of research therefore they should not be coerced into completing the questionnaires. They might be strongly encouraged but the decision whether to become involved and when to withdraw from the research is entirely theirs.

To safe guard the participants against the threats mentioned above the researcher constructed an anonymised questionnaire. Before commencement of data collection the researcher informed research participants of the objectives of the survey and informed them that they were free to take part and to withdraw from the exercise when they so wish. One advantage of an anonymised questionnaire is respondents do not write their names and thus they will never be identified.

The two main response formats used throughout the questionnaire are; close-ended, which simplify the quantification and analysis of results and require minimum effort from respondents and the open-ended, which allow the respondent to respond freely using his or her own language. This is used in instances where great detail and more options for response are desired (Bourque and Fielder, 1995).

3.4.2Face to face interviews

To augment research findings the researcher used a face to face verbal interview. A face to face interview is a dialogue between the interviewer and the interviewee where the interviewer values and respects the interviewee. The researcher interviewed 3 TICs from the schools selected. Kvale (1996) cited in Chikoko and Mhloyi (1995) defines an interview as an exchange of views between two or more people on a topic of mutual interest. Kvale (1996) sees the centrality of human interaction for knowledge production and emphasized the social situatedness for research data. Aldridge and Levine (2001) define an interview as a social, interpersonal encounter, not merely a data collection exercise.

The researcher prepared an open-ended schedule for each of the three TICs. Carspecken (1996) purports that interview schedules should be sufficiently open-ended to enable the contents to be reordered, digressions and expansions made, new avenues to be included and further probing to be undertaken. The authority further argued that in interviews the researcher might wish to further explore some matters arising from observations.

Oppenheim (1992) cited in Hale (2011) claims that in naturalistic research the canons of validity in interview include honesty, depth of responses, richness of responses and commitment of interviewee. Interviews are also recommended for high response rate and also giving the researcher the ability to read beyond words. However interviews are prone to both researcher and participant bias. The researcher was however aware of these shortfalls and thus he used questionnaires and observations to support the interviews.

3.4.3 Observations schedule

The researcher used observations as a way of verifying some of the data collected through questionnaires and interviews. An observation allows for insight into the process rather than getting research information about teaching and learning out of context (Dodge, Heroman, Charles and Maiorca 2004). The researcher observed three ECE science lessons. Checklists were used to record the type of media used in the lessons and pupils' reactions to the media used. The researcher found it justifiable to use an observation as it provides direct access to the main aspect of the research, the use of models in learning and teaching scientific concepts.

According to Johnson and Christensen (2004) an observation is defined as the watching of behavioural patterns of people in certain situations to obtain information about the phenomenon of interest. In a naturalistic observation the researcher has to go to wherever the behaviour occurs. According to Jablon, Dombro, and Dichtelmiller (2007) cited in Essa (2011), one of the requirements of a good observation is that it be objective. Your role as observer is to be as impartial as possible, to stand back and record what you see rather than what you think the child is feeling or experiencing.

The observer attempted to be unobtrusive so as not to affect what was being observed. According to Dodge et-al (2004) cited in Essa (2011) people do not always do what they say they do, so through observations the researcher could get unbiased information about participants. Another crucial advantage of an observation over self- reports research tools is the researcher's ability to record actual behaviour rather than obtain reports of preferences or intended behaviour.

3.5Data collecting procedures

Letter to go and seek permission was obtained fro Midlands State Univeristy, Faculty of Education. The sought permission to vist school from the Head Office, District Office and School Heads. When granted permission the researcher then visited the target schools. The researcher explained the objectives of the study to the respondents and addressed all ethical issues. He gave research participants an assurance that the information obtained would be used for academic purposes only. After securing consent he distributed questionnaires, interviewed respondents and observed ECD teachers conducting lessons. Anonymised questionnaires were used for confidentiality. The questionnaires were physically distributed to ensure that they get to the intended people. Personal follow ups were done to ensure they were all completed and returned.

3.6 Data analysis plan

Data collected from respondents was recorded, organised and summarised inform of frequency tables. This was done in order to communicate the value of the findings from each research instrument as well as making decisions. Descriptive statistics was used to analyse and present data.

