THE IMPACT OF USING STORIES IN PRE-SCHOOL MATHEMATICS TEACHING IN THE SAUDI ARABIAN CONTEXT

A Thesis submitted for the degree of Doctor of Philosophy

By

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Abstract

This study aims to investigate the impact of using stories in pre-school mathematics teaching in Saudi Arabia. An intervention was designed to promote interactive teaching and learning in eight classrooms across three private schools. Integral to the intervention was a series of five stories especially written by the researcher based around the same central characters; reflecting the cultural setting familiar to the children, and with a problem-solving storyline. The stories include a range of mathematical facts, skills and concepts applicable to young learners. Additional resource materials to accompany the stories were also designed and provided for the participating teachers.

The researcher adopted a qualitative, constructivist, technical action research approach and three data collection tools were used: a bibliographical questionnaire for the teachers; pre- and post-interventions semi-structured interview schedules, and classroom observations. A thematic analysis of the pre- and post-intervention data was undertaken in order to monitor the impact of using the stories in the pre-school classrooms.

The study considers the findings from the data in relation to both the teachers' and the children's' experiences pre- and post-intervention. In particular, the impact of the intervention on teachers' subject knowledge, attitudes, confidence and classroom practice is discussed along with the impact on children's engagement and enjoyment of mathematics; their mathematical understanding and thinking skills. The study concludes that using stories to teach mathematics had a positive impact on the quality of teaching and learning mathematics. Using the stories prompted a positive change in teacher's and children's attitudes and feelings towards mathematics; a greater understanding of key mathematical ideas; and an appreciation of the value and uses of mathematics in everyday life.

The implications from the study highlight the importance of providing appropriate training for pre-school teachers (and elsewhere) and the pivotal role that using stories can play in ensuring high quality mathematics teaching and learning.

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Acronyms Used in this Study

CPD- *Continuing professional development*

DC-*Developed Curriculum*

DfEE- *Department for Education and Employment*

EYFS- *Early Year Foundation Stage*

GPGE-*General Presidency for Girls' Education*

GSP-*General Secretariat of Pre-school*

MOE-*Ministry of Education*

MOK- *Ministry of Knowledge*

NAEYC- *National Association for the Education of Young Children*

NCTM- *National Council of Teachers of Mathematics*

OECD- *The Organisation for Economic Co-operation and Development*

RME- *Realistic Mathematics Education*

SA- *Saudi Arabia*

UK- *United Kingdom*

UNESCO-*United Nations Educational, Science and Culture Organisation*

USA- *United State of America*

ZPD- *Zone of Proximal Development*

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Dedication

I dedicate this work to

My Dear Father's Soul
The most determinant and tolerant man I have ever known, who always taught me to be honest, respectable, and supportive to others.

My Dear Mother
The most compassionate, supportive, and encouraging person in my whole life, who brought me up and stood by me throughout my life. Without her love, support, prayers, and blessings, I would never have been able to finish this work. May God bless her.

My Husband, My Lovely Partner
The most respectable, patient, and considerate person I have ever known, who helped me celebrate every triumph and provided support at every tribulation. His understanding, support, encouragement, love and prayers were the fuel and light that drove me to the end of this journey.

My Lovely Sweet Two Children
(Tala and Trad)
The most important people in my life
I love you from the bottom of my heart.

Chapter 1: Introduction

1.1 Introduction to the Study

As an early years educator I believe in the importance of pre-school education as an essential foundation for the next stages in education. In Saudi Arabia, children from birth to six years account for approximately 13.7% of the total population hence it is particularly important to make sure that this stage prepares children as well as possible for the next stages of learning and beyond.

This study focuses on using specially prepared fiction stories as a strategy for presenting mathematical concepts to pre-school children (aged 5-6 years) in Saudi Arabia and aims to explore how the use of story can make mathematics lessons more enjoyable, purposeful and relevant to everyday activity for both children and teachers. Based on interview data gathered from teachers, mothers and children, alongside observations of pre-school mathematics teaching, this study aims to investigate the emerging issues in using story as a teaching strategy and the consequent implications for practitioners and policy makers in Saudi Arabia and elsewhere.

The aim of this chapter is to provide an introduction to the study, specifying its focus and identifying its importance in the context of pre-school education in Saudi Arabia. It presents the background to the research problem and explains the personal motivation of the researcher. A discussion of the significance of the study is presented. The chapter closes with an outline of the structure of the thesis.

1.2 Research Problem

I chose this research subject due to my firm belief in the importance of early education as a vital time for children to gain the necessary skills to make them effective learners in readiness for the next stages in their schooling. Children who enter school ready to learn, usually learn more effectively, are more productive and enjoy the learning experience (Wasik et al., 2000). I believe that whilst children can be taught to add and subtract in informal ways, they seem to find it hard to record the operations using symbols or describe them in words perhaps because of the way that maths is generally taught in Saudi Arabian schools. Ideas are often introduced but then not revisited in any way that enhances understanding or supports recall. Hence there is scope to introduce teaching approaches that ensure opportunities for pupils to revisit mathematical ideas in a well thought-out and planned manner over the longer term.

In this study, I will focus on the place of stories in mathematics teaching, in particular, using stories as a way to help children form solid foundations in mathematics as well as ensuring that they will enjoy the learning experience. Children can often relate stories to their real lives and, according to Seifert (1993) stories are more memorable and young children may learn more easily when a task is presented in a story format rather than as expository instruction. Many scholars have argued that pupils' learning is less effective when undertaken in a de-contextualized format (Bruner, 1987; Casey et al., 2004; Schank and Abelson, 1995). And so, as well as providing a context for learning mathematics, stories can also replace the current teaching methods (mainly teaching by rote) which have previously caused some children to experience apprehension and to develop a fear of mathematics in later life (Buxton, 1981; Cockcroft 1982; Haylock and Cockburn, 2008; Thompson, 2008).

From my experience as a former pre-school teacher in Saudi Arabia, I strongly believe that the level of preparation for pre-school teachers is not rigorous or academic enough. At the same time, there are not enough schools with proper facilities for young children as pre-school education in Saudi Arabia is still in its infancy. Attendance at pre-school is not compulsory with the proportion of children enrolled in pre-schools estimated at 12%, which is very low. To further complicate matters, there is more than one sector providing pre-school education:

the private sector, the public sector and military organisations. The role of the Ministry of Education is to ensure that all sectors are following the general objectives that have been issued by the Ministry. As will be outlined in Chapter 2, teachers across the pre-school sectors (state, private and military) have different educational qualifications: a few have degrees in early childhood studies but the majority have either bachelor degrees in other subjects or high school certificates. This is an important factor in this research as teachers without the relevant qualifications or training may be limited in their ability to deal with the developmental needs of the pupils. Also, teachers without appropriate early years qualifications may have reduced expectations for this important stage of education and be limited in the range of teaching approaches and strategies for working with younger pupils.

Currently mathematics is taught in pre-schools in Saudi Arabia in a manner that teaches mathematics as a discrete subject not associated with or relevant to young children's life experiences. Also, each pre-school organisation follows a different mathematics curriculum, for example in the state schools only 'number' concepts are presented while in the private schools each school follows its own curriculum. My belief is that introducing children to mathematics through stories can help teachers to connect mathematical ideas to daily experiences which, in turn, can help to make mathematics an interesting subject for children to learn.

1.3 Personal Motivation

Several factors have motivated me to undertake research in this area, starting with my strong belief in the power and influence of story on human beings in general, and children in particular.

As a young adult, I believed that stories had a strong influence on children's lives and I used stories whilst looking after relatives' children to make them listen to what I was saying, at the same time, as ensuring that they enjoyed their time with me. I became a pre-school teacher with a strong belief in the importance of this stage in nurturing children's personality as well as ensuring a strong foundation to help them to move on confidently to the next stage in their learning journey. As a teacher, I continued using stories with my students in circle time sessions and literacy sessions but never in mathematics sessions. Every time I used stories, I witnessed how the stories worked their ‘magic’. My belief about the importance of this approach increased and I became convinced that using stories would be the solution to some of the challenges that teachers of young children face, for example, in motivating, managing, and engaging children’s interest in learning.

When the opportunity to undertake doctoral study came along, I decided to explore the topic of using stories as a cross-curricular teaching approach which could help teachers teach in an interactive and enjoyable way, thus helping children learn in an active and meaningful way - constructing their knowledge instead of passively receiving it from the teacher. As I started to read the literature in this field, my initial plan changed from using story as a cross-curricular teaching approach to the more specific focus of using stories in teaching mathematics to young children.

In the early stages of preparation for my study, I researched the literature on using stories as a teaching strategy and how adopting this approach could affect the teaching process and the learning outcomes (Daniel, 2012; Heuvel-Panhuizen and Elia, 2012; Hong1995; Hong, 1996; Jennings et al., 1992). Some authors focussing on the effectiveness of using stories in teaching mathematical concepts (Hong, 1996; Moyer, 2000; Murphy, 2000) emphasized how the traditional way of teaching mathematics (for example, teaching by rote, memorising facts, practising pencil and paper methods) does not necessarily achieve its basic goals as traditional methods do not help children to think logically, do not build new knowledge on from previous knowledge, and do not encourage interactive learning or reasoning. This reminded me of the maths sessions when I was teaching, and I recalled all the negative feelings, from lack of confidence to anxiety, that I had towards mathematics as a subject. All the images that crossed my mind focused on the fact that our way of seeing, learning, presenting, and teaching mathematics was inadequate in meeting children’s needs. At the same time, as a teacher I suffered during mathematics sessions because I did not know the best way to teach this subject to make it more attractive to children. Perhaps this was the reason why some children in my class did not like the maths sessions compared to subjects like literacy, Islamic study and English. For all the reasons stated above, I was highly motivated to research this area. I started to develop a strong conviction that the use of stories as a strategy to present mathematical concepts would overcome some gaps that teachers and children face when teaching and learning mathematics as well as enhance the quality of mathematics teaching.

1.4 Aim and Research Questions

The overall aim of the research is to explore the impact of using fiction (stories) as a strategy for teaching mathematics to young children (age 5-6 years) in Saudi Arabia. The stories have been designed and written specifically for early learners to help them link mathematical ideas with their daily life experiences and, in so doing, begin to construct their own understanding of mathematical concepts. At the same time, the impact of using stories in promoting interactive mathematics teaching and active learning approaches will be considered. The following two research questions will be addressed:

- What is the impact of teaching mathematics through fiction stories on pre-school *teacher practices*: subject knowledge, attitude and confidence, and classroom practice?
- What is the impact of teaching mathematics through fiction stories on pre-school children's *learning*: engagement and enjoyment, understanding, application and thinking skills?

Figure 1-1 summarises the research aim and objective:

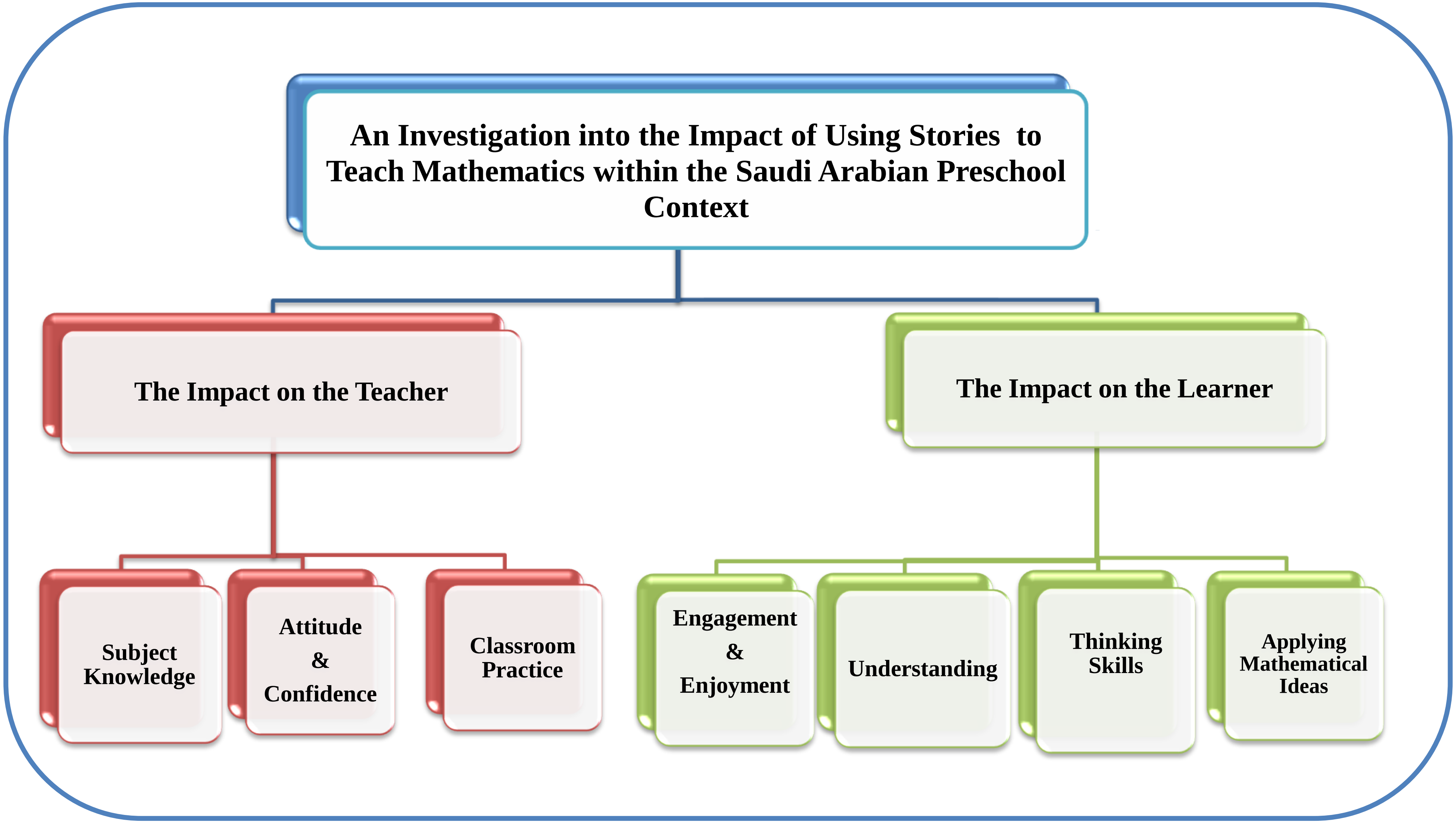

Figure 1-1: Research Aim and Objectives

1.5 Research Methods and Design

The aim of the research was to explore the impact of using fiction (stories) as an approach to teaching mathematics to pre-school children and so to begin with I established a baseline by analysing the nature and thinking behind the teaching method and procedures already in place for teaching mathematics to pre-school children in Saudi Arabia. Constructivism was adopted as the research paradigm and, since part of my focus was to help pre-school teachers to enhance their way of presenting and teaching mathematics, a technical action research methodology made a suitable framework for the study. Consequently, the research design was a qualitative, constructivist technical action research approach.

Based on my knowledge, the current study was the first research study to investigate using stories to teach mathematics to pre-school children in Saudi Arabia hence my decision to undertake a small scale, focussed, qualitative study.

I adopted three research tools to answer the research questions; a questionnaire for teachers; interviews with teachers, children and mothers pre-and post-implementation of the new method; and an observation checklist for mathematics lessons and play time periods.

I began my data collection by using a biographical questionnaire to gather basic background information on the teachers, for example, teacher qualifications, details of their training programme, and years of experience. This strategy is intended to ensure that the more formal interview stage runs smoothly.

Semi-structured interviews with teachers, children, and parents were conducted pre- and post-intervention. Questions with ‘purpose’ were designed, aimed at providing the interviewees with opportunities for reflection in order to reveal their perceptions of mathematics before and after the implementation of the new method.

Observation is deemed to be a good tool to see phenomena in reality rather than glean it from participants’ perspectives. Hence observation was chosen in order to enable me to look closely and deeply into how teachers teach and how children respond, both during the mathematics sessions and free choice play periods.

Figure 1-2 summarises the research methodology:

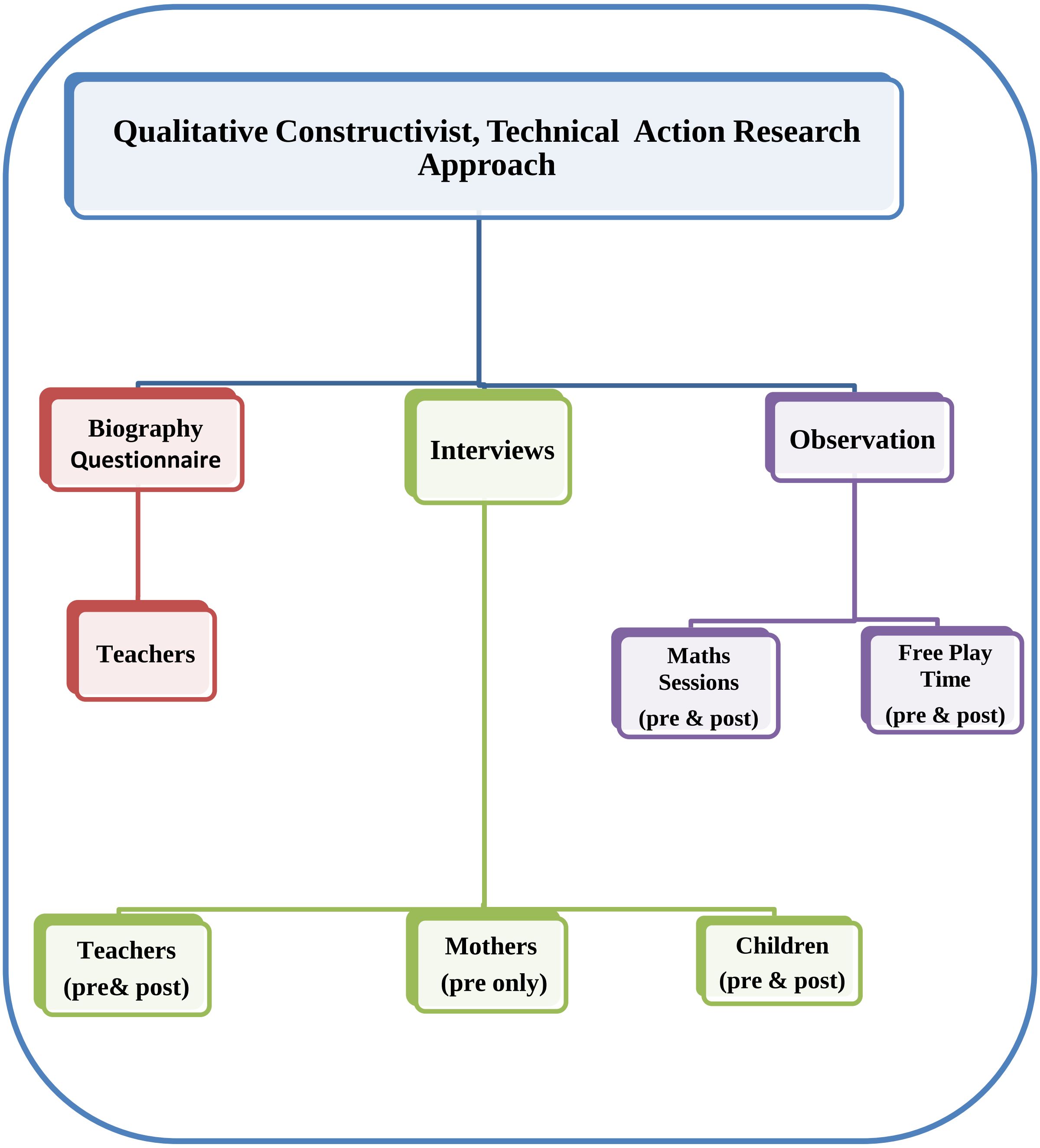

Figure 1-2: Research Methodology

The purpose of the research and the research questions are revisited in chapter four in greater detail along with the methodological approach adopted for the study.

1.6 Significance of the Study

Whilst considerable research has been undertaken in the area of mathematical learning in the early years of schooling in a number of countries, this study is the first to examine this field within Saudi Arabia. The researcher has read contemporary theories and practices throughout the world related to early years' education in an attempt to understand and explain how the differences in approaches are related to mathematical learning in Saudi Arabia. To do this, it has been necessary to develop a thorough understanding of learning methods and pedagogies that have been adopted by teachers, as well as determining their influence on the learning of children of this age.

The study will analyse and evaluate early childhood theories and practices in common use in Saudi Arabia, relating the local context to new developments and understandings in this field from other countries. Thereafter, the results of the study may provide a better understanding of children's mathematical learning in Saudi Arabia. It is anticipated that the outcomes of the study will have implications for curriculum design and pedagogy in the KSA and provide further insights into early mathematical learning applicable to both the KSA and the international community.

The significance of this study in such an important area of educational development also stems from the fact that it is conducted in a developing country where the children from birth to age six years represent approximately 13.7% of the total population. It is directly related to the value of children's later successes and, ultimately, for the benefit of the development and welfare of society.

The outcomes of the study may prove to be of considerable relevance to other countries in the Arabian Gulf and other Arabic countries, for example, Jordan and Egypt since Saudi Arabia shares the same language and religion as well as similar culture, values and background.

The study will provide evidence-based outcomes obtained from a specific place and moment in time which may stimulate further research to be carried out that will inform policy and practice in the field of early childhood education.

1.7 Structure of the Thesis

This thesis is structured in seven chapters.

- The current chapter is an introduction to the study, which specifies its focus and identifies its importance. It lists the specific research questions and provides a guide as to how the thesis is structured.
- The second chapter presents an overview of the Saudi Arabian education system in general and pre-school in particular, including background, curriculum content and theoretical perspectives, in order to clarify the context of the study.
- Chapter 3 reviews the literature and previous research related to the area of the study. The review considers the development of children's mathematical knowledge from different theoretical perspectives addressed in different studies. It provides a broad background to understanding and explaining children's mathematical knowledge and abilities in the current study and concentrates on the use of story as a teaching method. In addition, this chapter discusses different aspects of early childhood practices in relation to mathematics learning.
- Chapter four explains the methodology and the research design in detail. This chapter offers a justification for the choice of the constructivist paradigm and action research as a framework for the study.
- Chapter five describes the process of designing, implementing and evaluating the stories and workshops, and also discusses the outcomes and implications of applying such a method to teach and present mathematical concepts for early learning.
- Chapter six reports the analysis and coding stages of the interview and observational data within the context of the qualitative constructivist technical action research procedure.
- Chapter seven presents a discussion of the research findings and an evaluation of how the original aim and research questions of the study have been met. The chapter concludes by summarising the main findings and presents the implications of the study for teachers, head teachers

inspectors and policy makers in Saudi Arabia in relation to mathematics education. The limitations of the study are discussed. This chapter also presents my personal learning as a result of this investigation and outlines the contribution of this study in clarifying the potential of using stories as a method to present mathematical concepts to young children along. Possible topics for future research are identified.

Chapter 2: The Educational System in Saudi Arabia

2.1 Introduction

Since this research is about teaching mathematics through stories to pre-school children in Saudi Arabia, an overview of the salient features of the Saudi Arabian education system is presented to provide the reader with insights into the context of the research. Hence, the aim of this chapter is to provide a general overview of Saudi Arabia and the educational system in particular. Few research studies in the context of pre-school and childhood in Saudi Arabia have been published. In addition, Saudi researchers find it hard to access the available limited published research due to difficulties in getting access to university libraries, and there is no Saudi electronic (digital) library. Amazing progress certainly has been made in terms of creating a Saudi electronic research library at the end of 2013 but it has been with limited resources. The new developed e-library is dependent on the Saudi sponsored students to publish their theses and copies of their published papers. This study addresses this knowledge gap in the pre-school and childhood context for the unique educational system within Saudi Arabia, and is one of the few attempts to do so. Specifically it is the only one in relation to the used of story in teaching mathematics.

This chapter is divided into three main sections. The first section presents the key aspects of Saudi Arabia in terms of its geography, economics, and religion. In the second section the Saudi Arabian approach to education is presented along with the position of Islam in relation to education, and its impact on the formulation of the aims and objectives of education in Saudi Arabia. The third section offers a comprehensive view of pre-school education in Saudi Arabia, in terms of its inception and evolution. At the same time, the key roles and responsibilities within the educational system, the approach to curriculum provision, and, the challenges facing the pre-school stage of education are explored.

2.2 Geographical Location and Population of the Kingdom of Saudi Arabia

Saudi Arabia is located in the south western part of Asia, and is one of the largest Arab countries. It comprises almost four-fifths of the Arabian Peninsula, with an approximate area of 2,225,000 square kilometres (868,730 square miles). The geographical boundaries in the north are with Jordan, Iraq, and Kuwait; in the south by Oman and Yemen; in the east are the Arabian Gulf, Bahrain, Qatar and the United Arab Emirates; and in the west lies the Red Sea (Ministry of Planning, 2012 a)[1].

In 1974, the population of Saudi Arabian was approximately 7 million, by 2011 this had raised to 28 million, which includes 19.4 million Saudi citizens with the rest from other nationalities. The proportion of men is 50.4% and the proportion of women is 49.6%, with half of the population aged less than twenty years. The proportion of children from birth to age six years is approximately 13.7% of the total population. The average annual growth rate according to the Kingdom's population demographic survey of 2011 was 2.28% (Ministry of Planning, 2012 b)[2]. As illustrated in Figure 2-1, the highest proportion of the Saudi population is children less than 9 years old which encompasses the pre-school and early education populations.

Figure 2-1 illustrates the Saudi population pyramid base on their age and gender.[3]

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[1] http://www.cdsi.gov.sa/2010-05-08-09-59-55

[2] http://www.cdsi.gov.sa/index.php

[3] http://www.cdsi.gov.sa/yb45/Figures/Figure1.gif

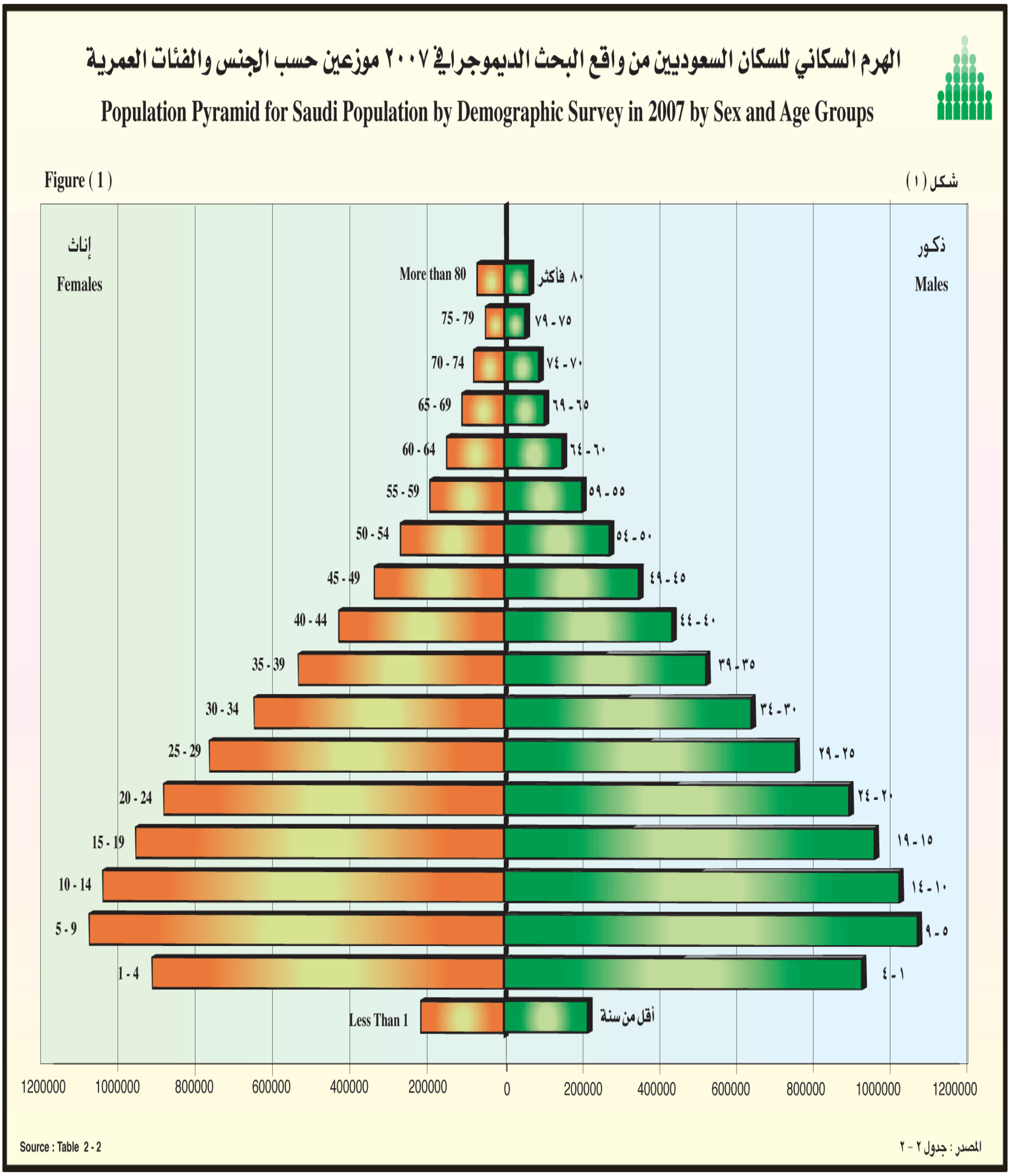

Figure 2-1: Saudi Population Pyramid

2.3 Key Geographical Regions of Saudi Arabia

Saudi Arabia is divided into five major areas:

The central region includes the capital city of Riyadh where the King and most members of the Royal Family live. Most of the embassies, ministries and key services facilities are also in Riyadh.

The western region comprised of Makkah, Jeddah, and Medina. Makkah, the religious capital of the Kingdom, and Medina are visited by nearly two million Muslims every year. Jeddah is the second largest city in the Kingdom (after the city of Riyadh) in terms of space and has the largest port of Saudi Arabia.

The eastern region is one of the most important areas of the Kingdom. The importance of this region lies with oil which is the main source of wealth for the Kingdom whilst the northern region is characterized by its abundant agriculture and moderate climate. In the southern region there is also an agricultural area characterized by a moderate climate but colder when compared to other regions. Each of the regions of the Kingdom has its own customs and way of life and people's origins can easily be recognized through the way he/she talks and acts. Figure 2-2 shows the map of Saudi Arabia delineating all five regions [4]

Figure 2-2: Map of Saudi Arabia

[4] http://universes-in-universe.org/eng/nafas/countries/middle_east/sau/(map)

2.4 Saudi Arabia's Economy

Saudi Arabia is now one of the richest countries in the world not because it is an agricultural or a commercial country but because it is the largest oil producer in the world. Currently, the Kingdom of Saudi Arabia (KSA) holds the world's largest reserves of petroleum, 25% of the known total (Ministry of Planning, 2012 c)[5]. As a desert area with very little rain, life in the KSA used to be difficult but the situation changed significantly subsequent to the discovery of oil in 1925. Since that time, many of the people who were tribes living in the desert now live in modern cities with all modern facilities and services, such as water, electricity, hospitals, schools and universities. The discovery of oil helped and promoted the development of Saudi society, particularly the development of the commercial, health, and agricultural, educational sectors.

Subsequent to the discovery of oil, the Saudi government has also paid considerable attention to the educational system. The key developments of the Saudi educational sectors from that time to the present can be summarized as follows:

- In 1925 the Directorate of Knowledge developed to supervise education in the Kingdom.
- In 1957 King Saud University opened as the first university in the Kingdom.
- In 1953 the Directorate of Knowledge changed to the Ministry of Knowledge to supervise and improve the regular and irregular educational institutions.
- In 1960 the General Presidency for Girls' Education developed to supervise Girls' education in the Kingdom.
- In 1961 the first four girls joined the university education at King Saud University in Riyadh.

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[5] http://www.cdsi.gov.sa/index.php

- In 1980 the supervision of the pre-school education stage transferred from the Ministry of Knowledge to the General Presidency for Girls Education.
- In 2003 the General Presidency for Girls' Education became part of the Ministry of Knowledge.
- In 2004 changed the name of the Ministry of Knowledge to the Ministry of Education.
- In 2004 the pre-school organization level changed to municipality and change its name to the General Secretariat of Pre-School.

Many changes have taken place throughout all stages of education from pre-school up to higher education where the government has opened the door for external scholarship. The continuing focus on education is because it is recognised that the oil source and wealth will not last for ever and so, Saudi Arabia is now investing more in people knowledge and research in all advanced sciences to lead the future and continuing development of the country (Ministry of Higher Education, 2013). The government realizes the importance of diversifying its economy through knowledge transfer. The King Abdullah Foreign Scholarship Programme provides the means to attend leading world universities to pursue studies that lead to degrees (bachelors, master and doctorate) and medical fellowships. Academic disciplines and scholarships are selected on the needs of government ministries, national corporations and the private sector (Ministry of Higher Education, 2013). The King Abdullah Foreign Scholarship Programme commissions qualifying Saudi youth to take an active role in the development in all fields of the governmental and private sectors as there is an acknowledged need, supported by a clear vision, 't*o prepare distinguished generations for a knowledge society built upon a knowledge-based economy'*. As a result, since the start of the program in 2005, more than 150,000 Saudis (male and female) are studying in leading universities worldwide with the aim of actively developing and qualifying Saudi human resource to be:

- world-competitive in the work market and academic research;
- a high calibre base in Saudi universities, public and private sectors.(Ministry of Higher Education, 2013)[6]

2.5 The Impact of Religion on Education

The beginning of Islam and the revelation of God to Muhammad, peace be upon him, started with the first word in Quran and Islam, which is *Read*. This was an explicit call to renounce ignorance, and start reading, research and meditation to establish the facts.

Many verses of Quran stress that the call of Islam is a call to education and knowledge, to accept facts and finds ways and means to uplift and progress the human mind and, therefore, progress and uplift the entire community. Where education is valued in a community it is hoped that there would be fewer problems, diseases and crimes, whilst a community which is characterized by the ignorance of its members is known for social problems, diseases and crimes.

2.5.1 Some of the Holly Quran Verses on the Request to Continue Seeking Education

As highlighted earlier, the first verse revealed to Muhammad, peace be upon him, is *Read.* This verse is the first step and the basic rule of Islamic thought that proposes to seek knowledge and favour the person who has knowledge over the person who has no knowledge. According to the Holy Quran, the person with knowledge will reach truth through research, experience, proof and persuasion. On the other hand, a person without knowledge will accept everything that is said, even if it is not true, without judging in his mind with his existing knowledge. A Muslim with his/her knowledge can contribute to the progress and prosperity of the society, and it is mentioned in the Quran verse *Say (unto them, O Muhammad): Are those who know equal with those who know not?* (Az-Zumar

[6] www.mohe.gov.sa/en/studyaboard/king-abdulla-hstages/pages/default.aspx

39/9), which is an indication that Islam is a religion of education and knowledge, and encourages both of them.

The Quran states, *God says: And Allah brought you forth from the wombs of your mothers knowing nothing, and gave you hearing and sight and hearts that haply ye might give thanks* (Al-Nahl 16/78). The previous verse demonstrates that every human being is equipped with the required tools of access to education, knowledge and scientific research. The basic tools needed for right of access to knowledge are the senses (hearing, sight, and mind) that are present since birth, and all modern theories emphasize that the first knowledge which must be obtained in humans at the beginning of their education from early childhood must be based on the senses accessing knowledge through the use of concrete materials. This is one of the Quran miracles that has provided this information before being available to modern science. As mentioned earlier, Islam has made it known that the community needs scientists everywhere and at anytime; a community without knowledge and scientists is considered a community living in illusions, ignorance and darkness. See appendix A for more details on the impact of religion on education.

2.6 The Impact of Islam on Saudi's Educational System

The educational system in any country is a reflection of the principles and values of the country itself (Al-Sunbl et al., 2008). Education plays a key role in building and preparing members of the society, who will produce the future wealth of any country. Saudi Arabia is an Arab Islamic country, whose mother tongue is Arabic, the language of the Quran, has a special place in the hearts of Muslims because of Islam's holiest sites of Makkah and Medina. Makkah has the Grand Mosque and the location of the Kaaba, to which all Muslims face five times each day during their prayers. Medina Mosque is the mosque of the prophet Mohammed, may Allah bless him and peace be upon him, who began the Islamic rule.

The Kingdom of Saudi Arabia is the heart of the Muslim world and Islam governs all aspects of life in the country: the political system, social system, economic system and education system. Islam in Saudi Arabia is not only a religious doctrine separate from the realities of life but is a method and a way of life.

Religion is the most influential force in the country especially in the educational system. Saudi Arabia considers religion as the basis for recognising or preventing any disorder of affairs, and in addition what is acceptable to Islamic law is introduced. Whatever is in line with religion will be approved, and whatever is contrary to religion will be avoided. The Saudi system, in general, and the educational system in particular, follows the lunar calendar linked to the migration of the Prophet Muhammad, blessings and peace be upon him, from Makkah to Medina in 622 AD.

In summary, Islamic thought impacts on both the *content* and the *organisational features* of the education system in Saudi Arabia including:

- the teaching of religious materials, such as the Quran, Tafseer (the meaning of the holy Quran), Fiqh (Islamic law), and Tawheed (Islamic faith), are taught at all educational levels commensurate with each phase;
- strengthening the Islamic identity in the personality of each student;
- the official language of instruction is Arabic, the language of the Qu'ran;
- gender segregation in education at all levels, except for the pre-school stage, which is approved by Islamic law;
- the calendar used in schools is the Hijri (lunar) calendar as all religious events follow this calendar.

2.7 The Structure of the Educational Ladder in Saudi Arabia

The Saudi educational system is a unique model compared to the educational systems prevailing in the rest of the Arab countries. The system provides compulsory education from primary phase to secondary phase but with separate special schools for girls with only female staff, and for boys with only male staff. Pre-school is the only stage where students mix, but all staff who work in the pre-school centres are women.

The general education system in Saudi Arabia is pursuing a 6-3-3 pattern: six years for the primary stage, followed by three years for the intermediate stage, and then three years for the secondary or high school stage. These are the stages of assessment in the structure of the Saudi education, preceded by three years of non-compulsory pre-school education, and thereafter followed by the stages of higher education, which include undergraduate, masters and doctoral level. This pattern, or structure, is typical of most Arab countries, for example, the United Arab Emirates, Qatar, Bahrain, Iraq, Egypt, Syria and Libya.

Table 2-1: The Structure of the Educational Ladder in Saudi Arabia

Number of years for each stage	Stage of Education	Age of Student (in years)
3	Pre-school (non-compulsory)	**3-6**
6	Primary	**6-12**
3	Intermediate	**12-15**
3	Secondary/ High	**15-18**
3+	Higher Education	**18+**

In April 2013, the Saudi Arabia government introduced compulsory education from age 6-15. To achieve this target, Saudi's government made a decision to include this new recommendation into the marriage certificate to ensure that all parents will register their children in school (Al-Zahrani, 2013).[7]

The following points outline the progression of education in Saudi Arabia:

- in 1953, the Ministry of Knowledge (MOK) was established to supervise the education institutions in Saudi Arabia (State and Private sectors);

[7] http://www.okaz.com.sa/new/mobile/20130415/Con20130415590471.htm

- as the number of girls joining schools increased, the General Presidency for Girls' Education (GPGE) was created in 1960 to supervise Girls' education in Saudi Arabia;
- in 2003 the GPGE became part of the MOK;
- in 2004 the name of the Ministry of Knowledge (MOK) was changed to the Ministry of Education (MOE) (Al-Sunbl et al., 2008).