3.7Summary

The chapter outlined the research methodology, research design and the data collecting instruments employed by the researcher. It also specified the population under study, the sample

as well as the sampling techniques adopted by the researcher. Lastly the chapter looked at data collection and analysis procedures used in the study.

CHAPTER 4 DATA PRESENTATION, ANALYSIS AND DISCUSSION.

4.1 Introduction

This chapter focuses on the presentation of research findings concerning the use of models in the teaching and learning of scientific concepts at Early Childhood Development level in Gokwe North district. The chapter focuses primarily on data presentation, analysis and discussion. Data is presented under the following themes. a) Benefits of models in the teaching and learning of scientific concepts at Early Childhood Education. b) Challenges ECD teachers encounter in using models in teaching scientific concepts. c) Teacher's knowledge base about the use of models in the teaching and learning of scientific concepts at ECD. d) Intervention strategies which can be put in place to address these challenges. The table below summaries the composition of the sample in terms of gender.

Table 4.1 Gender of respondents (n=20)

Gender	Number	Percentage %
Females	17	85%
Males	3	15%
Total	20	100%

Eighty-five percent of the questionnaire respondents were females. This implies that there are more females than males in the area and ECD is a feminised profession. However according to the researcher's understanding the research sample was dominated by females owing to progressive gender laws seeking to redress the historical gender imbalance. Apart from gender

composition of the sample the researcher also looked at the qualifications of the ECD teachers in the sample. Below is a table showing the composition of the ECD teachers by qualification.

Table 4.2 ECE teacher qualification (n=20)

Qualification	Number	Percentage %
Para-professionals	7	35%
Certificate and Diploma	13	65%
Degree holders	0	0%

Thirty-five percent of the ECD teachers in the sample are para-professionals. Para-professionals are ECD teachers who neither have a diploma nor a certificate in education but were in-serviced in teacher training colleges through the UNICEF funded programme. The majority of teachers taking ECD A and B classes in the sample are para-professionals. In addition to that the researcher noted that the majority of the trained staff taking ECD classes are general teachers not infant specialists. This implies that there is a critical shortage of ECD teachers in the cluster.

4.2Theme 1 Benefits of using models in Early Childhood Education

Questionnaire respondents reacted differently to issues in the questionnaire pertaining to the merits of using models in the teaching and learning of scientific concepts at Early Childhood Development level. Below is a table summarising responses from 20 ECD teachers.

Table 4.3 Teacher's responses on benefits of using models (n=20)

Item	Strongly agree		Agree		Disagree		Undecided	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Use of models in science teaching improve concept mastery	1	5%	11	55%	0	0%	8	4%
Use of models gives pupils control over their learning	0	0%	12	60%	1	5%	7	35%
Models help pupils develop observational skills	5	25%	9	45%	0	0%	6	30%
Models promote multi-sensory learning	2	10%	11	55%	0	0%	7	35%

Sixty percent of ECD teachers in the sample agreed that the use of models gives pupils autonomy over their learning and helps improve pupils' mastery of scientific concepts. None of the respondents disagreed with the above facts. However 40 and 35 percent of the respondents were undecided on the effects of model use on concept mastery and students autonomy over learning respectively. In addition to the above 70 percent agreed that the use of models helps pupils develop observational skills. Researchers in Early Childhood Development argue that observational skills are essential for science learning and a component of process skills. However 30 percent of the sample was undecided on the relationship between use of models and observational skills. Apart from the positive contributions of models in science learning mentioned above 60 percent of questionnaire respondents agreed that models promote multi-

sensory learning in that pupils will have the advantage of using more than one sense in their learning process.

The advantages of using models mentioned above were also noticed in one of the three science lessons observed by the researcher. The plastic models used enabled pupils to use more than one sense in their learning process. The models enabled pupils to engage in cooperative learning as well as facilitating observational learning. The plastic models were big enough to encourage manipulation and the development of psychomotor skills.

In addition to questionnaire responses and observations, the researcher held face to face interviews with three ECD Heads of Department from the three schools. Below is a list of responses from HODs on advantages of using models in teaching and learning scientific concepts at ECD. The order in which the responses are presented indicates the frequency with which the responses appeared.