2.8 Objectives of the Education Stages in Saudi Arabia

Education is a preparation for membership of the community in line with the strategic vision and objectives of Saudi Arabia and put into practice by the organisers of the educational process. These central educational objectives are formulated and written in a manner approved by the education policy makers and derived according to the policies of SA, largely from the teachings of Islamic Sharia (Islamic law).

2.8.1 The Objectives of the Pre-school Stage

As mentioned previously, pre-school in Saudi Arabia is not a compulsory stage for children age 3-6. It is divide into three levels, KG1 for the children age 3-4, KG2 for children 3-4, and KG3 for children from 5-6 .

The Saudi Arabian pre-school goals derive from the requirements for early childhood which are aimed at developing the child's personality in an integrated manner. The objectives of this stage are (Ministry of Education, 2013 a)[8] :

- Protecting the instincts of children, looking after their moral, mental and physical growth in a natural environment similar to their family environment, and responsive to the requirements of Islam.
- Composition of the child's religious learning based on belief in the oneness of god; this conforms to the child's instincts.

[8] http://www.moe.gov.sa/Pages/educationPolicy.aspx

- Teaching the child good behaviour and helping him/her to acquire the virtues and expected behaviours of Islam, by providing a good example for him/her at school.
- Familiarising the child with the school atmosphere, preparing him/her for school life, and transferring him/her gently from self-centredness to a social life shared with schoolmates.
- Providing the child with a wealth of correct expressions and easily understood fundamental truths and information that suit his/her age, and are relevant to his/her surroundings.
- Training the child in body exercises, teaching him/her sanitary habits, cultivating his/her senses, and training him/her to use them properly.
- Encouraging the child's imaginative thinking, and opening doors for his/her energies to blossom under guidance.
- Meeting childhood needs, making him/her happy and educating him/her, all without spoiling or burdening him/her.
- Protecting the child against dangers, treating the early signs of bad behaviour, and facing childhood problems in an appropriate way

It is clearly evident that the objectives reflect the thinking of the Islamic state policy and are designed to establish the Islamic faith in the hearts of children from a very young age.

2.8.2 The Objectives of the Primary Stage

Since the primary stage is the first stage of compulsory education, it is considered to be the foundation which prepares students for the subsequent national objectives for the intermediate and secondary stages of education. Students start this stage when they are 6 years old and complete it at age 12, which means students take six years to completing this stage. The objectives of the Primary Stage are delineated by the Ministry of Education, 2013 b[9]:

[9] http://www.moe.gov.sa/Pages/educationPolicy.aspx

- Plant the true Islamic creed in the soul of the child and integrate Islamic upbringing in his mind, behaviour, language and belonging to the nation of Islam.
- Train them to establish prayer and adopt ethics and virtues.
- Development of basic skills of language, numeracy and motor control.
- Be available to provide him with sufficient information on various topics.
- Define the grace of God in him and in the social environment surrounding him. Improve the use of geographical blessings to benefit himself and his environment. Creative education and undertake innovative activity and the development of appreciation for work by hand.
- The development of his consciousness to realize his rights and the rights of others within the limits and characteristics of his age, and instil the love for his country and dedication to the governors of the order.
- Generate a desire to gain an increase of beneficial knowledge and righteous deeds, and train to take advantage of his spare time.

The objectives of the intermediate and high school stages are expressed in more details in appendix A.

2.9 Pre-school Education in the Kingdom of Saudi Arabia

The importance of pre-school education in Saudi Arabia can be linked to the high proportion of the total population in this age group: 13.45% of the population are from birth to age 6 years of age. At the same time, there has been significant social change in Saudi society since 1970. For example, the nuclear family has begun to replace the extended family, women go out to work (careers) coupled with an increased awareness of the importance of this stage in the life of the child particularly its impact on future stages (Al-Sunbl et al., 2008).

Before writing about the development of the pre-school education in Saudi Arabia, Table 2-2 will highlight the difference between the state and private pre-schools.

Table 2-2: The Difference between State and Private Pre-school

Elements	State Pre-school	Private Pre-school
Supervision	Ministry of Education	Ministry of Education
Daily Working Hours	7.30-11.30 am	7.30- 1.30 pm
Teachers' Qualification	BSc Degree	High School and above
Teachers' Training	Four hours a week for eight weeks compulsory training in the teaching training centre for teachers with no childhood degree.	No compulsory training by the Ministry of Education, however, it depends on the private school management and the advice of the pre-school inspectors.
Daily periods	The main five periods (circle time, outdoor free play, meal period, free play at corner, and last meeting)	The main five periods plus literacy, Religion. English, and mathematics (other school may have extra other periods)
General Curriculum	Developed Curriculum (DC)	Developed Curriculum (DC)
Literacy Curriculum	Recognise the Alphabet (Provided to children during circle time once a week)	Recognise the Alphabet plus focusing on reading and writing (literacy provided to children four times weekly as a separate session)
Mathematics Curriculum	Recognise the numbers from 1-20 (Provided to children during circle time once a week)	Recognise and writing the numbers from 1-20 plus colour, shapes, and adding (other schools may provide subtraction and groping). (mathematics provided to children once a week)

2.9.1 The Development of Pre-school Education in Saudi Arabia

Pre-school education is a non-compulsory stage of education in Saudi Arabia despite its importance in the development of the child's personality and preparation for subsequent phases of education. Some educators have attempted to make this stage mandatory and a necessary condition for enrolment into primary school. Based on the magazine of Al-Marefh (2009)[10], there has been a call for action to make the pre-school education stage compulsory because of its importance. Pre-school is intended to achieve the following:

- feelings of happiness and joy;
- cognitive development;
- provide experiences and skills that cannot be given at home;
- identify learning difficulty or talent, and
- help to improve child-school readiness and transition to the next stage. (Al-Affaan, 1993; Al-Marefh, 2009; Al-Otaibi, 2007; Al-Sagher, 1996; Al-Sunbl et al., 2008)

Furthermore, a long term comparative study by Al-Otaibi and Al-Swailem (2002) indicated that the students who attended pre-school were better than other students who did not join pre-school with the following advantages:

- reduction in school failure;
- higher high school completion rate;
- fewer behavioural problems inside and outside the school;.
- less criminality and theft;
- better opportunities to participate in the labour market and to be more productive.

In (2009) Al-Dwaihi in Al-Watan newspaper made an urgent request to make pre-school education compulsory, reinforcing the notion that it is an important stage in helping children to continue and succeed in the educational process. The article

[10] http://www.almarefh.org/news.php?action=show&id=1392

showed that the failure rate of using the Arabic literacy skill was lower for students who entered the stage of pre-school compared with students who did not. The request was to pursue the approach adopted by the Arab Emirates, which has worked to make pre-school education compulsory (Al-Dwaihi, 2009).[11]

The contributions of the private sector, the Ministry of Knowledge (MOK), the General Presidency for Girls' Education (GPGE) and the General Secretariat of Pre-School (GSP) in the evolution and development of pre-school education in Saudi Arabia is illustrated in Figure 2-3 and will then be explored in detail in the following sections.

11 http://www.alwatan.com.sa/news/writerdetail.asp?issueno=3262&id=14131&Rname=368

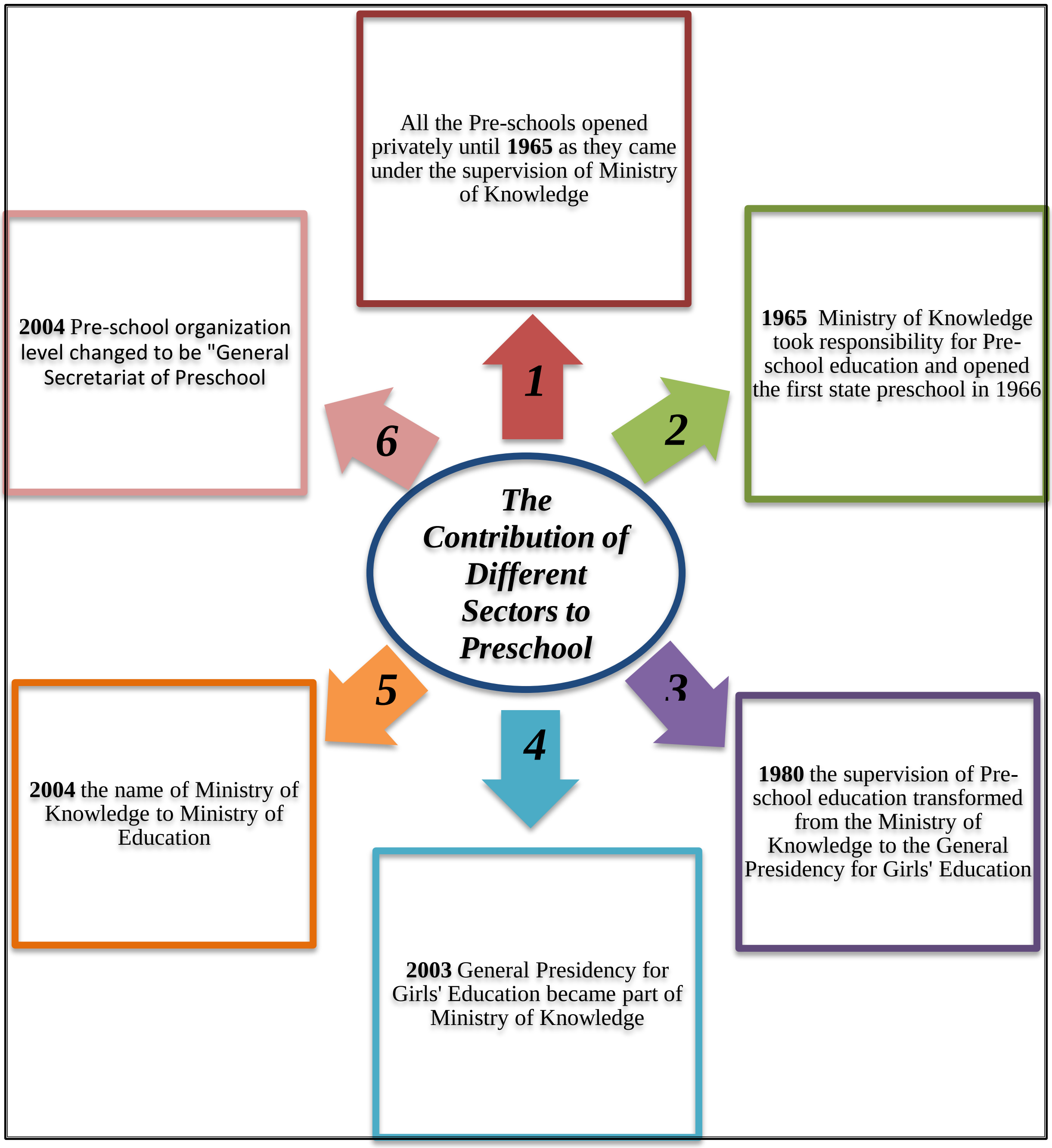


Figure 2-3: The Development of Pre-school Stage in Saudi Arabia

2.9.1.1 The Contributions of the Private Sector

In supporting, spreading and developing education, the private sector has also contributed to pre-school education in Saudi Arabia. The first steps in the evolution process were taken by individuals within the private sector, for example Dar Alhanan school, but over time, a more organised stage evolved whereby private school pre-school education came under the auspices of the Ministry of Knowledge (MOK) (Al-Sunbl et al. 2004) .

Al-Sunbl et al. (2008) clarified that the private sector was solely responsible for early education until 1965 when the private schools came under the supervision and support both technically and financially of the MOK. The number of institutions for early education sponsored by the private sector included 92 centres with 15,485 children (Al-Sunbl et al., 2008).

The demand for this type of education has grown due to an increased awareness of the importance of this educational phase coupled with an increase in the number of women and mothers going out to work. However, the overriding reason for an increase in provision is that government pre-school education centres only accepted the children of supervisors, administrators, and women teachers working in the General Presidency for Girls' Education (GPGE). Depending on the space available, others could be accepted to enrol based on certain conditions such as retired working mother who used to work in the GPGE, children of high school mother, then intermediate, then primary, and lastly for any Saudi nationality student.

2.9.1.2 The Contributions of the Ministry of Knowledge (MOK)

As outlined in the previous section, the first and only chance for early education in Saudi Arabia was via the private sector until 1965 when the MOK took responsibility for pre-school education. One of the positive consequences of the involvement of the MOK was that the status of pre-school education was raised. (Ministry of Education, 2013 f)[12]

In 1966, the first public kindergarten affiliated to the Ministry opened in the city of Riyadh, and subsequently, in 1968, two additional kindergartens were opened in the city of Dammam and the city of Ahsa. This situation continued until the decision was made in 1980 to transfer the supervision of the pre-school education stage from the Ministry of Knowledge, which was originally responsible for the education of boys, to the General Presidency for Girls' Education (Al-Sunbl et al., 2008). This was a necessary decision because the workers in pre-schools are female and most of the children who attend these pre-schools are the children of the working women who are working for to the General Presidency for Girls' Education (GPGE).

2.9.1.3 The Contributions of the General Presidency for Girls' Education (GPGE)

The GPGE paid great attention to pre-school children and, in 1975, opened the first state pre-school centre subsidiary in the holy city of Makkah. The main goal of this pre-school centre was to take care of the children of employees of the General Presidency or in the education sector. When the decision was made in 1980 to transfer the supervision of pre-school education from the MOK to the GPGE, the General Presidency hastened to open a number of new pre-school centres and to provide an enhanced service to the children of female workers in the GPGE. Ten state pre-school centres were trialled in the city of Riyadh from 1980 to 1981. After the successful experience of establishing number of pre-school centres in Riyadh in providing the female workers a safe place to leave their children as well as giving children opportunity to develop necessary early skills, the GPGE opened 25 pre-school centres in various regions, such as Jeddah, Makkah, Medina, Taif, Hofuf, Dammam, Abha, and Buraidah. A statistical study,

[12] http://www.moe.gov.sa/Pages/EstablishmentoftheMinistryofEducation.aspx

made in 2002, found that the number of pre-school centres affiliated to the GPGE reached 350, with an overall cohort of 22,300 children (Al-Sunbl et al., 2004).

2.9.1.4 The Contribution of the General Secretariat of Pre-school (GSP)

An important shift to the pre-school system occurred after the declaration of the deputy Minister of Education in 2004 to change the pre-school organization level to municipal and change its name to the General Secretariat of Pre-School (GSP). Furthermore, the newly developed General Secretariat of pre-school became connected organizationally, directly to the deputy of Academic Affairs. As a result, the pre-school at this important era becomes an independent educational stage.

With the establishment of this government body, pre-schools started to enjoy a unique position with a clear mission and set of objectives to develop this important stage of education. The objectives of the General Secretariat of Pre-school can be summarised as follow (more information about the objectives and mission of the General Secretariat of Pre-school can be found in appendix):

1. Working towards developing the proper infrastructure for the pre-school stage.
2. Working towards expanding and spreading the pre-school stage around the Kingdom of Saudi Arabia.
3. Enhancing and ensuring the quality of education and teaching in the pre-school stage.

With the establishment of the GSP, many achievements have been realised such as:

- the Allocate a high financial budget of 170 billion SR to pre-schools;
- an increase in pre-school schools in 2009 from 1060 to 1667 in 2011;
- an increase in the percentage of children enrolled to 11% in pre-schools (previously it was 8.4 % in 2003);

- the development of 7,000 jobs for kindergarten teachers. (Ministry of Education, 2012 g)[13]

With this new vision of the pre-school stage and substantial support from government officials, we could envisage that the next stage might see an unprecedented development for pre-school at all levels from increasing the number of schools to developing the curriculum and teachers' training programmes.

2.9.2 The pre-school National Curriculum in Saudi Arabia

As outlined in the previous section, from 1965 onwards different private and public groups assumed responsibility for pre-school education in Saudi Arabia. Each pre-school setting followed its own curriculum and there was no fixed nationally agreed curriculum or specific goals that needed to be achieved - everything was dependent on the individual setting and the values and beliefs of the staff in charge such as the schools' owners or headteachers.

Therefore, after the pre-school stage came under the supervision of the GPGE it was essential for the decision maker at the GPGE to take a decision to develop a unified theory based approach, taking into consideration the characteristics of young children in terms of growth, psychological and social development in a way that would not contradict the ideologies of the Kingdom of Saudi Arabia. Following the joint efforts of several domestic bodies, Arab and international, to develop a curriculum taking into account previous approaches, in 1981, the GPGE introduced the Arab Gulf Programme for the United Nations Educational, Science and Culture Organisation (UNESCO).

This programme was developed by using the available information and principles and taking into account the Arab-Muslim cultural environment along with exploring the views of some of the educationalists and educators inside and outside the Kingdom, for example, from the Gulf area such as Bahrain and

[13] www.moe.gov.sa/Kindergrten/pages/aboutagency.aspx

Kuwait. The Arab Gulf curriculum programme passed through several stages based on field trials in three different areas in the KSA as well as seeking the opinion from groups of educators inside and outside the Kingdom. By1982, there was a thoroughly tested, nationally agreed distinctive curriculum for pre-school education designated as the *Developed Curriculum (DC)*.

This approach aimed to provide the following:

- a single authority and source of information to ensure that this stage would have a unified vision for all workers in the field of pre-school education;
- more care and development for all workers in the field of pre-school education benefiting all children in all regions of Saudi Arabia.

Hence, an agreed common curriculum with a consistent vision for all workers in the field of pre-school education was created. The DC was underpinned by a theory based approach that addressed the characteristics and needs of young children. This approach was then developed into seven curriculum books as outlined in the following sections.

2.9.2.1 The Teachers' Manual in the DC

Before starting to describe the Teachers' Manual book, I would like to explore aspects of the teachers' training. The training program in relation to using and applying the DC is compulsory for state sector teachers who do not hold a degree in early learning. This training program is very short as it is only four hours a week for eight weeks. This period is not enough to prepare a qualified teacher who can deal proficiently and effectively with children at this stage.

The teachers' manual includes the overarching educational framework for the curriculum along with the requirements for the teachers who will deliver the education policy in the Kingdom. The manual is divided into five chapters which are essential reading for all pre-school teachers. The first chapter clarifies the general objectives of the pre-school education policy in Saudi Arabia described earlier in this thesis (section 2.8.1.) This chapter also sheds light on the needs of the child at this stage and provides a summary of recommended teaching methods, for example, self-discovery, research and investigation. The second chapter provides specific guidance on the child's behaviour from an Islamic perspective in a way that highlights the characteristics and features of child development in pre-school. It also explains the processes and methods to be used for improving children's behaviour. This latter section focuses on the *role model method* which demands that the teacher should set an example and finally, by providing practical examples of guiding behaviour, it focuses on effective methods of encouragement and praise in guiding behaviour.

The third chapter of the manual details the organisation of the classroom environment at the pre-school stage. It demonstrates the importance of using teaching corners, some of which are fixed corners throughout the year for example, the blocks and building corner, the reading corner and the art corner. Other corners are more flexible individual or collaborative corners that can be changed for example, the family living corner. This chapter also explains the factors affecting the organisation of these corners, such as space, light, ventilation, and the number of children at any one time in each corner. The fourth chapter provides information about the daily program for this stage and can be summed up as follows:

- 8-8:30 am, circle time period. In this session children meet with the teacher in a learning situation. The teacher in this session introduces new concepts to the children, the content of which depends on the particular curriculum unit. Also, the teacher uses different materials during this time to help children make sense of new concepts - sometimes the teacher might use pictures whilst at other times she might use concrete objects.
- 8:30-9:30 am, outdoor play period. In this session children play freely outside, developing the large muscles through jumping, running, climbing, digging, and balancing games. All these types of games help children to get used to controlling their bodies and to become flexible and confident.

- 9:30-10:15 am, meal period. In this session the teacher gives children instruction about the Islamic manner of eating and the nutritional value of meals, urging children to experiment with new dishes.
- 10:15-11 am, free-play period in corner areas. This session is based on the principle of self-learning and discovery where the child chooses the corner, for example, he can play in an art corner or a discovery corner. The teacher must present different activities in these corners, and these activities must be in line with the training unit in providing children with the opportunity to discover the concepts that relate to the new unit through playing.
- 11-11:20 am, final meeting with the teacher. In this session the children listen to a story or sing a song. The teacher then summarises what has happened during the day and reminds the children of the new concepts which have been presented during circle time. Finally, she has to motivate children to attend the next day.

These periods are considered as the daily periods in the pre-school stage programme. The state pre-school sector is the only sector that maintains exactly the same programme as described above. The private sector follows the same program as described above but they add more periods, including literacy, religion, English, and maths. Hence there is always a criticism from year one's teachers that there is a difference in the educational outcomes between the private centres and the public centres at this stage of education.

The fifth chapter of the curriculum manual includes information on how to prepare for the new school year. It gives some strategies about how to communicate with parents and work out a good relationship with them in order to collect useful information about the children in their care.
The chapter explains clearly how the teacher should set up daily programmes for the first two weeks of the study year with the first unit unsurprisingly entitled 'Welcome Unit'. The guidance contained in this chapter helps the teacher to know

exactly how to work with a new group of children to motivate and encourage them to enjoy the experience of coming to school.

The other six books in the DC define the curriculum topics within each unit. The first five books cover one unit each. Each of these units needs between two and three weeks to cover. They are the units of *water*, *sand*, *food*, *hands*, and *housing*. The seventh book contains five short units (*family*, *books*, *my health and safety*, *friends*, and *clothes*). Mathematics is not specifically mentioned in these booklets.

At the same time, each unit contains an introduction to the unit topic or theme, how it relates to the children's lives, the basic concepts covered by the unit and the overarching objectives of the unit. And finally, teachers are provided with suggestions for activities and appropriate applications of the unit, as well as appropriate stories and songs. For example, the unit of Water starts with introduction about the importance of the Water, different sources for Water, different usage for Water, and different stories and song relating to water. Table 2-3 summarises the content of the Developed Curriculum.

Table 2-3: The Content of Developed Curriculum

NO	The Title of the Book	Number of the Chapters	Content of the Book
1st	Teachers' Manual	Five chapters	Ch 1 about pre-school's objective. Ch 2 child's behaviour from an Islamic perspective. Ch 3 classroom environment. Ch 4 information about the daily programme. Ch 5 prepare for the new school year & how to communicate with parents.
2nd	Units of Water	………..	Different topics relating to water such as the importance of water, the different sources of water.
3rd	Units of Sand	…………	The importance of sand, how to play with sand, different uses of sand, and other topics relating to sand.
4th	Units of Food	………..	The importance of food, different sources of food, the parts of plant and many other topics.
5th	Units of Hands	………….	The importance of hands, things that we can make with our hands, various professions that use hands in society.
6th	Units of Housing	………….	The importance of housing, different type of houses, materials to build houses and other topics relating to houses.
7th	The Five Units	Contains five different units	Contains five small units(family, books, my health and safety, friends, and clothes)

2.10 Challenges within Pre-school Education in Saudi Arabia

At the pre-school stage of education in Saudi Arabia there is a set of challenges that needs urgent attention in order to find some workable solutions (Kahwaji, 2006; Al-Sunbl et al., 2004; Al-Hawwaas, 1998). The challenges include:

- addressing the need for compulsory pre-school education;
- ensuring that pre-school settings are ‘fit for purpose’;
- ensuring appropriate training for teachers and sufficient female staffing;
- ensuring greater access to pre-school education;
- addressing the limitations of the DC;
- addressing the diversity of practice in the pre-school mathematics curriculum.

Each of these challenges will be considered in turn in the following sections.

2.10.1 Ensuring that Pre-school Education in Saudi Arabia is Compulsory

Despite all the findings of modern literature regarding the importance of pre-school education and its impact on subsequent stages of teaching and learning, Saudi Arabia has not decided until now to make this stage compulsory or include it with other general education stages.

Early childhood is the stage of readiness to learn and begins the process of gaining skills, knowledge and understanding. The personality traits of the individual develop at this stage as recognised by the UK Department for Education and Skills which identifies the need to give more attention to early childhood education in order to build the skills, knowledge and understanding of the child, and provide him/her with the necessary confidence for the next stages of education (Department for Education and Skills [DFES], 2007).

The first years of a child's life represent the formative phase that determines the basis of an individual's personality, emotional and social characteristics, and level of intelligence to a large extent (Al-Affaan, 1993; Al-Nashef, 1995).

Al-Afnan (1994) found that there are clear differences which are statistically significant for children who have studied in pre-school institutions before beginning primary school in terms of motivation and academic achievement. Kahwaji (2006) suggested that the main goal of early education is to prepare a generation of forces capable of success and creativity in adulthood. This objective will be reflected in a positive manner not only socially but also economically, and according to Kahwaji (2006), the focus should be directed towards finding high quality kindergartens in terms of educational provision that will impact positively on the social and economic development of society.

Al- Sunble and his colleagues stressed the importance of raising research awareness regarding the importance of this stage of education and the extent to which it impacts on the development of the child's future whether educational, social, moral or emotional (Al-Sunbl et al., 2004).

2.10.2 Pre-school Settings need to be ‘Fit for Purpose’

High quality educational provision for pre-school children requires an appropriate setting in order to achieve the teaching and learning objectives at this stage (Kahwaji, 2006; Zamzami, 2000).The pre-school buildings and facilities need to be ‘fit for purpose’ and include spacious interior classroom areas, outdoor play spaces, suitable classrooms, and size-appropriate furniture and equipment. The safety and well being of the children needs careful consideration, for example, where possible the classrooms should be on one floor level (preferably the ground floor) and the type of doors and the number of windows in each room should meet safety regulations and specifications. In Saudi Arabia many of these specifications and standards exist only on paper and not necessarily in reality except in some rare cases where the pre-school settings have been newly built with the education of young children in mind. In both the private and public sectors, most of the pre-school buildings are either rented or part of an existing building belonging to a primary school (Kahwaji, 2006).

The link between an appropriate and stimulating school environment and successful teaching and learning is well documented in international research and policy guidance (e.g. Hadeed and Sylva, 1995; Kahwaji, 2006; NAEYC, 2003).

The classroom environment is a very important element in pre-school learning process as it is considered the 'third teacher' for example, in the approach adopted in Italy's Reggio Emilia. Furthermore, the role of the environment in teaching and learning in Reggio Emilia illustrates how children recognize and use space to create meaning especially if we reflect that childhood is the first place where human beings see and use the environment imaginatively (Strong-Wilson and Ellis, 2007).

Fraser (2006) recognized eight Reggio Emilia principles as key to the environment as 'third teacher', which include the following: aesthetics, transparency, active learning, flexibility, collaboration, reciprocity, bringing the outdoors in, and relationships. These principles clarified how children interact with their environment to build and construct their knowledge affectively (Strong-Wilson and Ellis, 2007).

Preparing a suitable environment for pre-school children is of equal importance to the preparation of appropriately qualified and skilled pre-school teachers. High quality learning at this early learning stage is not only strongly dependent upon the quality of the interactions between the children and their teacher but also on the quality of the interaction between the children and their environment.

2.10.3 Ensuring Appropriate Training for Teachers and Sufficient Female Staffing

One of the biggest challenges facing pre-school education in Saudi Arabia is the need to ensure appropriate training for pre-school teachers and the availability of sufficient female staff. Unfortunately, there are not enough numbers of trained qualified teachers to apply the Developed curriculum (DC) properly where there is no policy controlling the licence for teaching pre-school children; any one can work as a pre-school teacher in Saudi Arabia (SA) (Al-Ameel, 2002). Many early education practitioners do not graduate from university and college training courses with higher level qualifications (Al-Otaibi, 1997) mainly due to a lack of time spent in classroom practice. The educational process is constantly evolving so there should also be centres for the in-service training of teachers and administrators (headteacher) in order to keep their practice up to date and in line with new developments in their field of work (Al-Sunbl et al.,2008).

As cited in Al-Otaibi, 2007, in spite of the resolution issued in 1993 recommending that only teachers who carried an 'early learning' degree should teach children at the public pre-school, almost half of teachers working in pre-school education centres do not hold special degree in early learning but have degrees in other disciplines (Al-Otaibi, 2007). It seems that non-specialist teachers in the public sector remain in pre-school settings for a number of reasons as explained by Al-Sunbl et al. (2008) and Al-Otaibi (2007):

- Non-specialist teachers refuse to move from this stage on the pretext that they have acquired the necessary skills and knowledge. (Al-Otaibi,2007)
- There are less working hours in the state pre-school centres compared to other state stages of education (primary, intermediate, and high school) which makes non-specialist teacher unwilling to move. (Al-Sunbl et al.,2008)
- Non-specialist teachers believe that pre-school teaching does not require a lot of preparation, especially as this stage of education has no tests in the final year and so the teacher does not feel the same pressure of work as teachers in subsequent stages of education (Al-Sunbl et al., 2008).

2.10.4 Ensuring Access to Pre-school Education

Despite all the studies that have shown the importance of early education and its positive impact on the subsequent stages of education, there is still a shortfall in the number of children being enrolled in pre-schools. A study by Al-Khuthila and her colleagues found that only 7.81% of first grade students had been enrolled in early education (Al-Khuthila et al., 1999). In another article in Al-sharq Al-awsat newspaper (2003), entitled *4 million children boys and girls without education in 2020*, written by Al-Khuraif, Dr. Abdel Rahman Saiegh, Professor of Planning Education and Economics in KSA, stated that according to the statistics, the rate of enrolment in early education in the Kingdom of Saudi Arabia was 8.6%, whilst the enrolment rate into the first grade was 73%. According to statistical data, it is expected that by the year 2020 the number of children at the age for early education will be 4 million. If the same pattern of enrolment persists, then the expected number of children enrolled in early education will be in the region of 200,000 children still representing a very small proportion of the overall pre-school age population (Al-Khuraif, 2003).[14]

According to Al-Sunbl et al. (2008), the reasons underpinning the low numbers of children enrolled into pre-school education can be summarised as follows:

- There remains a lack of awareness of the importance of this stage in the life of the child, both at the level of individual households and at the level of society as a whole. A common perception is that pre-school provision exists because of the need for a safe place for children while their mothers are working outside the home. Therefore, it is necessary to increase the number of programmes aimed at raising community awareness in relation to the importance of this stage in the life of the child and its impact on subsequent stages.
- The short length of the day spent by children in pre-school settings centres when compared to the length of their parents' working day can be problematic. Pre-school educational provision at Government centres begins at 7.45 am and ends at 11.30 am whilst most working days in Saudi Arabia end at 1.30-2.00 pm for teachers and 3.00-3.30 pm for staff of other institutions. Therefore, most parents prefer their children to stay at home with a maid or childminder rather than accessing pre-school provision.

[14] http://www.aawsat.com/details.asp?section=53&article=177232&issueno=8969

Table 2-4: Summary of General Education Schools, Students and Teachers (Pre-school to Secondary) 2010/2011 [15]

Stage	Schools	Classrooms	Students	Academic Staff	Administrative Staff
Pre-school	1,667	6,617	117,653	11,431	2,244
Elementary	13,628	127,756	2,513,815	228,325	11,952
Intermediate	7,999	49,215	1,198,414	122,480	6,345
Secondary	5,013	41,978	1,125,602	102,416	4,798
Total	28,307	225,566	4,955,484	464,652	25,339

As illustrated in table 2-4, only a small number of pre-school centres (1,667 centres) are available compared to other levels of education. The proportion of establishments offering facilities for the early stages compared to other education stages (primary education 13,628 school, intermediate education 7,999 schools, and secondary education 5,013 schools) is a very small percentage – only 6% (Figure 2-4). However, the interest in this phase at national level has increased since the establishment of the General Secretariat of Pre-school (GSP) in 2004. If they work hard to meet their targets and objective, the pre-school stage in Saudi Arabia could be similar to the pre-school stage in developed countries.

Figure 2-4, shows that the percentage of the pre-school level in the categories of classrooms, numbers of students, academic and administrative staff compared to the other educational stages.

[15] www.moe.gov.sa/Pages/stats31-32aspx

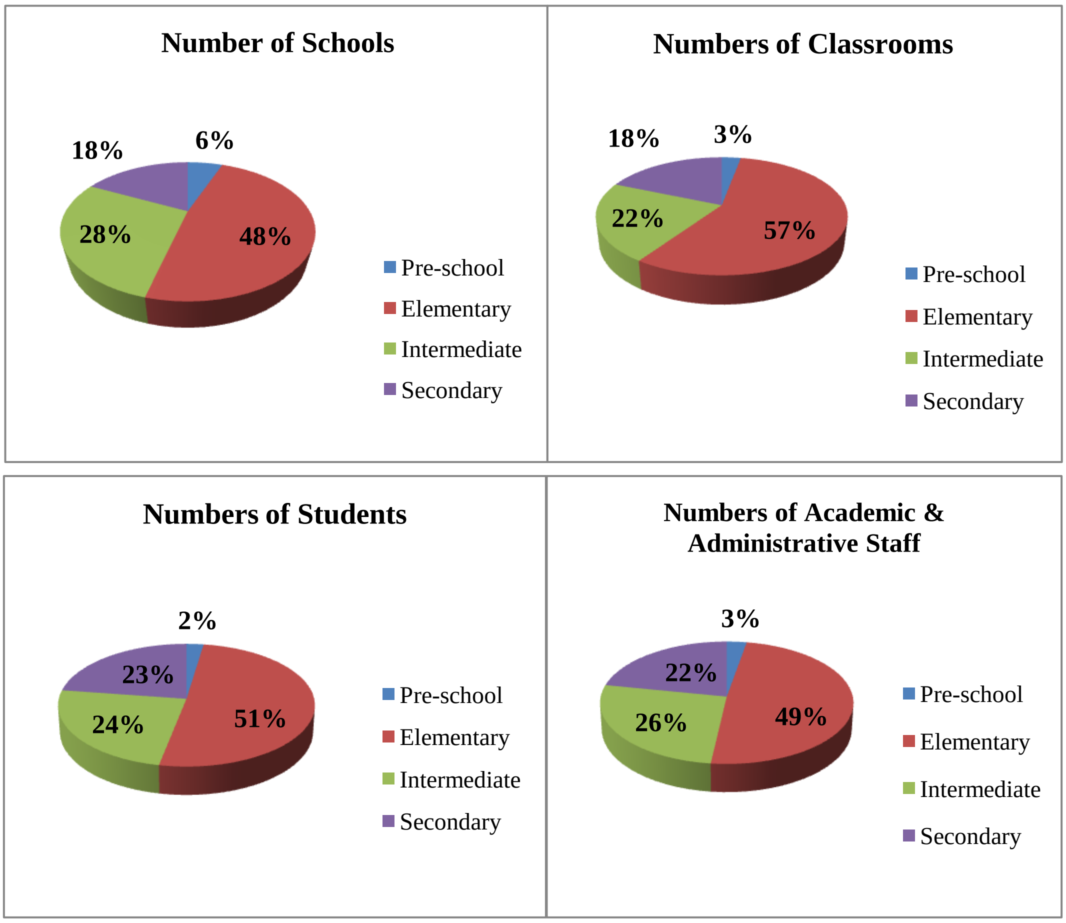


Figure 2-4: Graphical Representation of General Educational Schools, Classrooms and Teachers (pre-school to secondary) 2010/2011

(Ministry of Education, 2011) [16]

2.10.5 The Limitations of the Developed Curriculum (DC)

As discussed previously (section 2.9.2), the DC was introduced in 1981 by the GPGE in cooperation with the Arab Gulf Programme for United Nations Development and UNESCO. This became the official curriculum followed in the early education centres, for both government and private schools in Saudi Arabia. The only centres committed to this method without any changes or additions were those run by the government. The private schools for this stage added reading,

[16] www.moe.gov.sa/Pages/stats31-32aspx

writing and mathematics education to the curriculum because of the perceived deficiency in the DC to cover these topics. Additionally, the private schools wanted to achieve their own objectives which included preparing children for later stages of study and satisfying parents who were also concerned with the subsequent stages of education.

There was also a demand to evaluate the official Developed Curriculum method in order to identify any gaps in provision and to make any necessary modifications. Zamzami (2000) evaluated the DC by sending questionnaire to 220 teachers, 55% of whom were with 11 to 22 years of working experience, 55% of the sample had a bachelor's degree majoring in early childhood. The responses showed that all of them agreed that the Developed Curriculum was suitable for pre-school children and covered the characteristics related to the growth of this phase. However, all of them also agreed that the curriculum was weaker in terms of educational activities, for example, the curriculum did not cover the introduction of the alphabet to young children. In addition, the teachers' manual (discussed previously in section 2.9.2.1) did not provide teachers with sufficiently detailed guidance on how to integrate the self-learning approach into their teaching. Further support was particularly important for the large numbers of pre-school teachers who did not have the necessary academic background or expertise in early childhood studies.

In 1996, the GPGE commissioned a team of early education specialists to review the DC in order to identify any weak points and to address them. The main problem found by the team was that a major weakness of the DC was that it did not include any educational activities, for example, for learning letters or special activities to learn numbers. Hence, the team provided additional information to solve the problem and integrated special activities directed at teaching letters and numbers into the original six units of work. The team also added more detailed guidance into the first book and the teachers' manual to provide more support for pre-school teachers (Al-Muneef, 1999).

2.10.6 The Diversity of Practice in the Pre-school Mathematics Curriculum

There is a diversity of practices within the pre-school settings. For example, each pre-school centre makes its own decisions on the content of the mathematics curriculum, hence some centres only address number concepts whilst others include the processes of addition and subtraction. In the government sector, number is the only concept which is directly taught by the teachers. On the other hand, in the private sector, some pre-school centres choose a maths book from libraries to be used in the teaching of mathematical concepts. Mostly, the authors of these books are from the neighbouring Arab countries such as Jordan and Lebanon. Other privately run centres design their own mathematics curriculum, and print and present exercises to the children. Other private centres use translations of western books (such as texts from the UK or USA).

Young children's experiences of the mathematics curriculum is very different according to whether they attend public or private pre-school education. One way of ensuring greater consistency of educational opportunities for pre-school children in Saudi Arabia would be to develop a unified approach to the pre-school mathematics curriculum and to include some of the approaches taken in the first grade in order to prepare pre-school children for the first stage of formal education. It seems then, that a more united approach is required in order to acquire a greater consistency of curriculum content. The research undertaken for this study will provide some possible ways forward in this quest.

2.11 Summary

This chapter has presented a snapshot of Saudi Arabia in terms of geographical and economic considerations. It has looked at the educational system in terms of stages or levels, and the objectives associated with pre-school and primary phases. Consideration was given to early education in terms of the key policy developments and the various sectors that contributed to the development of this stage. The elements of the Developed Curriculum have been detailed and critiqued and the limitations of the mathematics content highlighted. Finally, some of the fundamental challenges inherent in Saudi Arabian pre-school education (challenges which stand in the way of progress for this stage) were outlined. From the available data on the current situation, it seems that there is a genuine desire amongst those responsible for the pre-school education stage to bring about changes that will help the progress of this stage. The early education phase is undoubtedly an important stage given its impact on the next stages of the life of the child.