TICs responses on benefits of models

- *Models stimulate interest and motivation and help pupils understand more abstract scientific concepts*
- *Proper use of models promotes cooperative learning and facitates the development of psychomotor skills among learners*
- *Planned engagement of models make teaching and learning easier and enjoyable*

All the three TICs claimed that models help pupils understand more abstract scientific concepts and stimulates in pupils the interest and motivation to learn. Sixty-seven percent of the HODs added that models promote cooperative learning among learners an argument supported in literature by Vygotsky a constructivist proponent. Lastly, thirty-three percent of them further

argued that models facilitate the development of psychomotor skills and makes teaching easier and enjoyable. Responses from both ECD teachers and their supervisors indicate that teachers are aware of the role of models in science teaching and learning at ECD. Statistics show that only a small percentage of the population is not aware of the benefits of using models.

The research has shown that using models for teaching and learning scientific concepts helps ECD learners in many different ways. Both ECD teachers and their HODs have shown that the use of models encourages cooperative learning. Vygotsky (1938) stresses that cooperative learning gives pupils the opportunity to learn from more experienced peers thereby getting scaffolding on more challenging experiences. Both interview and questionnaire respondents agreed that models encourage the development of observational skills. Majed (1996) purports that the use of models help pupils acquire observational skills that will them understand scientific concepts. Majed (1996) goes on to say the use of models and other instructional technologies makes possible increased individualised instructional opportunities and edged teachers to dedicate a lot of their time to the preparation of instructional technologies. In addition to the above, about 60% of questionnaire respondents agreed that models promote multi-sensory learning involving seeing, feeling, hearing, tasting and touching. Thus they promote a hands-on approach to learning. A report by the Child Development Institute (2015) states that models allow for hands-on experiences. They give pupils the opportunity to have fun while practising the things they will learn in later life. Research participants agreed that the use of models improves concept mastery. This is supported by Doering and Roblyer (2010) who claim that models as physical manipulations are a mainstay of ECD classrooms because they help students bridge the conceptual difference between concete and abstract scientific concepts.

4.3 Theme 2 Challenges teachers encounter in accessing models

The research examined challenges ECD teachers encounter in accessing models. Participants were asked about their experiences with models and various responses were given. Below is a table to summarise the responses given by ECD teachers on that aspect.

Table 4.4 ECD teachers' experience with models (n=20)

Item	Number	percentage
ECD teachers with experience on how to use models	5	25%
ECD teachers with out experience on how to use models	15	75%

Seventy-five percent of questionnaire respondents indicated that they have never used models before. This is an alarming percentage given that most researches on Early Childhood Education emphasize the importance of concrete instructional media. Only 25% have shown that they have used models before. This is an indication that ECD teachers in the sample rarely use models. The questionnaire went on to probe why models are not being used in the cluster and below is a table showing how ECD teachers responded to that.

Table 4.5 availability, accessibility and adequancy of models in schools (n=20)

Item	Always		Most of the time		Sometimes		Rarely	
	No	%	No	%	No	%	No	%
a)availability of models in schools	_		_		5	25%	15	75%
b) accessibility of models to teachers	_		_		4	20%	16	80%
c) adequacy of models in schools	_		_		_		20	100%

Seventy-five percent of ECD teachers indicated that there are no models in schools. Only twenty-five percent showed that models are sometimes available in their schools. Those who claim to have used models cited only the blair toilet and borehole models. This explains that only a few scientific concepts are being taught effectively in schools. Hope (1997) reiterated that for technology to be harnassed in the environment it must first exist. Schools must therefore make funds available for the procurement of three dimensional instructional media. Apart from availability of models, eighty percent of ECD teachers in the cluster have shown that the few models for science instruction in schools are rarely accessible when needed.

To add on to the above, the researcher observed that very few science concepts are taught using models. Of the three lessons observed only one ECD teacher used models. This shows that there are no models in schools. In addition to the above, three TICs interviewed showed that there are numerous challenges ECD teachers encounter in accessing models. Below is a list of responses from the three ECD HODs.