Chapter 3: Literature Review

3.1 Introduction

Although mathematics in the early years stage of learning is not always considered an academic subject, improving children's early mathematical knowledge and skills has became an important educational goal throughout the world (Aubrey, 1994a; Palaiologou, 2010; Pound, 2006). The reason for teaching mathematics at this stage is to help children to make sense of their world, where all mathematics knowledge, method, and practice should be connected to children's daily experiences to provide a better understanding for them (Aubrey, 1994a; Williams, 2008). As a result, many researchers in the field of early years education have drawn attention to the importance of developing appropriate approaches for teaching mathematics to young children depending on their existing knowledge and the methods that are familiar and reasonable for their thinking and abilities (Aubrey, 1993; Clements and Sarama, 2004; Ginsburg et al., 1998; Montague-Smith and Price, 2012; Pound and Lee, 2011; Williams, 2008). Meaningful learning arises from children's own reasoning, which helps them to understand and use mathematics effectively as they grow up. Social interaction is very important for improving mathematical knowledge. Pound (1999) stressed that young children's future abilities to think mathematically depends heavily on the experiences, social interaction and accompanying language that children meet in these formative years.

The current chapter consists of five sections and each section is justified within its discrete section. The first section focuses on the importance of mathematics. It includes a discussion about the importance of mathematics as a discipline and as a curriculum subject. The second section focuses on the development of pedagogy in teaching mathematics. The third section presents some international comparisons about education in the early years of schooling. The fourth section discusses possible strategies relevant to teaching mathematics to children in the early years of schooling, such as the importance of using multiple representations of concepts. The final section reviews the established research in the use of stories as a vehicle for presenting mathematical concepts. A short summary of the key messages is provided at the end of the chapter along with a conceptualisation of how the literature review was used to design the study.

3.2 The Importance of Mathematics

In an increasingly technological world, an understanding of mathematics is ever more important (Boaler, 2009; Devlin, 2002; McGrath, 2010). In order to know our world 'mathematical literacy' becomes ever more demanding. The Organisation for Economic Co-operation and Development (OECD) (1999) defines the term mathematical literacy as:

> *"The capacity to identify, to understand and to engage in mathematics and make well-founded judgements about the role that mathematics plays, as needed for an individual's current and future private life, occupational life, social life with peers and relatives, and life as a constructive, concerned, and reflective citizen" (p:41).*

Mathematics has been described as "the abstract key which turns the lock of the physical universe" (Devlin 2002, p: 10 cited in Polkinhorne). If this is the case, why is it that the teaching of mathematics is considered, by both educational practitioners and society as a whole, to be less important than the teaching of language skills? (Ginsburg et al., 2008)

A focus on language and literacy has left many teachers feeling that mathematics often takes a back seat in terms of teaching priorities. While teachers speak passionately and confidently about teaching language and literacy, they are more hesitant to speak about the teaching of mathematics in the same way (Ginsburg et al., 2008).

Mathematics is as important as the teaching of literacy (Duncan et al., 2007). Studies indicate that mathematical ability upon entry to school is a strong predictor of later academic success and, is in fact an even better predictor of later success than early reading ability (Duncan et al., 2007; Ginsburg et al., 2008). The importance of mathematics as a core subject throughout a child's educational career is emphasised in several high profile international reports and research

(Aubrey and Godfrey, 2003; Aubrey et al., 2006; Jordan et al., 2009). Ginsburg et al (2008) for example, have also pointed out the importance of mathematics education for young children for later achievement, stating the following:

> *"…effective mathematics education for young children (approximately ages 3 to 5) seems to hold great promise for improving later achievement, particularly in low-SES students who are at risk of inferior education from pre-school onwards*"(p: 1).

Boaler (2009) spoke of mathematics as being similar to magic, as she explained that the mathematics of the real world is different and surprisingly engaging, as solving real life mathematical problems may be considered to be magical. An example of the usefulness of mathematics can be found in McGrath's (2010) description of a foundation degree student who excitedly explained how mathematics helped in the task of measuring curtains. While completing the task, the student realised the need to visualise more material than for just the width of the window. This is an example of how important mathematics can be in everyday life. When talking about how mathematics can filter into everyday life, Liebeck stated that "its appeal for us lies in the intellectual or aesthetic satisfaction that we derive from it" (Liebeck 1984, p: 13).

The National Curriculum in the UK (England & Wales only) describes mathematics as a "uniquely powerful set of tools to understand and change the world" (DFEE, 1999, p: 60). Mathematics as described by Pound and Lee is a vital part of everyday life. Without mathematics, it would become more difficult to do basic everyday things such as;

- *A baby matching two sounds to two objects, or to recognise errors when a small number of toys are added or removed from another group of toys*
- *A golfer judging the distance he or she must hit the ball*
- *Snooker players getting the white ball to ricochet off the coloured balls at exactly the correct angle*
- *A cook estimating the timings to ensure that all elements of meal are ready at the same time*

- *All of us cross the road safely*

(Lee and Pound 2011, p: 2)

One of the primary functions of mathematics education is to help children advance beyond their informal, intuitive mathematics that Vygotsky (1986) called ‘everyday knowledge’. According to Vygotsky, the aim of mathematics education is to aid the development of a powerful and organised ‘scientific’ knowledge, leading to an understanding of the formal concepts, procedures and symbolism of mathematics. As children make their way through life, children engage with mathematics as they push their way forward; making sense of life. While mathematical learning happens naturally, it is enhanced by good quality experiences. Ideally, these experiences should be based on the child’s sense of reality and generated by adults central to the child’s life (McGrath, 2010). Mathematics is the central intellectual discipline of any technological society; it plays a crucial role in the development of society and in a child’s understanding of how the world works (Peter, 2011). In spite of all of this, statistics from the UK Government show that every year around 6 per cent of 11 year olds in England leave primary school with very poor numeracy skills - below National Curriculum level 3 in mathematics (McGrath, 2010; Williams, 2008). The Every Child a Chance Trust in the UK (2009) indicates that this failure to address numeracy difficulties incurs a £2.4 billion cost to the country, hindering employability and contributing to poor self-esteem, which affects mental health.

According to Boalor, the ‘maths classroom needs to catch up not only to help future employers and employees, or even to give students a taste of authentic maths but to prepare young people for their lives’ (Boalor, 2009, p: 9).

Mathematics is one way in which we describe and make sense of the world around us (Montague-Smith and Price, 2012). As humans we make sense of the world around us by looking for patterns; for example, patterns of behaviour, patterns of seasons, and cycles of growth. However, one of the reasons that people find mathematics difficult is that they do not understand that mathematics has pattern (Montague-Smith and Price, 2012). Research has indicated that humans are born with a wide range of mathematical competence (Devlin, 2000; Pound, 2006). However, the majority of people develop an aversion to mathematics from early on. Studies indicate that people find mathematics difficult and are ‘hard wired’ to think that way. In spite of this, pre nursery children spend the first few years of their lives practising and learning about mathematics (Pound, 2006). Subsequent studies have shown that several children start nursery with a “huge and powerful amount of informal mathematics knowledge which often the teachers do not realise” (Seo and Ginsburg, 2004).

Epstein et al (2010) described mathematics thinking as an important cognitive skill which enables people to deal with a logical problem incisively and critically. Mathematics is a fundamental part of our everyday lives, incorporating everything from counting the number of potatoes needed for dinner to the directions we give to a lost stranger (Boaler, 2009). In short, we use mathematics to understand the world in terms of seeing patterns in nature, art and even life in general (Devlin, 2000). When presented in this way, mathematics has its own aesthetic pleasure and understanding, and it can serve to enrich a person’s lived experiences (Pound, 2006).

3.2.1 Mathematics as Application or Discipline?

Devlin (2003) stressed that mathematics is not about number, but about life. It is essential for all members of society to understand a range of basic mathematical knowledge in order to allow them to make informed decisions in their work, households and communities (Glenn Commission, 2000).

Additionally, in their everyday lives children develop an understanding of space, shape and pattern, number and number operations through their interaction with the world around them (Seo and Ginsburg, 2004). Studies conducted by experts such as Saxe et al. (1987) have shown that children will spontaneously count and that mathematical language will permeate their play unconsciously.

In order to become confident and competent twenty-first century users of mathematics, children need to recognise mathematics as an essential and powerful tool for communication. We use mathematics to solve problems and to identify recurring patterns and themes thereby making it a very useful tool for todays' technological world. However, the way that mathematics is being taught in schools and its relevance to the real world has long been a concern for researchers. For example, Boaler (2009) points out that mathematical thought in school does not reflect mathematical reality and should be presented for ordinary people to understand and get the 'bigger picture' of mathematics as applied in everyday life practices. As a result, Boaler stresses that there is an urgent need to address this gap.

It seems that the teaching approach that many teachers adopt helps students to gain mathematical skills and knowledge without helping them to know how to use and apply mathematics to solve everyday problems. Robitaille and Taylor (1997) observed:

> *Amongst the goals most frequently mentioned [in their curricula] were…increasing the relevance of mathematics through a focus on real-world applications and teaching the children the skills and processes needed for successful problem solving [in novel contexts] (p:32).*

Carruthers and Worthington (2006) have compared children's attempts to learn mathematics to someone learning a new language and in a similar vein, the founder of Realistic Mathematics Education (RME), Hans Freudenthal, felt that the teaching of mathematics "should not be seen as subject matter that had to be transmitted but as a human activity" (Treffers and Beishuizen, 1999, p: 27).

Being able to transfer mathematical learning to new and unfamiliar situations has long been the major goal for those in primary education (e.g. in the UK: Department for Education and Employment (DFEE) 1999; and in the USA: The National Council of Teachers of Mathematics (NCTM), 2000). Robitaille and Taylor (1997) suggest that some of the most-repeated axioms in mathematics are its relevance to everyday real-world applications and the importance of teaching children the skills and processes needed for successful problem solving in a range of contexts. It seems then, that many authors and policy makers value the application of mathematics (mathematics as an applied science) as it is indispensable in our daily life situations. Additionally, all improvements and developments in human lives, such as technology, equipment and communication systems are based on developments in mathematics (Furner and Berman, 2005; Kelly, 2004).

On the other hand, Ernest (2000a), cautions against placing too much emphasis on the usefulness of mathematics particularly as a justification for teaching mathematics to *all* pupils of compulsory school age. Moreover, Ernest (ibid) highlights the complexity of the inter-relationship between the social application of mathematics (the applied science) and mathematics as an academic discipline. Contrary to the commonly held belief that it is academic mathematics that 'drives' the agenda for using and applying mathematics in areas such as education, industry and government, Ernest provides evidence to demonstrate that historically, it was the everyday contexts that prompted the development of the academic mathematics:

> *Five thousand years ago in Mesopotamia it was the rulers' need for scribes to tax and regulate commerce that led to the setting up of scribal schools in which mathematical methods and problem were systemised. This led to the academic discipline of mathematics.*
>
> (Ernest, 2000a, p: 2*)*

Ernest goes on to describe how pure mathematics developed from this starting point "whilst practical mathematics has maintained a continuous and a vitally important life outside of the academic, in the worlds of government, administration and commerce."

Furthermore, Ernest highlights that the content of the school mathematics curriculum is not the same as the content of the academic discipline of mathematics but a *reselection* of content based on particular values and purposes as illustrated in the examples in the next section.

3.2.2 Mathematics as a Curriculum Subject

The National Council of Teachers of Mathematics (NCTM) in the USA (2000) described their goals as teaching children to value mathematics, to develop their confidence in their own mathematical ability, to become problem solvers, and to communicate and reason mathematically. Part of mathematical education for young children should also focus on acquiring the essential mathematical skills and developing a disposition to do mathematics (Dutton and Dutton, 1991).

Similar messages are conveyed by the UK's National Curriculum for mathematics (for England and Wales) which indicates the key aims of teaching the subject and stresses that mathematics equips pupils with tools such as logical reasoning, problem solving and an ability to think in abstract ways - all necessary elements for understanding and changing the world. The subject is important in everyday life, employment, science and technology, medicine, the economy, the environment and in decision-making. According to The National Curriculum of the UK, England and Wales, (DfEE, 1999), mathematics is a creative discipline and has the ability to stimulate moments of pleasure and wonder when a pupil solves a problem or suddenly sees hidden connections. Different cultures have contributed to the development and application of mathematics, and the subject transcends human boundaries with its importance universally recognised (Haylock and Thangata, 2007).

There is a great deal of research evidence to support the conclusion that students face many problems when using their mathematical knowledge in new and unfamiliar contexts. Research has shown that people rarely use learned methods to solve problems encountered out of school (Carraher et al., 1985; Hughes et al., 1999; Lave, 1988; Nunes et al., 1993; Saxe, 1988). Saljö and Wyndhamn (1990) found that children had substantial difficulty deciding which aspects of their school knowledge they could apply to 'real life' problems, as in school, most teachers present the new mathematical concepts without making connection between students' previous knowledge and their daily life situation.

In spite of the amount of research that has been done in the area of mathematics teaching and the importance of mathematics in everyday life, mathematics remains a subject in which the majority of the population lacks confidence (Pound, 2008, p:12). Pound attributes this to the fact that "… the abstract nature of mathematics and concern for accuracy make mathematics a hard subject" and goes on to state that admitting that you are 'not good at maths' has become socially acceptable, a state which she describes as being "as disempowering in our society as not being able to read" (p: 5). Boaler (2009) identifies one difficulty that lies in the way in which mathematics is taught:

> *Students are forced into a passive relationship with their knowledge – they are taught only to follow rules and not to engage in sense-making, reasoning, or thought, acts that are critical to an effective use of mathematics. This passive approach, which characterises maths teaching in many schools, is highly ineffective.* (p: 36)

More discussion about attitudes towards mathematics will be included later in this chapter. The different areas of mathematics teaching and learning in schools have been identified by Bell et al. (1983) and include learning facts, skills and concepts; understanding conceptual structures, and developing an appreciation of mathematics. In an illuminating discussion on 'what is mathematics?' Ernest (2000b) explains that facts, skills and concepts; understanding conceptual structures, developing positive attitudes and an appreciation of mathematics can help to provide clear guidelines and an effective framework for teachers to follow when presenting mathematical concepts to students. He further explained these elements as follows:

- ***Facts*** are items of information that must be learned to be known. Facts, therefore, represent the basic 'atoms' of mathematical knowledge, with each one being a small and elementary piece of knowledge. They need to be learned as individual pieces of information.
- ***Skills*** are well-defined multi-step procedures, including commonly used skills such as basic number operation. Skills are most often learned through examples and practice.
- ***Concepts and conceptual structures:*** A concept is the idea behind a name. To learn the name is just to learn a fact, but to learn what it means and how it is defined is to learn the concept. A conceptual structure consists of a set of concepts and their inter-relationships.

- ***Attitudes to Mathematics*** involve the learner's feelings and responses. The importance of attitudes to mathematics is widely accepted, and one of the common aims of teaching mathematics is that, after study, all learners should like mathematics and enjoy applying it. Attitudes to mathematics cannot be directly taught; they are the indirect outcome of a student's experience of learning mathematics over a number of years, which means mathematics teachers play a crucial role in helping students to build a positive attitude toward mathematics by adopting an interactive teaching procedure full of interesting meaningful methods.
- ***Appreciation*** involves awareness of what mathematics is as a whole and understanding its value and role in society. This includes mathematics in everyday life, the history of mathematics, and how mathematical concepts and problems have developed, as well as mathematics across all cultures, in art, science, history, and in all school subjects.

If teachers use a framework that links facts, skills, concepts, conceptual structure, attitudes and appreciation this may help them to see the bigger picture of learning and teaching mathematics. This is likely to help them to present mathematics comprehensively and more purposefully, reflecting positively on the teaching process and the learning outcome. In this way, teachers, as well as students, will fully understand the importance of mathematics as a subject and as a discipline for everyday situations. Ernest's framework is used in the present study in the design of the teaching sessions for the intervention.

3.3 Early Mathematical Development

There is general agreement that numeracy and literacy skills are the most basic educational aims in primary education (Duncan et al., 2007). It is not possible to over-emphasise the importance of mathematics in the development of people and societies, especially in this technological era. This is supported by Ginsburg et al. (1998, p: 402), who point out that "we live in a society in which mathematical knowledge is commonly portrayed as vitally important for economic success, and indeed for everyday functioning”.

As previously mentioned, several researchers (Aubrey, 2004; Aubrey et al., 2006; Ginsburg et al., 1998) mention that mathematical experiences before the start of formal schooling are important for the achievement of mathematical skills in later school years. They suggest that real learning is the result of children’s own reasoning because it acts as a key to help them understand and use mathematics spontaneously when they are older. These research findings agree with other assumptions about young children’s incompetence, which have focused on children’s *abilities* rather than their inabilities. This has led to a different view of mathematical development and learning, confirming the importance of social interaction as a means of developing mathematical knowledge (National Council of Teachers of Mathematics, 2000; Pound, 1999; Williams, 2008).

Children’s experiences, both in and out of school contexts, will have considerable influence on their development. Their ability to think mathematically, like other aspects of their development, is heavily dependent upon the experiences, social interactions and accompanying language that they have been exposed to in previous years (Pound, 1999, p: 6). Mathematics at this age should not necessarily be considered as an academic subject but as an integral part of their world experiences (Khalil, 2009). For example, Seo and Ginsburg (2004) found that young children incorporate a substantial amount of mathematical activity into their free play, accounting for as much as half of their playing time. Such spontaneous interest could provide an effective starting point for establishing an enjoyable introduction to learning mathematics. Therefore, early years teachers should be able to identify and build upon the children’s spontaneous mathematical interests in order to support them to achieve a better understanding of specific mathematical ideas. This is only possible because interesting and meaningful mathematical knowledge for children continues to act as a useful tool to solve problems and facilitate everyday life practices (Clements and Sarama, 2000). Early mathematics teaching and learning is about understanding the world from a child’s perspective, and then connecting formal mathematical language, notation and methods to their informal experiences to enable better understanding that makes sense to them (Aubrey, 1997; Fuson, 2004; Munn, 1994; Sophian, 1992, 1999).

Conversely, mathematics is widely acknowledged as a hierarchical domain of knowledge in which acquiring different concepts and skills is dependent upon understanding previously gained ones (Denvir and Brown, 1986). Research has shown that the beginning of children's mathematical performance is evident at the pre-school age before they have received any formal instruction in school mathematics classes (Ginsburg et al., 1998). It has been noted by Askew and William (1995, p:6) that before starting formal schooling many young children can count effectively, use terms such as 'more' and 'less' appropriately, have an understanding of the concepts of addition and subtraction with small numbers, and are likely to invent strategies to solve problems. However, teachers are often seen to fail to recognize this so-called informal knowledge when children begin their schooling (Orton, 2004). Furthermore, the teaching methods that are used often fail to support and encourage children to solve problems creatively, use logical thinking or pursue learning mathematics voluntarily and with enthusiasm (Hong, 1996).

The early years of schooling lay a valuable foundation that will determine children's future attitudes towards mathematics (Philippou and Christou, 1998). Young children will construct their own knowledge and develop their own strategies within everyday situations as a result of their discoveries about the environment in which they live. To determine any links between such knowledge and formal mathematics knowledge learned at school, it is necessary to analyse the strategies used and errors made by the children. Bottle (2005), however, counters this by suggesting that it is important to relate mathematics to the child's everyday experiences and in other areas of the curriculum, rather than treat mathematics as a single, discrete subject. Bottle further points out that a commonly-held belief, not only in European countries, is that mathematics for young children cannot be isolated from everyday life, such as playing, shopping, and cooking, and that it is firmly embedded in societal values and ideals.

Graham, et al (1997) found that pre-school teachers typically teach a narrow range of mathematical content. Leading professional organisations, such as the National Association for the Education of Young Children, recommend covering the ‘big ideas’ of mathematics, such as number and operations, geometry (shape and space), measurement and algebra (with a focus on patterns). They also advocate the promotion of problem solving, analysis and communication as stressed by the National Council of Teachers of Mathematics, (2000) in the USA.

Hilton (1980) states that the type of mathematics that students learn should be genuinely relevant and the students themselves should recognise that this is the case. In other words, mathematical concepts taught to children should exhibit direct relationships with their world, not simply be directed towards a world that adults perceive to be appropriate for children. It is the responsibility of the teacher to make links between mathematics and other subjects, and also to help students understand how mathematical ideas and concepts are interrelated and how they build on one another to produce the logical and coherent whole with which we are familiar (Casey et al., 2004). Nunes and Bryant (1996, p:1) claim that children should have a knowledge of mathematics in order to understand the world around them and in doing so they are able to explore their world, become rational human beings, take advantage of the opportunities which come their way and develop conceptual abilities for problem solving. Knowledge gained from routine daily activities and spontaneous opportunities is generally viewed as informal, and does not involve any direct intentions towards teaching or learning. However, Ginsburg (1997) contends that formal mathematics knowledge cannot be readily gained from everyday activities as it includes complicated concepts that require specific procedures and processes to be followed. Perhaps, in the field of pre-school education, different levels of experiences, both informal and formal, need to be consolidated to provide high-quality learning, although younger children need simpler and more open activities than older ones (Clements and Sarama, 2000).

Three types of learning are described by Charlesworth (2000), reflecting typical circumstances in early childhood settings. The *naturalistic learning* experiences constitute the first steps towards learning, with children spontaneously initiating these activities through their everyday life. The *informal learning* experiences are also unplanned but are generally initiated by adults at an appropriate time to enhance children's learning during their engagement in naturalistic experiences. The third type of learning depends on *structured learning* experiences, which are pre-planned activities directed to achieve specific goals. Effective teaching of pre-school mathematics requires a combination of these three types of learning. As Tobeyns et al. (2002, p:250) explains; "In pre-school, teachers stimulate the development of these intuitive mathematical notions and informal counting skills through spontaneously occurring learning activities, as well as through more or less intentionally and systematically organized educational activities."

Clemants and Sarama (2005) emphasise the importance of building childrens' mathematical experiences upon their play as it is very easy for them to explore mathematical concepts such as patterns and shapes, counting and comparing size. According to the authors, six categories of mathematics content emerged during free play:

- Classifying
- Exploring magnitude
- Enumerating
- Investigating dynamics
- Studying pattern and shape
- Exploring spatial relations

During play, there is potentially a number of mathematical concepts waiting for children to explore and the teachers' role is to help children get benefits by engaging them in reflecting on and representing the mathematical ideas that have emerged in their play (Clemants and Sarama, 2005).

3.3.1 Pedagogy in Teaching Mathematics

Pedagogical issues are important in all aspects of early childhood education, and especially in early childhood mathematics. There is currently a great deal of guidance available to teachers in terms of high-quality early childhood mathematics teaching hence the essential characteristics of effective early years mathematics education can be clearly identified. For example, building on young children's prior-to-school knowledge; engaging children in general mathematical processes; and assessing and documenting children's learning are all identified as key aspects of high-quality early childhood mathematics education (Aubrey, 1995; Dunphy, 2009; Ginsburg et al., 2005;Williams, 2008).

The Committee on Early Childhood Pedagogy for the United States Research Council suggested that pedagogy was 'the deliberate process of cultivating development' (Bowman et al., 2001, p: 182). Consequently, Dunphy (2009) stated that pedagogy is composed of three basic components: curriculum (the content of what is taught), methodology (the way in which the teaching is done), and techniques for socialising children (the cognitive and affective skills required for the successful functioning in society that education is designed to promote).

Essential to effective early years mathematics pedagogy is supporting children's natural interest and curiosity in areas such as numeracy, problem solving, reasoning, shapes and measures (Williams, 2008). In his report, Williams (2008) emphasised that children should be encouraged to develop a broad range of contexts (both indoors and outdoors) in order to explore, enjoy, learn, practise and talk about their developing mathematical understanding. Experiences of this kind help to develop a child's confidence for tackling problem solving, asking probing questions, and pondering and reasoning answers across their learning. It is essential to ensure that children's mathematical experiences are fun, meaningful and likely to develop confidence. The UK Early Year Foundation Stage (EYFS, 2013) guidance is clear regarding the importance of good quality mathematical learning and development that will promote positive attitudes and deeply-rooted learning.

Draper (2002) contends that The Principles and Standards (origin not clear) included a communication standard for school mathematics. In particular, the communication standard states that instructional programmes, from pre-kindergarten through to grade 12, should enable all students to:

- organize and consolidate their mathematical thinking through communication;
- communicate their mathematical thinking coherently and clearly to peers, teachers, and others;
- analyse and evaluate the mathematical thinking and strategies of others, and,
- use the language of mathematics to express mathematical ideas precisely.

The way to achieve these targets is to present mathematics to students in a problem-solving format which will help them to develop the necessary knowledge and skills, as well as building a positive attitude toward mathematics.
Williams (2008) stated that it is essential for effective early years teaching to have a suitable mathematics pedagogy that supports children in:

- learning new skills;
- developing their understanding of concepts and process;
- using, consolidating and refining skills and understanding.

Initially, effective and suitable pedagogy cannot support children without adult support. Aubrey (1995) stated that the process of learning mathematics requires the support of an adult, in some form or discourse, which facilitates its own sequence of development, changing from grounding in practical and social contexts to a more abstract system. The role of adults in early childhood mathematics education for three, four and five-year old children involves providing strong adult guidance (Ginsburg et al., 2005). However, it is necessary for teachers to change the way they teach to ensure that the pedagogy used is appropriate for this age-group. Ginsburg et al. (2005) suggest that one of the fundamental requirements for early childhood teachers is the ability to develop appropriate pedagogy for young children. Dunphy (2009) points out that early childhood mathematics education should combine three essential elements: the guidance of the adult, the introduction of challenging mathematics and the development of children's natural interest in mathematics.

Carlsen (1991) noted that marked differences in the style of discourse may be related to teachers' own confidence or competence in the subject being taught. A high number of questions requiring correct answers will lead to less pupil talk, less investigation and an increasing sense that mathematics subject knowledge requires the gaining of approval from the teacher. This way of teaching mathematics may lead children to see mathematics as a boring subject that is irrelevant to their daily lives. In England, the authors of a major longitudinal study of effective pedagogy in early childhood (Siraj-Blatchford et al., 2002) suggest that, in general terms, specifying pedagogy for the early childhood field may be more important than specifying the curriculum.

Margaret Donaldson, as cited in Haylock and Thangata (2007), provides a research-based critique (along the theme of Vygotsky's theoretical framework) stating that social interaction plays a fundamental role in the development of cognition. Vygotsky (1978, p: 57) states that "every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (intrapsychological) and then inside the child (intrapsychological)." A second aspect of Vygotsky's theory is the idea that potential for cognitive development depends upon the 'zone of proximal development'. Thus, children can extend their knowledge, skills or understanding beyond what can be attained alone through adult guidance or peer collaboration (Haylock and Thangata, 2007). However, Vygotsky's idea is that language and social experience play a dominant role in learning. His argument is based on the idea that most new knowledge is learned through language and other symbolic forms, such as pictures, diagrams and mathematical symbols. To clarify, Vygotsky describes what a learner can do in terms of zones. The first zone consists of what the student can do independently. The second zone consists of what students can do with help from someone else, such as their teacher, peers or parents (Ernest, 2000b).

Gresham (2007) maintains that Bruner's theoretical framework is based on cognitive structure, and views learning as an active process in which learners construct new ideas or concepts based upon their current or past knowledge. Further features of effective early years' mathematical pedagogy that build on this constructivist approach by Williams (2008) include:

- *Building on play*
- *Making the most of everyday routines and spontaneous learning to develop mathematical skills and concepts*
- *Requiring practitioners to support, challenge and extend children's thinking and learning through sustained shared thinking and use of accurate mathematical language*
- *Giving children opportunities to record their understanding and thoughts in early mathematical mark-making.* (p: 34)

Williams recommends that teaching very young children at the foundation stage requires specialist skills and preparation for the practitioners to ensure that learners are going to receive high quality mathematical teaching by adopting the appropriate pedagogy. These specialist skills and preparation for the practitioners include:

- *Enthusiasm of practitioners for, understanding of, and confidence in mathematics*
- *Ability to teach mathematical skills and knowledge in meaningful contexts*
- *Opportunities for open-ended discussions of solutions, exploration of reasoning and mathematical logic*
- *Exploitation of mathematics in everyday activities, as well as in play where children use and apply their knowledge, skills and understanding*
- *A breadth of mathematical experiences*
- *Understanding of the links in mathematics*

- *Understanding of mathematical concepts*

(Williams, 2008, p: 37)

If the teachers have all these skills (or most of them), that should reflect positively on the learning process as they will be able to teach and use appropriate pedagogy and help the learners become confident in their mathematics ability and build positive attitude toward mathematics.

Additionally, teachers can ensure effective learning when they employ activities that call on students to use their prior knowledge and experiences to construct their own frames of thought (Aubrey, 1993; Aubrey, 1994b; Bevevino et al., 1999; Johnson et al., 1996). As a consequence of such inquiry approaches, students are placed into situations that require critical thinking and encourage the internalising of major concepts. Inquiry activities also allow students the opportunity to express, confront and analyse preconceptions (and misconceptions) in an active, non-threatening way (Bevevino et al., 1999).

3.3.1.1 The Importance of Child-centred Approach

As a result of the latest reforms, some mathematics educators have called for teachers to move away from 'teaching by telling' (the traditional approach of much of school mathematics) and move toward the constructivist teaching paradigm (Draper, 2002; Grant, 1998; Noddings, 1993). Education theorists are encouraging and urging early childhood educators, in general, towards a socio-cultural approach in their practices (Anning et al., 2004; Bruner, 1996; Carr, 2001; Dunphy, 2009; Fleer and Richardson, 2004; Rogoff, 1998). Such an approach perceives effective practice as that which is built on the idea of the learner as an active and equal partner in any transaction. The constructivist viewpoint which considers learning as an active process in which learners use their current and prior knowledge to construct new ideas or concepts. Knowledge is not waiting 'out there' to be acquired, but needs to be constructed (Haylock and Thangata, 2007). Constructivists rely on teaching practices that are rich in conversations from which the teacher is able to understand what the learner is prepared to learn (wants to learn) and, therefore, how to orchestrate experiences and further conversations so that the learner is able to construct meaning, understanding and knowledge (Draper, 2002).

Constructivist teachers, reject the transmission model of teaching (Draper, 2002; Larochelle & Bednarz, 1998; Richardson1, 1997), or the pedagogy of control or telling. Instead, they embrace teaching methods that put students in contact with the environment, with one another, and with the teacher in order to pose questions, search resources and propose solutions to problems. In his explanation Ernest (2000b) proposes that constructivist learning in its initial stage for people, particularly learners, is to make sense of their situation and tasks. This will be in relation to their existing knowledge and schemas (conceptual structure). All new knowledge is developed and extended from ideas that are already in existence. In this way, new concepts and ideas are only understood in relation to things that are already known or understood.

According to some researchers, many pre-school teachers use a method of instruction that is both narrow and limited in terms of mathematical content, often limiting their focus to common shapes and counting up to 20 (Ginsburg et al., 2008; Graham et al., 1997). This does little to support the learning of concepts such as estimation and often fails to incorporate useful mathematical terminology (Frede et al., 2007, p: 21). However, research shows that children are capable of much more (Aubrey, 1993; Aubrey, 1995; Clements and Sarama, 2007; Ginsburg et al., 2008; Williams, 2008). Leading professional mathematics organisations, such as the National Association of Education for Young Children and the National Council of Teachers of Mathematics (2002) suggest that early mathematics teaching should include more important complex ideas, especially when dealing with number and operations, geometry (shape and space), measurement and algebra (especially pattern). This should be achieved within learning contexts that are directed towards the development of problem-solving skills, analysis and communication (Clements and Sarama, 2005; Ginsburg et al., 2008; National Council of teachers of Mathematics, 2006; Williams, 2008).

Mathematics teaching, which is based on problem-solving, is associated with the active involvement of children in realistic and meaningful problems, involving imagination, investigation, gathering and analysing data, reasoning, making conclusions and communication (Lampert, 1990; National Council of Teachers of Mathematics [NCTM], 1989; Wilkins, 2008; Williams, 2008). Furthermore, teachers adopting problem-solving approaches are more likely to present the idea that mathematics is a social activity which includes discussion, justification, argument, negotiation, and reasoning. These are all skills that students need in order to apply mathematics concepts and knowledge in their daily life situations.

Bloom’s Taxonomy is suggested as a useful framework for teachers to follow when they plan lessons and evaluate their work (Athanassiou et al., 2003; Krathwohl, 2002) as it would help them to ensure that children use both their lower-order and higher-order thinking skills effectively. Bloom’s Taxonomy for thinking contains six levels; starting with knowledge and ending with evaluation, with each level requiring more complex thinking than the previous one (Bloom et al.,1956). Figure 7 displays these six levels, as well as showing the specific kind of action for each level:

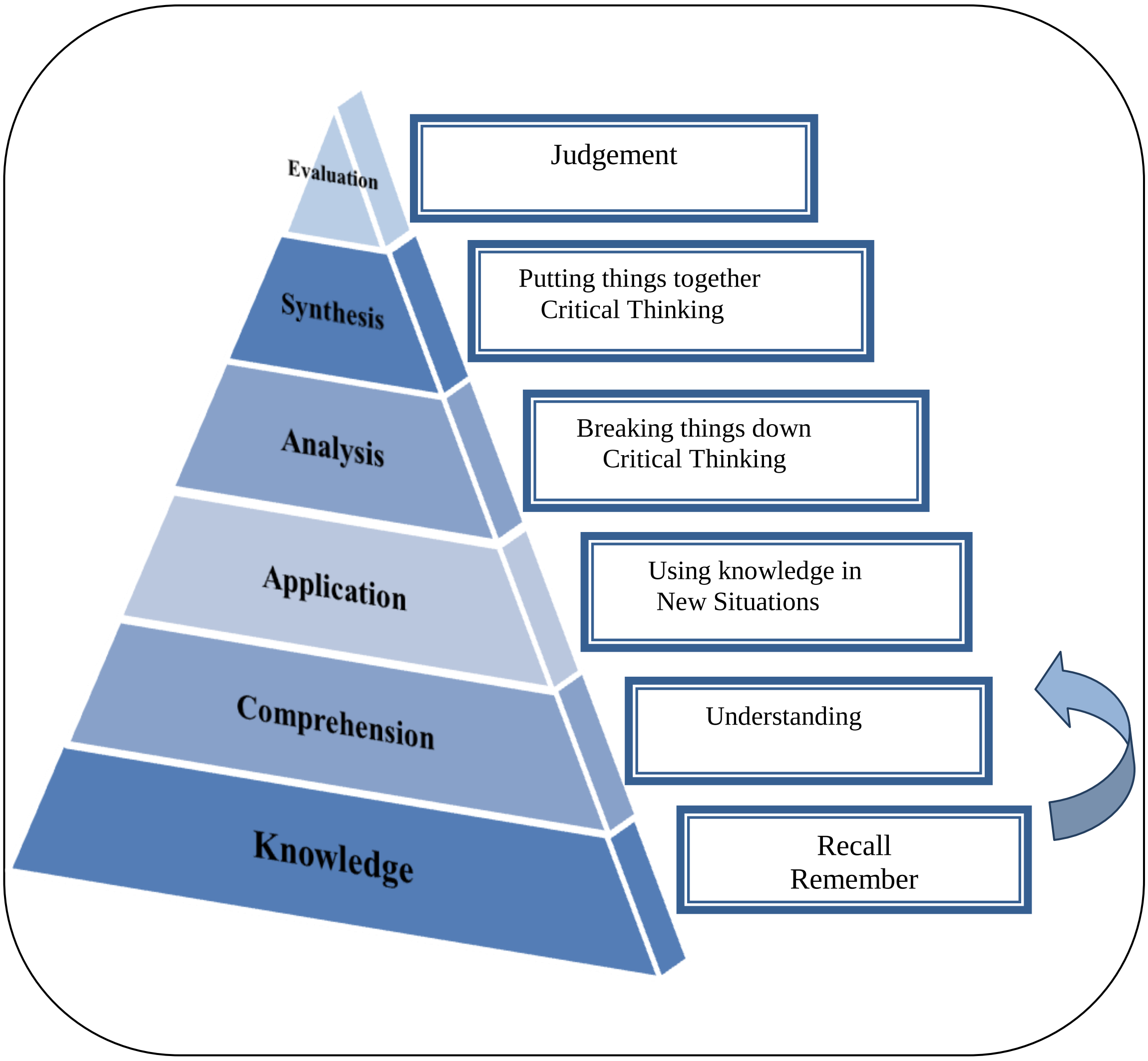


Figure 3-1: Bloom's Taxonomy of Thinking

As we can see from figure 3-1, the taxonomy is divided into six categories, ordered from simple to complex and from concrete to abstract. Bloom (1956) explained each level and gave some examples about the cognitive domains:

- ***Knowledge*** is the recall of previously learned knowledge, such as remembering and recognising information.
- ***Comprehension*** is an awareness of what the material means, such as interpreting, translating and giving descriptions.
- ***Application*** is applying acquired knowledge, facts, and techniques in a new environment and situations.

- ***Analysis*** is breaking information and knowledge into its constituent parts so that its organisational structure may be understood, such as classifying, contrasting and discovering.
- ***Synthesis*** is recombining the parts created during analysis in a new pattern or proposing alternative solutions.
- ***Evaluating*** is presenting and defending opinions by judging the information and knowledge. This is the highest level in the cognitive domain.

If teachers follow Bloom's Taxonomy when they teach mathematics, it is likely to help to develop children's thinking skills, as well as help them to gain new knowledge and effectively use and apply mathematics in different situations.

Papert (1976), an avid supporter of the role of communication and application of mathematics in teaching, stressed the importance of *communication* by highlighting that mathematics is about *doing* rather than *knowing*. Based on this theory, he developed a computer programming language (LOGO) and Turtle Geometry which used a computer controlled turtle robot as a transitional object for learners (including very young children) to think with and to develop their reasoning skills. This view of thinking is clearly linked to Bloom's Taxonomy, as knowing mathematics is not just about the lower levels of thinking skills (remembering, recognizing and recalling information) which can result in children simply learning facts and skills without being able to use and apply their knowledge. In contrast, *doing* mathematics falls within Bloom's middle to high level thinking skills (application and analysis) which should enable children to use the mathematical knowledge that they have gained to good effect. Papert (1972a, 1972b) argued that using LOGO fosters arithmetical reasoning by linking abstract mathematical principles to daily life situations, helping to develop problem-solving skills. He gave a perfect example of how talking to the robot turtle in order to learn mathematics is similar to learning dancing by practice, "... learning math by talking to Turtles is like learning dancing by dancing with people; while learning math by doing pencil and paper "sums" is like learning dancing by rote memory using pencil and paper diagrams of dancing "steps"…" (Papert, 1976, p: 10)

3.3.1.2 Multiple Representations

Using multiple representations is an important technique used in teaching as it can create situations for meaningful and effective learning which leads to high quality understanding of the subject. This is supported by the Principles and Standards for School Mathematics (2000), where it is emphasised that "students can develop and deepen their understanding of mathematics concepts and relationships as they create, compare and use various representations. Representations, such as physical objects, drawings, charts, graphs and symbols, also help students communicate their thinking" (NCTM 2000, p: 280).

According to Goldin & Shteingold (2001), the general definition of multiple representations is providing the same information in more than one form of external mathematical representation. By using multiple representations, learners can demonstrate deep understanding of a concept by translating a representation of that concept to other modes (Meij and Jong, 2003). Furthermore, Duval (2002) stated that using multiple representations for the same mathematical concept is at the core of mathematical understanding. Cleaves (2008, p: 447) gave more explanation about how using different representations helps students to understand the 'big ideas' of learning mathematics as follows:

> *"By moving in and out of different representations, students make more connections with multiple mathematical ideas, see the bigger picture of mathematics, and recognize that there is always more than one way to both represent and solve a problem".*

Ainsworth (1999, p: 131) comments that "using more than one representation is more likely to capture a learner's interest and, in so doing, play an important role in promoting conditions for effective learning" and Mayer (2003) suggests that students who only received the knowledge by listening or reading explanations are unable to remember most of the important information, as well as facing difficulty in apply that knowledge to solve new problems.