TIC responses on challenges

- *Most rural shools do not have models for teaching scientific concepts at ECD*
- *Due to tight budgets most schools can not provide materials for making models*
- *The few models in schools are not appropriate for the teaching and learning of scientific concepts at ECD*

The three TICs interviewed pointed out that there are no models in schools for teaching and learning scientific concepts at ECD. The HODs indicated that models found in schools are specific for teaching and learning scientific concepts for upper grades only. Sixty-seven percent of interview respondents claimed that due to tight budgets schools can hardly afford to provide materials for making models. They agreed that the situation is limiting the innovativeness of ECD teachers. Both TICs and ECD teachers have agreed that there are a lot of challenges in accessing and using models. TICs attribute the problem to lack of resources. However Majed (1996) argues that decision makers in schools do not emphasize the importance of media. The authority added that due to tight budgets instructional media does not come into their priorities. Hope (1997) observed that management must create an environment where teachers are encouraged to be creative. However this can only be possible when ECD teachers are provided with materials to make models.

4.4Theme 3 Teachers' knowledge base about the use of models in the teaching and learning of scientific concepts

Research data have shown that apart from challenges presented by the situation most ECD teachers lack knowledge on how to make and use models. Responses from ECD teachers and

their supervisors agree on this. Below are responses from ECD teachers from the three schools in the sample.

Table 4.6 teachers knowledge on how to use and make models (n=20)

Item	Yes		No	
	No	%	No	%
a)can you make simple models	8	40	12	60
b) do you have any problem with using models	18	90	2	10
c) do you know of any one consideration to make before using a model	5	25	15	75

Research data revealed that most ECD teachers cannot make simple models for teaching and learning scientific concepts. Sixty percent of questionnaire respondents indicated that they have problems with making models. Apart from making models, 90% of the same teachers showed that they have problems in using models. This helps to explain how serious the situation is. About 70% percent added that they do not know what to consider before engaging models for classroom instruction. Only forty percent have indicated that they can make simple models from locally available materials and only ten percent have shown that they do not have problems using models. Questionnaire findings on this theme are also supported by observations made by the researcher. Of the three science lessons observed for ECD B, grade one and grade two only one ECD teacher made use of models. The failure of teachers to improvise simple models from locally available materials such as clay and wood indicate that ECD teachers need in-service on how to make and use models. The statistics shown above indicates that something must be done if meaningful learning is to take place. To support questionnaire responses and observations the

following are interview responses from TICs on the ability of ECD teachers on making and using models.

TICs responses on ECD teachers' knowledge on how to use models

- *ECD teachers rarely feature models in their scheming and planning.*
- *Very few ECD teachers who request for models seem not to practise using them before lessons.*
- *Most teachers taking ECD A and B class are semi-skilled hence lack an understanding of how to use models in classroom instruction.*

All the HODs interviewed stressed that most ECD teachers rarely scheme and plan for the use of models and therefore do not use models in their teaching. They added that very few ECD teachers request for models from their offices indicating that there is very little use of models in classrooms. They all pointed out that most ECD teachers for ECD classes A and B are semi-skilled therefore they lack the knowledge on how to make and use models. In addition to that, about seventy percent of the interviewed HODs pointed out that a few ECD teachers who sometimes use models seem not to practise using them before lessons resulting in both the teacher and the pupils learning the model at the same time.

Responses from ECD teachers, their supervisors and observation evidence show that ECD teachers from the cluster lack an indepth understanding of how to make and use models. This is also supported by literature from other researches. Beggs (2000) argues that research has shown that it is not only the technology that is important but also how it is used that improves and increases pupils' interest and motivation. Russell (2012) added that models can disturb learning

when not properly used. This implies that ECD teachers must have in-depth knowledge on how to make and use models. ECD teachers must make sure that they familiarise with the models first before engaging them for classroom instruction.

4.5Theme 4 Intervention which can be put in place to address the challenges

The information gathered by the researcher through questionnaires, interviews and observations have shown that ECD teachers have a little knowledge base with regards to the use of models and how to improvise if there is shortage. According to a research on professional development by Geber (2003) this knowledge gap can be successfully addressed by introducing school based staff development programmes, district workshops and demonstration lessons. The table below is on issues related to frequency of school and district based SDPs and demonstration lessons in schools.

Table 4.7 Staff development initiatives (n=20)

Item	Often		Once in 2 weeks		Once per term		Rarely	
	No	%	No	%	No	%	No	%
School staff development programmes on models	-	-	-	-	4	20	16	80
Demonstration lessons on use of models	-	-	-	-	-	-	20	100
District workshops on media making and use	-	-	-	-	-	-	20	100

The information shown in the table above indicates that little is being done in schools in line with professional development. Only 20% of questionnaire respondents confirmed that they are staff developed but once per term. However eighty percent of the participants indicated that such programmes are not existing in their schools. All the ECD teachers indicated that schools have since stopped demonstration lessons and that the district office is not doing workshops on media making and use. In addition to responses given by ECD teachers interviewed HODs echoed the following sentiments.

TICs responses on staff development initiatives needed to address the situation

- *The district office and schools should plan workshops to staff develop ECD teachers on model use.*
- *Teacher training programmes should focus more on use of technologies and the ministry should consider in-servicing old ECD teachers.*
- *The District Education Office should rationalise the deployment of ECD specialist teachers so that all areas of the district benefit.*

All TICs interviewed indicated that there is need for school and district Staff Development Programmes for ECD teachers on how to make and use models. They all stressed that district workshops should be facilitated by knowledgeable practitioners from CDU and colleges. The three heads of department also suggested that the ministry should work out a national in-service programme for all primary school teachers that they get acquainted with modern technologies coming into the system. About 70% percent of the TICs interviewed added that teacher training colleges and universities should put more emphasis on technology use in their teacher training

programmes. They argued that this will improve the primary teacher's innovativeness. Lastly about 30% of interview respondents argued that the District Office should distribute specialist ECD teachers in a way that most schools in the district benefit. This is against the background that most teachers for ECD classes A and B in the cluster are para-professionals.

Research findings on what can be done to improve the status of instructional technologies in schools have shown that there are various strategies that can be adopted. Most participants have shown that there is need for agent attention to this issue. Researches have shown that the situation can be addressed by revisting Staff Development Programmes, demonstration lessons, school based mentoring services and engaging the District Office to carry out symposiums on technology integration in the Early Childhood Education programme. Fourie and Meyer (2004) added that schools can also overcome the challenge through collaborative peer support. ECD teachers can assist each other on how to improve classroom instruction through collaborative peer support.

4.6 Lesson observations

the researcher used lesson observations to support the research data. the researcher observed three ECD science lessons for ECD B, grade one and two. The following are recordings of the observations made.

4.6.1 Observation 1

An ECD B class activity on domestic and wild animals

Teacher asks pupils to play the rhyme **"Two two we are here."** Pupils play the rhyme moving to the rhythm getting into groups of twos. Pupils keep playing the rhyme as the teacher gets into the storeroom. Teacher comes out with a big black cardboard box in her arms, singing and moving rhythmically to the centre of the classroom. Teacher places the black cardboard box on the floor, stops and gazes surprisingly at the class folding her hands. The class shouts "**Open! Open! Open!"** Teacher opens the big box and starts distributing small closed but transparent cartons of colourful plastic models of domestic and wild animals. Teacher asks pupils to pick and show cats.All the pupils get the activity right except two pairs. Teacher asks pupils to pick and show giraffes and the whole class gets it right. Teacher and class shouts **"Showers showers! Showers showers! Thunder!"** with a loud clap. Teacher asks pupils to show the brown bull, the grey monkey, green snake and the colourful peacock on a big animal chart hanging in the classroom individually. The whole class does very well. Teacher concludes the activity with the rhyme **"Two two we are here"**

4.6.2 Observation 2

A grade 1 science lesson on body parts

Teacher tells the class the old shona legend of the argument between the head, the hand and the leg. Pupils name body parts in the story. Teacher asks class to name other body parts not mentioned in the story. Two girls Mellisa and Thelma are drawing circles in the soil and one boy

is dozing head on the shoulder. Pupils explain functions of different parts of the body. Teacher shows class chart on body parts and asks them to draw and label a human body. Teacher concludes the activity with a rhyme on body parts showing he importance of inter dependence.