For constructivist educators, the use of multiple representations offers a way to consider how people think and learn. To use constructivist pedagogy effectively, teachers must consider students' previous knowledge, what they want to know, and how they can move toward desired knowledge (Draper, 2002) as the meaningful learning happens when learners engage in the learning process and examine the knowledge from different representations (Mayer, 2003). According to Seufert (2003), "the combination of representations that both complement and constrain each other enables learners to deal with the material from different perspectives and with different strategies, and therefore can have synergetic effects on the construction of coherent knowledge structures" (p: 228).

According to Ainsworth et al (1997), teachers use multiple representations to make abstract situations more concrete; and to set questions which require children to translate from one representation to another. Ainsworth (1999, p: 146) believes that multiple representations "can provide complementary information and processes, can constrain interpretations, and can help learners construct a deeper understanding of the domain". Aubrey (1994a) puts forward similar views in that she recommends that early years children are introduced to a variety of activities when they learn about numbers, such as matching sets of objects and learning their number name and symbol. Lesh (1979) has suggested pictures, written symbols and manipulative aids as methods of representation children use, in addition to real-world situations and spoken symbols, all of which children are exposed to in the pre-school years. In the early years, play is considered a perfect way of learning, as it is motivating and enables children to develop nature and flexible approaches to learning mathematics (McGrath, 2010).

Several decades ago, Bruner (1966) put forward his theory that children are able to learn any mathematical aspect, at an appropriate level, if the teacher follows these three steps modes of representation:

- enactive representation;
- iconic representation, and
- symbolic representation.

Hansen et al. (2005) interpretation of Bruner's theory includes "our knowledge of the world is based on a constructed model of reality" and what informs this model is the 'innate nature of our three techniques for representing or "modelling" each reality: actions, imagery, and symbolism'. Hansen uses the context of money to exemplify Bruner's modes as follows:

- children may use (play) money within a role play situation to find different coins that make ten pence (enactive);
- they may also drag and drop images of coins on the computer and print out their 'purses' (iconic);
- in addition to this, they may write: '5p + 2p + 2p + 1p= 10p' (symbolic).

To conclude, the use of multiple representations has the potential to present and learn mathematics as meaningful. Also multiple representations can help learners to understand and construct new knowledge as well as being able to apply it more effectively in different situations.

3.4 Early Years Education - some International Comparisons

The importance of early learning and its impact on children's later achievement is acknowledged by many researchers (Aubrey, 1994a; Aubrey, 2004; Barnett, 1995; Sammons et al., 2004; Wasik et al., 2000). Aubrey stressed that early learning determines later achievement and understanding of mathematics; and Wasik emphasises that the importance of early learning impacts on children's readiness in language development skills. Sammone et al. (2004) found that there are differences between children who entered pre-school and those who did not. They maintained that those who entered pre-school were prepared for a better start at primary school from a number of different perspectives, such as pre-reading, early number concept and cognitive development. Furthermore, many researchers suggest that the pre-school age is an important time for early intervention to help those children who may have a high-risk of failure in mathematics learning (Aunola et al., 2004; Jordan et al., 2006; Wright et al, 2000).

In spite of all the evidence about the importance of early learning in children's school readiness and later achievement, the early learning stage is not compulsory in most developed or developing countries, and also the structure of education is different in different countries .

The next section examines the structure of early year education systems in five sample countries: United Kingdom (England), the Netherlands, the USA, Jordan, and Saudi Arabia. For each country, the structure is described, including details of the main phases with their age ranges.

Table 3-1: Some International Comparisons of Early Years Education

Country	Name of Phase	Age Range	Compulsory Yes/No	National Curriculum (NC)
UK (England)	Nursery Reception Year one	3-4 4-5 5-6	No Yes Yes	EYFSC EYFSC NC
USA	Pre-School Kindergarten	3-5 5-6	No Yes in 11 States	No NC
Netherlands	Pre-school Playgroups Grade 1 Grade 2	2.5-4 4-5 5-6	No No Yes	No national curriculum No national attainment targets exist for the under-fives
Jordan	Pre-school (public) Pre-school (private)	4-6 3-6	No No	Developed Curriculum
Saudi Arabia	Pre-school (KG1, KG2, KG3)	3-6	No	Developed Curriculum

As shown in table 3-1, different countries have different early learning systems. The differences are not only limited to the name given to this stage of education, but also the duration, levels and curriculum. For example, the UK (England) and Netherlands are two developed European countries, but they have different pre-school education systems. In the UK (England), the pre-school stage includes two age phases: Nursery (3-4yrs) and Reception (4-5yrs) and is known as the Early Years Foundation Stage (EYFS) with a recommended curriculum (EYFSC). The Reception class is the first compulsory stage of school in England and also the second stage of the EYFS. The Netherlands divides early education into two levels: the first level (pre-school playgroups) includes children from 2.5 to 4 years old, whilst the second level (Grade 1 and Grade 2) includes children age 4-5 (not compulsory) and children aged 5-6 (compulsory) (Broekhof, 2006).

In Saudi Arabia and Jordon (two developing Middle East countries) have some similarities in their pre-school education system, as children from 4 to 6 years old in both countries attend the pre-school stage, and then start their primary school at age 6 years. Also, the pre-school curriculum at both countries are almost the same as they provide the Developed Curriculum (containing eight different educational units) but neither of them has a specific literacy or mathematics curriculum.

The difference in the US between the States relates to the compulsory kindergarten stage, with eleven States requiring children to attend kindergarten and the other 39 States providing kindergartens where it is the parent's decision whether or not to enrol their child. With regard to the curriculum, in the US there is no national curriculum for pre-school or kindergarten.

Table 3-1 demonstrates that the very early learning stages in both developed and developing countries (nationally and locally) have such very different organisational features and structures. At the same time, variations in the curriculum requirements inevitably affect the teaching and learning process and the learning outcomes at this stage. The lack of standardisation (organisational and curriculum) makes comparisons between settings difficult particularly in relation to the impact of teaching on learning at this stage. This, in turn, makes it difficult to take the necessary steps to carry out any changes, for example, in relation to teachers' classroom practice and improving the curriculum.

3.4.1 Effecting Change in Teachers' Practices

There have been many efforts worldwide, to improve young children's mathematics skills (Ginsburg et al., 2008; National Council of Teachers of Mathematics (NCTM), 2000; Pound, 2006; Williams, 2008). These include designing national pre-kindergarten and kindergarten mathematics standards (NCTM, 2000), proposing improved methods of teaching and learning mathematics (Aubrey, 1994b; Ginsburg et al., 2008; Lee, 2005; Williams, 2008), and producing highly skilled educators (Aubrey, 1994; Williams, 2008). Improving quality in the teaching of mathematics is seems to be influenced by improving teachers' subject knowledge and teaching (Aubrey, 1994b; Ball, 1991; Ball et al., 2001; Lee, 2010). Provision of challenging, accessible and high-quality early mathematics education becomes an important concern for early childhood educators, and being an effective teacher requires positive attitudes toward the subject, proficient subject matter knowledge, and pedagogical knowledge (Aubrey, 1994b; Lee, 2005; Pound and Lee, 2011).

Ball et al (1990) maintain that the key aim of teaching must be to help students to develop intellectual resources to enable them to participate in (not merely to know about) the major domains of human thought and inquiry, it is necessary to use intellectual ideas and skills as tools to gain control over everyday, real-world problems. To achieve this, teachers must go beyond the workbooks and textbooks, and begin to teach mathematics in creative, relevant and meaningful ways. According to Jennings et al (1992), teaching meaningfully has three basic steps: applying the concepts into real-life problem situations; integrating real-life problem-solving situations as a motivational technique for both students and teachers; and using suitable activities encouraging discussion among children.

Decades ago an influential report, into mathematics teaching in the UK stated that at all levels, the teaching of mathematics should provide opportunities for the following:

- *Exposition by the teacher*
- *Discussion between teacher and pupils, and also amongst pupils themselves*
- *Appropriate directed practical work*
- *Consolidation of fundamental skills and routines, as well as practical activities to support this*
- *Problem solving exercises to include the application of mathematics to everyday situations*
- *Investigational work*

(Cockcroft, 1982, p: 71)

However, "there is a great disjunction between what is optimal pedagogically for children's learning and development, and the level of preparation that currently typifies early childhood educators" (Bowman et al. 2001, p: 311). For pre-school children, to succeed and build a positive attitude toward mathematics, they must be actively encouraged to become involved in appropriate activities in order to mature in mathematical ability (Cockcroft, 1982; Williams, 2008). If teachers adopt a 'rote learning' method of teaching without encouraging understanding, this may result in developing children's negative attitudes toward mathematics which in turn can decrease their motivation to learn mathematics. This view is supported by Ryan and Williams (2007, p: 156), who claim that "rote learning or 'training' without meaning is a major source of failure in motivation and performance".

The National Research Council emphasized the critical need for well-prepared teachers, who know the "big ideas" in academic domains such as mathematics, literacy and science, and the education of pre-kindergarten children (Bowman et al., 2001; Todd Brown, 2005).

Based on their extensive work with teachers and teacher trainees, Koshy and Murray (2011) have shown that teachers play a pivotal role in presenting the beauty of mathematics to young children. Slavin (2009, p: 3) considers that it is effective teaching strategies, rather than the curriculum, that can make significant differences to the quality of teaching. Slavin further goes on to state that "changing the way children work together to encourage more interaction, and classroom management and motivation, can improve the mathematics learning outcomes for all students".

Research into the relationship between the backgrounds of teachers and the quality of their teaching has indicated that teachers with degrees or higher degrees in early childhood studies are able to provide improved quality pre-school experiences which directly lead to more successful outcomes for students when contrasted with teachers lacking such qualifications (Barnett, 2003; Bowman, et al., 2001; Ginsburg et al., 2008; Todd Brown, 2005).

Commenting on children's motivation, Copley (2000) highlights that when young children develop a negative attitude towards mathematics it is extremely difficult to change this mindset in subsequent years. The reasons for failure and negative attitudes toward maths can be attributed to classroom issues, parental pressure, and mismatch of teaching and learning methods which could change children's enthusiasm to apprehension, lack of confidence and even fear (McGrath, 2010). Additionally, Copley (2000) stressed that unsuitable teaching, rather than intellectual inadequacy, is the reason why children may not succeed at mathematics.

In recent years, there has been a significant shift in the direction of early childhood mathematics teaching in that the focus is placed on helping children learn a set of skills and procedures to enabling them to solve mathematics problems and apply their knowledge effectively in different situations (Fox and Surtees, 2010; McGrath, 2010; Ng and Rao, 2008; Pound and Lee, 2011; Williams, 2008).

Prospective early years teachers often feel intimidated by mathematics, and would rather teaching literacy (Copley, 2004; Ginsburg et al., 2008; Zacharos et al., 2007). Zacharos et al. (2007) suggest the following as a reason for teachers' lack of confidence to teach mathematics:

- Teaching mathematical concepts is difficult for them, as they do not possess an intimate knowledge of mathematics.
- Early Childhood Education teachers are oblivious to essential mathematical procedures such as reasoning, problem solving, as well as the relation between mathematics and the ability of children to comprehend its concepts.
- Teaching strategies tend to focus on methods of calculation and presenting the procedures leading to the 'correct' answers, rather than develop the children's autonomy and encourage them to develop their own methods and reasoning. (p:315)

The beliefs and routine of traditional school mathematics need to be changed in order to help students gain meaningful, lasting and useful mathematical knowledge. This has not proved easy as teachers have faced problems transforming their classroom methods as a result of the latest wave of reform (Smith, 1996). As a theory of learning, Draper (2002) suggests that constructivism provides the necessary framework to help teachers adopt a mathematics teaching approach in which the teacher and the pupil work in conjunction with one another towards a common goal of solving problems, engaging in inquiry, and constructing knowledge. Learning mathematics effectively also needs an environment that engages children in operating mathematically. For example, situations at home or school, in the playground and shopping are all likely to require skills such as counting comparing, exploring relations, reasoning and identifying patterns.

The ability to solve problems is the basis of all mathematical learning and an approach to teaching mathematics based on this principle can only prove to be effective if it is possible to apply mathematics to particular situations. It is this specific ability to apply mathematics to a range of different situations that leads to the term 'problem solving' and is the view point stressed in the Cockcroft Report, (1982) and subsequent official reports and curriculum guidance in the UK (Koshy and Murray, 2011). It is also recommended in all the guidance that problems should relate not only to the application of mathematics to everyday situations with which the pupils are familiar but also to situations which they have not experienced.

Carpenter and Lehrer's (1999) proposition that mathematical understanding emerges from the following mental activity provides useful guidance for early years mathematics teaching:

1 *Constructing relationships*
2 *Extending and applying mathematical knowledge;*
3 *Reflecting about experiences*
4 *Articulating what one knows*
5 *Making mathematical knowledge one's own* (p:20)

Teachers' understanding of mathematics affects their ideas about how they should present it to their students. Teachers' methods of teaching mathematics show what they believe to be most essential, and consequently influences the way in which children understand and learn mathematics (Cai, 2004). Some researchers have called for changes in *what* mathematics should be learned and *how* mathematics should be taught, if we want to see improvement in mathematical teaching practices (Cai, 2007; Lee and Ginsburg, 2007).

A teacher can, through a variety of ways, transform understanding, performance skills or desired attitudes or values into pedagogical representations and actions. These include talking, showing, enacting or otherwise representing ideas so that those learning or lacking understanding can comprehend and discern, and the unskilled can become adept. Thus, teaching necessarily begins with a teacher's understanding of what is to be learned and how it is to be taught.

According to Ball (1988), student teachers are rarely treated as learners who actively develop understanding about specific subject matter and its pedagogy. Often they are considered as simply lacking particular knowledge or skills without any regard to what knowledge they may already have. This lack of attention to what teachers bring with them to the process of learning to teach mathematics may explain why teacher education is often such a weak intervention and why teachers, in spite of courses and workshops, are most likely to teach maths in the same way that they were taught. Consideration should be given to finding ways to break this conservative cycle if a change to the nature of mathematics teaching and learning in schools is to be effective. Without this, changes in requirements or improvements in curriculum alone are unlikely to prove beneficial.

Teachers' knowledge is, to some extent, a dynamic process constructed according to the demands of the teaching context, and it is not directly verifiable or easily separable from beliefs. In recent years, teachers' knowledge of the subject matter they teach has attracted increasing attention from policymakers.

Good teaching practices should make mathematics learning interesting and meaningful; improving teachers' subject knowledge, attitudes and beliefs towards mathematics are vital ingredients for this to happen.

3.4.1.1 Teachers' Subject Knowledge

Effective teaching practice which results in high quality learning requires expert teachers who should not only have the subject knowledge but also know how to teach this knowledge which is referred to as pedagogical content knowledge (Ball and Bass, 2000; Kennedy, 1998; Lee, 2010; Shulman, 1986). It is essential that strong standards and a high quality curriculum are implemented. However, the curriculum does not teach itself, and standards do not operate independently of the professionals who use them. To be effective, school systems depend upon the work of trained teachers who have a sound understanding of the subject matter (Ball et al., 2005). The extent to which teachers 'know' mathematics is a key factor in their capacity to use instructional materials wisely and help their students to achieve the appropriate knowledge, build up the right skills and develop positive attitudes toward mathematics.

In recent years, the role of teachers' academic mathematics subject knowledge in influencing teaching activities has been recognised by many researchers (Aubrey, 1994b; Aubrey, 1995; Ball et al., 2005; Ball et al., 2008; Kleickmann et al., 2013; Shulman, 1986). Shulman (1986; 1987) identified that the teacher must grasp the structure of the subject matter and the principles of its conceptual organisation in order to appreciate the important ideas and skills in the specific domain.

The twin and complementary roles of sound academic mathematics subject knowledge and pedagogic expertise is explained by Aubrey (1994a):

> *Pedagogical knowledge goes beyond subject matter knowledge to the examination of subject matter for teaching. For the teacher this should entail the transformation of subject content into a form that children understand. Pedagogical subject knowledge includes knowing what knowledge, concepts and strategies children bring to learning, their misconceptions as well as their understandings, and the stages through which they pass towards mastery of topics within a subject area.* (p:106)

These two aspects – academic mathematics subject knowledge and pedagogical knowledge – are desirable in both trainees and practising teachers. Student primary teachers who fail to demonstrate strong academic mathematics subject knowledge are likely to show poor performance in their teaching of mathematics, even during the latter stages of their training (Henderson and Rodrigues, 2008; Rowland et al., 2000). Most experts would agree that initial teacher education should ensure that pre-service teachers have the skills and knowledge needed to use appropriate pedagogy and mathematics subject content knowledge in an effective way (Henderson and Rodrigues, 2008).

Carpenter et al (1989) support the idea that a teacher with pedagogical content knowledge of mathematics will lead to high-quality mathematics education. Their study showed that teachers with an understanding of how to promote problem-solving skills in mathematics had considerably more success developing problem-solving strategies for children than teachers who lacked such understanding.

Shulman (1986, p: 9) argues that knowing a subject for teaching requires more than knowing its facts and concepts. Teachers must also understand the organizing principles and structures, as well as the rules for establishing what is legitimate to do and say in a field. Moreover, “the teacher should be expected to understand why a particular topic is important to a discipline whilst others may be less so.”

Philosophical arguments, as well as common sense, support the view that teachers' own academic knowledge of a subject influences their efforts to help students learn. Conant (1963, p: 93) contends that "if a teacher is largely ignorant or uniformed, he can do much harm". If teachers possess inaccurate information or conceive of knowledge in narrow ways, they risk passing these ideas on to their students. They may, for example, fail to challenge students' misconceptions; use texts uncritically or alter them inappropriately. In this way, teachers' conceptions of knowledge shape their practice through the kinds of questions they ask, the ideas they reinforce, and the sorts of tasks they assign.

Brophy (1989, 1991) has demonstrated that, where their subject knowledge is rich and better integrated and more accessible, teachers are more likely to teach dynamically, represent the subject in a more varied way, and encourage and respond more fully to children's questions and comments. However, where knowledge is more limited, there is more emphasis on facts, more reliance on subject texts for content, more time spent by pupils in working individually and less interactive discourse.

Knowledge of subject matter and content do not impact teachers' teaching practices or the quality of their instruction directly, but they have an indirect effect on teaching practice (Brophy, 1992; Lee, 2010). In other words, when teachers' subject matter knowledge is clear and solid, it will enable them to teach the subject more effectively and confidently. Aubrey (1995) maintains that the interactions between pre-school children and their teachers reveal that more academic mathematics knowledge supports dynamic interactive discussion between the teacher and children during teaching and learning mathematics. Furthermore, the analysis demonstrated that in cases where there is limited academic mathematics knowledge, teachers are likely to focus on facts and place emphasis on workbooks and worksheets, paying more attention to individual work by children.

Shulman (1987, P: 8) proposes that teacher knowledge should always include:

- *Content knowledge*

- *General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter*
- *Knowledge of the curriculum, with good grasp of the materials and programmes that serve as 'tools of the trade' for teachers*
- *Pedagogical content knowledge – i.e. that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding*
- *Knowledge of learners and their characteristics*
- *Knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; and knowledge of educational ends, purpose, and values, and their philosophical and historical grounds*

Shulman (1987) emphasised that pedagogical content knowledge identifies the distinctive bodies of knowledge for teaching, as the teachers translate the theoretical knowledge into practice through the suitable pedagogy, as he stressed in the following:

> *"The key to distinguishing the knowledge base of teaching lies at the intersection of content and pedagogy, in the capacity of a teacher to transform the content knowledge he or she possesses into forms that are pedagogically powerful and yet adaptive to the variations in ability and background presented by the students" (p: 15).*

Without sufficient knowledge about pedagogy, teachers could face barriers to transfer the knowledge meaningfully and effectively to the learners.