4.6.3 Observation 3

A grade 2 science lesson on animal shelter

Teacher shows pupils the following words **nest, hole, bush, branches and tree bark** on word cards. Pupils read the words as a class. A group of boys is busy eating boiled maize throwing some out through a window.Teacher shows pupils pictures of different animals in their natural shelters. Teacher asks the class to identify where the following animals live **mouse, bird, lizard, buffalo and snake.** Pupils answer oral questions individually, teacher praises pupils for good responses. Teacher shows pictures of animals in their shelters. Teacher asks pupils to draw a nest. Teacher concludes the lesson with the rhyme **"Chilly, chilly night"** illustrating the importance of shelter.

CHAPTER 5: RESEARCH SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.

5.1Introduction

The focus of this chapter is to summarise the entire study, draw conclusions and make recommendations in light of research findings obtained.

5.2Summary

Chapter one

The study aimed at finding out whether Early Childhood Development teachers are aware that the use of models as an instructional media in the teaching and learning of scientific concepts has myriad benefits. The first chapter looked mostly at the statement of the problem by attempting to define reasons for including models in ECD instruction and factors contributing to ECD educators' reluctance to use models. It also looked at limitations of the study and research questions derived from the statement of the problem. All the questions had reference to the teaching and learning of scientific concepts at ECD. These included the following a). What are the benefits of using models? b) What challenges do teachers encounter in accessing and using models? c). How knowledgeable are teachers about the use of models? d).What intervention strategies can be put in place to address these challenges?

Chapter two

The unit gave a detailed review of relevant literature. It is mainly on what researches outline as advantages of using models and challenges ECD teachers encounter in accessing and using

models. It also looked on teacher related problems, for example the knowledge base of ECD teachers in relation to models. Literature has shown that children learn most through the play way method. Driscoll (2005) asserts that knowledge is constructed through social collaboration as learners interact with models in groups. The researcher noted this during one of the lesson observations. Before the teacher had finished issueing out sets of plastic models, pupils were already comparing them, sorting them according to colour and manipulating them in groups without anyone asking them to do that. The chapter also examined measures that can be put in place to address challenges ECD teachers face in accessing models in schools.

Chapter three

The research adopted a descriptive survey design.The simple random sampling technique was used to come up with a representative sample from a population of 128 primary schools for the study.Three participating schools were then purposively selected. A respondents set comprising of twenty ECD teachers and three TICs was then established. The researcher employed three data collecting tools.The researcher used the questionnaire for ECD teachers, an interview guide for TICs and an observation guide for lesson observations. A descriptive survey design was used to obtain raw statistical data for presentation, analysis and discussion. The researcher personally conducted the interviews and administered the questionnaire distribution process to ensure that all were returned. The researcher observed and adhered to all ethical issues before conducting the study. Permission was sought from the Ministry of Primary and Secondary Education, District Education Office and school heads to carry out the study in the schools. A hundred percent return rate was achieved. The researcher observed three science lessons for ECD grades and the observations are recorded in chapter four above.

Chapter four

Data collected was coded, collapsed and put in frequency tables for presentation, analysis and discussion. Questionnaire, interview and observation findings were treated separately. They were accorded individual attention to ensure that all are dealt with accordingly. Tables were drawn to enable clear presentation of numbers and percentages. It was noted that questionnaire and interview responses had some similarities. For instance on availability of models about 75% of questionnaire respondents showed that there are no models for teaching and learning scientific concepts in schools. The percentage was similar to that of HODs on the same issue. This is a clear indication that this is really a matter of concern. After a comprehensive presentation and analysis the findings were discussed linking them to literature.

5.3Conclusions

5.3.1 What are the benefits of using models in the teaching and learning of scientific concepts?

The focus here was to establish whether ECD teachers are aware that the use of models has a variety of advantages for Early Childhood Education learners. Questionnaire responses have revealed that most ECD teachers are aware of the benefits of using models for the teaching and learning of scientific concepts at ECD. Interview responses from the three TICs also indicated that models play an integral part in the ECD curriculum. The three TICs stressed that models facilitate the play way learning strategy recommended for minors. The researcher observed that pupils got very enthusiastic the moment the ECD B class teacher started distributing plastic

models of different animals. Pupils were really motivated by the models and the teacher had no problems with controlling the class.

5.3.2 what challenges do ECD teachers encounter in accessing models?

The research has shown that there is a critical shortage of instructional materials in most schools in the cluster. Most questionnaire respondents confirmed that they have never used models. The three TICs interviewed also acknowledged that and blamed the situation on lack of resources in schools. However, about 67% percent of interview respondents blamed ECD teachers for not being innovative. Their argument was that ECD teachers should improvise learning materials from locally available materials. Responses from ECD teachers and their supervisors agreed with what the researcher noted during lesson observations. Of the three science lessons observed only one was conducted using models. The research revealed that lack of resources hinders the use of models and other forms of modern technologies in most rural schools.

5.3.3 How knowledgeable are ECD teachers about the use of models in teaching science concepts?

Research findings have shown that over 85% percent of ECD teachers in the cluster have problems with using models and about 60% can not make simple models from clay and paper marchie. This indicates that most ECD teachers in the district have little or no knowledge on how models are used in classroom instruction. Interviewed TICs reiterated that ECD teachers neither come to their offices for models nor feature models in their scheming and planning. This is also supported by the fact that out of three science lessons observed only one lesson featured models.

During observations the researcher noticed that ECD teachers in the cluster prefer using two dimensional media to concrete media. The researcher also learnt from interviewed TICs that most teachers in the ECD department in the cluster are not ECD specialists hence lack knowledge and skills for making and using models.

5.3.4 What intervention strategies can be put in place to address these challenges?

About 80% of ECD teachers in the sample agreed that the tradition of school based Staff Development programmes have since stopped. Only twenty percent confirmed that they are staff developed but once per term. TICs interviewed also echoed the same sentiments. This is also supported by evidence gathered from the observations made by the researcher. The way in which two of the three lessons observed were conducted indicated that ECD teachers in the cluster lack knowledge on how to use models. Responses from both ECD teachers and TICs agreed that professional development programmes are not being done in the cluster. Both groups of respondents blamed the District Office for not carrying out workshops on instructional media as is done for reading and mathematics through the Early Reading Initiative (ERI) and plap.

5.4Recommendations

The researcher noted with concern that most ECD teachers for ECD A and B classes are semi-skilled and lack indepth knowledge on how to use models. The research has also revealed that there is a critical shortage of ECD learning materials in schools. ECD teachers are finding it difficult to improvise materials for science concepts. Most ECD teachers do not have skills to make models from locally available materials. Most ECD teachers interviewed indicated that

both schools and the District Office are doing very little to help the situation. The researcher also learnt that most ECD teachers in the cluster have at least five years of teaching experience. Sixty-five percent of interviewed HODs argued that such teachers are very conservative. They prefer holding on to traditional instructional technologies and pedagogies despite changing trends in education. Such teachers need induction on current technologies being introduced. Taking cognisance of the findings from the study the researcher has the following recommendations to help improve the situation.

- Schools should prioritise ECD requirements in their yearly budgets and the issue of media should be seriously looked at.
- Schools should plan and carry out SDP on media making and use that new teachers are inducted and old teachers are reoriented.
- Schools should organise mentoring services where newly qualified teachers are attached to experienced teachers for a short time being assisted on professional issues such as media preparation and use
- Schools should intensify the carrying out of demonstration lessons that teachers are kept reminded of what is expected of a lesson
- The District Office should carry out symposiums for ECE teachers on how to make and use models in classroom instruction.
- Schools should offer an incentive package in order to attract qualified ECD teachers since most of them are shunning rural schools for urban schools.
- Teacher training programmes in colleges and universities should be revised to give more emphasis on media construction and use.

- The Ministry of Primary and Secondary Education should work out a national in-service programme for ECD teachers that they are reoriented on new technologies in teaching and learning.

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