During the course of their professional training, teachers should ideally be expected to have acquired both a general understanding of teaching pedagogy and specific pedagogical content knowledge. Student teachers and newly qualified teachers need a range of mathematical educational experiences and professional development in content knowledge and pedagogy to combine mathematics content learning effectively and efficiently with their regular interactions with students (Todd Brown, 2005).

It is clear that most teachers, teacher educators, and researchers believe that the teaching of mathematics should involve the use of different types of learning activities such as appropriate methodology, asking appropriate questions, evaluating children's understanding and building a positive attitude toward mathematics. All of these actions depend on the teacher's own understanding of mathematics as this has considerable influence on their effort and ability to help pupils learn (Bruce, 2004; Henderson and Rodrigues, 2008). Nevertheless, teachers' mathematics subject knowledge and its relationship to effective mathematics teaching (and learning) is complex as illustrated by the different models that researchers have evolved since Shulman's (1986) seminal work. Broadbent (2012) provides a comparison of the subject knowledge classifications which informed his approach to analysing primary teachers' subject knowledge alongside addressing the question of teachers' *deep* subject knowledge.

3-2: Broadbent's (2012) Comparison of Subject Knowledge Frameworks

Shulman (1986)	Ball *et al.* (2008)	Aubrey (1994)	Rowland *et al.* (2003)	NCETM (2009)	Broadbent (2012)
Subject matter knowledge (SMK)	Common content knowledge		Foundation		Basic mathematical knowledge (BMK)
Curricular knowledge	Horizon content knowledge	Subject content knowledge	Connection	Knowledge about mathematics	Knowledge of teaching mathematics (KTM)
Pedagogical content knowledge (PCK)	Specialised content knowledge (SCK) Knowledge of content and teaching (KCT)	Pedagogical subject knowledge	Transformation	Knowledge about ways of teaching mathematics	
Knowledge of learners and their characteristics	Knowledge of content and students (KCS)	Knowledge of conceptions of pupils	Contingency	Knowledge about students' mathematics conceptions	Knowledge of learning mathematics (KLM)

(Adapted from Broadbent, 1212, p: 10)

The taxonomy adopted for exploring the pre-school teachers' subject knowledge in Saudi Arabia delineated three distinct yet inter-related strands:

Attitudes Beliefs Confidence	Pedagogical Knowledge Mathematics Curriculum Representing Mathematics	Subject Knowledge (Academic)

The importance of teachers' attitudes and beliefs about mathematics in relation to their mathematics teaching practices will be outlined in the next section.

3.4.1.2 Teachers' Beliefs and Attitudes toward Mathematics

In the past two decades, many researchers have revealed that teacher attitude toward mathematics was the primary factor influencing teaching practice (Aubrey, 1994b; Ernest, 1989; Ginsburg et al, 2008; Lee, 2005).

According to Ajzen (1988), as cited in Zacharos et al. (2007), 'attitudes are considered as a multidimensional mental construction containing cognitive, affective and cognitive elements relating to each other. Cognitive elements comprise expressions of beliefs about an attitude object; affective elements consist of feelings towards an attitude object; while cognitive elements relate to expressions of behavioural intention. Beliefs, on the other hand, are defined as a "combination of subjective knowledge and feelings about a certain object or person" (Philippou and Christou, 1998, p: 190).

The kind of knowledge, beliefs and attitude that teachers carry toward mathematics shapes their practices. According to Ernest (1989) teachers' knowledge includes knowledge of

- Mathematics
- Other subject matter
- Pedagogy and curriculum,
- Classroom management
- Context of teaching

- Education

Teachers' beliefs include

- Conception of the nature of mathematics
- Models of teaching and learning mathematics
- Principles of education

Teachers' attitudes include

- Attitudes toward mathematics
- Attitudes toward teaching mathematics

Therefore, knowledge, attitudes and beliefs are all posited to have a direct influence on teachers' instructional practices (Wilkins, 2008). Evans's (2003) view is that teachers' abilities to create meaningful classroom activities are strongly related to their beliefs towards mathematics. Further support that the beliefs and attitudes of teachers, both pre-service and in-service, play a significant role in the development of teaching practices and, consequently, affect the attitudes of students toward mathematics is provided by many experts in mathematical education (Abu-Jaber and Al-Shawared, 2010; Ernest, 1996; Lee, 2005; Zacharos et al., 2007).

There is evidence to show that attempts to alter classroom practices and methods without consideration of teachers and their beliefs have often resulted in misunderstanding (Lee and Ginsburg, 2007; Ryan, 2004) or, even worse, in strong resistance to change (Bailey, 2000; Lee and Ginsburg, 2007). As highlighted previously, Koshy & Murray (2011) emphasise that teachers play a significant role in instructing children about the beauty of mathematics. However, this cannot be achieved if the teachers do not *believe* in that beauty, or carry a negative attitude toward mathematics.

A constructivist perspective holds that children's learning of subject matter is the product of a combination of what they are taught and what they bring to any learning situation. Evidence from cognitive science research confirms that pupils' prior knowledge and beliefs significantly affect the way they make sense of new ideas (Ball, 1988). As with pupils, the constructivist view of learning applies to pre-service teachers also, in that when they start their preparatory phase, they come with ideas and knowledge that in some way affects and influences what they learn, as well as their field experiences. All these ideas and knowledge have developed through their schooling years (Ball, 1988).It would seem that teachers' own experiences at school, when they were students, shape their feeling about mathematics, which will affect their teaching practice and their students.

Olatunde (2009) states that attitude as a concept is concerned with an individual way of thinking, acting and behaving. It has very serious implications for the learner, the teacher, the immediate social group with which the individual learner relates and the entire school system. Attitudes are formed from a variety of learning experiences. They may also be learned simply by following the example or opinion of parent, teacher or friend. That means, our attitude is something we develop and construct from interacting with people around us, such as parents, teachers and peers (Celia and Nadarajan, 1212). Based on that, we could say that teachers' attitudes towards the teaching of mathematics play an important role in shaping the attitude of students towards mathematics.

Shaw and Wright (1967) explain that attitude is a relatively enduring system of affective, evaluative reactions based upon and reflecting the evaluative concepts or beliefs which have been learned about characteristics of a social object or class of social objects. According to Bloom et al. (1964), affective domains have five major categories: receiving phenomena; responding to the phenomena; valuing; organizing; and internalizing values. Bloom and his colleagues point out that in each of the five categories an individual will build up either positive or negative attitudes.

According to Haladyna et al. (1983), it is very important for every individual to build a positive attitude toward mathematics for the following reasons:

- *A positive attitude is an important school outcome in and of itself.*
- *Attitude is often positively, albeit slightly, related to achievement.*

- *A positive attitude toward mathematics may increase one's likelihood to opt for careers in mathematics or mathematics-related fields. (p:20)*

Our attitude is a translation of our beliefs. Teachers' attitudes toward mathematics are a translation of their beliefs about the importance of the subject. Todd Brown (2005) state that the beliefs that teachers hold influence their perceptions and judgments, which in turn affect their behaviour in the classroom, so that understanding the belief structures of teachers and teacher candidates is essential to improving their professional preparation and teaching practices.

The use of mathematics by adults depends on whether they liked mathematics at school. Many researchers have stressed that teachers' understanding of what mathematics is will influence the way in which they teach the subject (e.g. Beswick, 2011; Sullivan and Mousley, 2001). Additionally, teachers' past experiences in their early schooling have an effect on their motivation, expectations and values in their classrooms (Hollingsworth, 1989; Nespor, 1987; Todd Brown, 2005). Ball and Cohen (1996, p:6) point out that "teachers have implicit beliefs about subject matter, their students, and their roles and responsibilities that significantly influence how they behave in their classroom" and Thompson (1984) concludes that "there is strong reason to believe that in mathematics, teachers' conceptions (their beliefs, views and preferences) about the subject matter and its teaching, play an important role in affecting their effectiveness as the primary mediators between the subject and the learners" (p: 105).

Appreciating the importance of teachers' beliefs is essential to enable understanding and to explain classroom practice (Maxwell et al, 2001; Ng et al., 2008). Teachers' beliefs play a significant role as they guide the teachers' choice of appropriate mathematics content, teaching method and how they interact with children (Ng et al., 2008). As result of this, educational reforms often aim to influence teacher beliefs. In order to promote changes in classroom practice, it is necessary to consider teachers' beliefs about mathematics because of the connection between beliefs and practice. Researchers have noted that pedagogical knowledge is influenced by teachers' beliefs and attitudes towards mathematics teaching (Aubrey, 1994b; Brophy, 1991).

Research has shown that there are clear differences in practice between teachers who do not enjoy mathematics and those who do, as the teachers who do not enjoy it are likely to spend as much as 50 per cent less time teaching the subject (Schmidt and Buchmann 1983; Sloan, 2010). It is also highlighted that teachers with negative attitudes toward mathematics frequently rely on teaching by rote, thus avoid interactive learning, problem solving processes and mathematical reasoning (Karp 1991). This way of teaching increases the feeling of mathematics anxiety in students, as well as decreasing students' positive attitude towards mathematics. (Ernest, 1989; Greenwood, 1984; Karp, 1991; Sloan, 2010)

The quality of teachers' training to teach mathematics is important. Battista (1986) identified a relationship between the quality of mathematics instruction at elementary school and the quality of pre-service preparation. He found that "a lack of knowledge and poor attitudes towards mathematics exhibited by many pre-service elementary teachers may inhibit their learning and later use of effective methods for teaching mathematics" (p: 10).

Ernest (1989) clearly describes three categories of teacher beliefs concerning the nature of mathematics as follow:

- *The first is the Instrumentalist view, which sees mathematics as an accumulation of facts, skills and rules to be used in pursuance of some external end..*
- *The second category is the Platonist view, in which mathematics is seen as a static body of unified, pre-existing knowledge awaiting discovery.*
- *The third category is the Problem-solving view, in which mathematics is regarded as a dynamic and creative human invention; a process, rather than a product* (p: 250).

It would seem that the third category is likely to help teachers and students to see mathematics as an interesting and meaningful subject that relates to their daily life practices.

Moreover, to develop children's positive attitudes to mathematics, teachers need to learn how to integrate learning experiences that are enjoyable, interesting and that provide the learner with a sense of success. In order to be able to do this, teachers must have had such experiences themselves, either during their earlier school years or at their pre-service training stage.

3.4.1.3 Teachers' Anxiety about Mathematics

As early as 1951, research into negative attitudes towards mathematics amongst elementary pre-service teachers' was published. Dutton (1951), as cited at Harper and Daane, 1998), found that students using elementary methods reported a lack of understanding of mathematics, a lack of interest in mathematics, a fear of making mistakes, and feelings of insecurity and inferiority. Further studies showed that the reason was that many pre-service elementary teachers suffered a lack of mathematics subject knowledge, which was compounded by negative attitudes and anxiety toward mathematics (Harper and Daane, 1998; Lester, 1984).

Page and Thomas (1979), as cited in (Haylock and Thangata, 2007), defined anxiety as a "complex emotional response, often unconscious in origin, with fear or dread as its most notable characteristic". Trujillo and Hadfield (1999) have defined mathematics anxiety as "a state of discomfort that occurs in response to situations involving mathematical tasks that is perceived as threatening to self-esteem". Therefore, anxiety about mathematics affects the ability of some individuals to achieve their potential in this subject and makes them see mathematics as a source of fear (Haylock and Thangata, 2007).

If mathematics anxiety is common-place among pre-service teachers (Hembree, 1990), this is a cause for concern as teachers possessing higher levels of mathematics anxiety may unintentionally pass on those negative feelings to their students (Sloan et al., 2002; Wood, 1988). Mathematics anxiety has an effect on learning, and may perhaps be a greater barrier to mathematics learning than any deficiencies in the curriculum or teacher preparation programmes (Gresham, 2007; Martinez, 1987). Research has found that pre-service teachers with higher levels of maths anxiety feel less confident in their abilities to teach elementary mathematics. (Ball, 1990; Bursal and Paznokas, 2006)

Mathematics anxiety has been found to have direct links with personality type, negative attitude towards mathematics, mathematics avoidance, mathematics background, lack of confidence, level of mathematics achievement, and negative school experiences (Bursal and Paznokas, 2006; Stuart, 2000; Trujillo and Hadfield, 1999).

It is interesting to note Hadfield and Lillibridge's (1991) report that primary school mathematics experiences have, in many cases, led to mathematics anxiety. The primary stage is considered as a foundation for the secondary stage and so, if the students do not build a strong foundation and understand the 'big ideas' behind learning mathematics at this stage, then they may face future misconceptions in learning mathematics and be less confident about their mathematical abilities, possibly suffering mathematics anxiety. Harper and Daane (1998) have linked the beginning of mathematics anxiety to prior experience with formal mathematics at the primary and secondary stage:

> *These experiences have tended to lower confidence in one's mathematical ability, leading to mathematics avoidance by the time the student reached secondary school. Thus, the elementary mathematics classroom might be considered as a starting point for the creation of mathematics anxiety in many students.' (p: 29)*

Several educators agree that teachers pass on their fear and trepidation of mathematics to their students (Furner and Berman, 2005; Gresham, 2007; Lee and Ginsburg, 2007; Sloan et al., 2002; Wood, 1988). When it is realised that teachers, who possess higher levels of mathematics anxiety, may unintentionally pass on these negative feelings to their students, this represents a cause for alarm (Gresham, 2007; Wood, 1988). Potentially, this process has no end as today's students go on to be future teachers, where they will pass their own anxieties toward mathematics to the next generation and so on (Sloan, 2010). Additionally, the root of some mathematics anxiety lies in how effectively one is taught mathematics. This is particularly significant as many teachers have a tendency to teach just as they were taught (Furner and Berman, 2005; Gresham, 2007). Vinson (2001) points out that, the nature of teaching itself seems a powerful source in shaping later attitudes, expectations and conceptions of learning. The possible solution to break this circle and solve the problem may lie in the pre-service preparation of teachers to teach mathematics (Bursal and Paznokas, 2006).

The instruction of mathematics and methods that teachers use seem to play a significant role in shaping one's attitudes toward mathematics (Jackson and Leffingwell, 1999). Lee and Ginsburg (2009) comment that "our experiences tell us that, despite their good efforts to provide best practices to young children, many teachers remain confused and anxious about the teaching and learning of mathematics, and are generally hesitant to change". This could be a sign of weakness in pre-service teachers' preparation programmes and in-service teachers training programmes. Clark-Meeks et al, (1982) maintain that early childhood and primary students often express fear, dislike and insecurity regarding mathematics. Vinson (2001) noted that 'negative attitudes toward mathematics can produce negative results in mathematics' (p: 90). Such negative results in mathematics could be the result of an inappropriate teaching approach that teachers have adopted, as Karp (1991) found that teachers with negative attitudes toward mathematics used methods that were more rule-based, preferring a teacher-centred approach. Teachers with more positive attitudes used methods that focused on understanding, and discovering mathematical relationships through a problem-solving approach.

Cornell (1999) listed a number of pedagogical practices that can discourage the development of positive attitudes toward mathematics which in turn could increase mathematics anxiety. These included:

- the assumption on the part of many mathematics teachers that mathematical processes and procedures were inherently simple and self explanatory;
- the use of mathematics vocabulary without enough explanation ;
- an overuse of 'skill and drill' exercises;
- an overemphasis on rote memory; and

- the fact that mathematics tended to be taught in isolation, without clear connection to the ‘real world’ and daily experience.

Similar views are put forward by Furner and Berman (2005) who point out that handing over the same work to everyone, teaching from the textbook in a set fashion, concentrating more on basic skills rather than concepts, and devoting more time to whole class instruction are all ‘traditional’ ways of teaching that commonly lead to mathematics anxiety (Buxton, 1981)**.**

In summary, effecting change in teachers’ practices to improve teaching mathematics cannot be achieved without improving the quality of teachers’ training programmes, and making sure all the teachers have a strong foundation in mathematics subject knowledge, which in turn reflects positively on their attitude toward mathematics and increases their ability to teach mathematics confidently by using interesting and meaningful methods.

3.5 The Early Years Mathematics Curriculum

Williams (2008) stated that “irrespective of the age and ‘stage’ of a child, a high-quality curriculum and excellent teaching are twin conditions for successful learning” (p: 61). This is also stressed by the National Council of Teaching of Mathematics (NCTM) and the National Association for the Education of Young Children (NAEYC) (2002), who stated that “…high-quality, challenging and accessible mathematics education for 3 to 6 year old children is a vital foundation for future mathematics learning. In every early childhood setting, children should experience effective, research-based curriculum and teaching practices” (p: 1).

Stevens (2008), emphasises that whatever happens in the early years during mathematics learning influences the future, so “it is crucial that practitioners ensure those children’s early experiences of problem solving, reasoning and numeracy are successful” (p: 73). Teachers should present mathematical concepts, strategies and vocabularies, and help children understand mathematics and build strong foundations for mathematical knowledge. This cannot be achieved without structured planning and a well-developed curriculum.

Williams (2008) states that a mathematics curriculum should include the knowledge, skills, and understanding that is necessary for all children. Also, he stressed that "it is widely agreed that our mathematics curriculum must measure up to 'world class' standards as an entitlement for all children" (p: 61). However, just as there is no agreement on the right age to start and finish the early learning stage internationally, there is also no agreement on the content of the mathematics' curriculum.

Mathematics is different from other subjects as mathematical language is universal and it is important for every society, as people need it for their everyday functioning as well as to develop and improve their economic success (Ginsburg et al., 1998). Also, mathematics is widely acknowledged as an accumulative domain of knowledge where gaining different concepts and skills are dependent on understanding previous ones. Therefore, it would seem that it is possible to develop an international mathematics curriculum based on the results and findings of international researches.

The following section presents examples of the early learning mathematics curriculum (main objectives) from two different countries. These are from:

- The UK as an example of Western developed countries; and
- Saudi Arabia, as an example of developing countries, where this study took place.

❖ ***The Early Years Mathematics Curriculum in UK***

According to Aubrey (1994a), after a major revision of the British mathematics curriculum in 1989, the mathematics curriculum was broadened to provide five stands: *using and applying mathematics*, *number, algebra*, *shape and space*, and *handling data*.

In the latest version of the Early Years Foundation Stage Profile Handbook (2013), the mathematics curriculum involves numbers, shapes, spaces and measures, as children at this age need to know:

- how to count up to 20;
- numbers order ;
- some strategies to solve problems, such as sharing, halving and doubling;
- how to recognise and describe patterns and notice them in the environment; and
- how to use money and tell the time.

Table 3-2 gives an overview of the main objectives of teaching mathematics in the foundation years in the UK (England and Wales only), and provides an explanatory note on how each strand is related to children's daily life situation in the UK.

Table 3-3: Main Objectives of Teaching Mathematics in the Foundation Years in the UK (England and Wales)

Specific Areas of Learning	
Mathematics development involves providing children with opportunities to practise and improve their skills in counting numbers, calculating simple addition and subtraction problems, and to describe shapes, spaces, and measures.	
ELG 11	Numbers: Children count reliably with numbers from one to 20, place them in order and say which number is one more or one less than a given number. Using quantities and objects, they add and subtract two single-digit numbers and count on or back to find the answer. They solve problems, including doubling, halving and sharing.
Explanatory note: Within play and other practical situations, the child counts and orders numbers from 1-20 and finds one more or one fewer than a given number. **Using every day and play objects, the child applies a range of strategies to add and subtract quantities involving two single-digit numbers such as counting on to add and counting back to subtract.** **In a range of practical and play contexts the child explores and solves problems involving doubling, halving and sharing, utilising his or her own methods.**	
ELG 12	Shape, space and measures: Children use everyday language to talk about size, weight, capacity, position, distance, time and money to compare quantities and objects and to solve problems. They recognise, create and describe patterns. They explore characteristics of everyday objects and shapes and use mathematical language to describe them.
Explanatory note: The child uses everyday language to share their thinking about size, weight, capacity, position, distance, time and money. **The child demonstrates that they understand that one quantity is different to another even if they do not know the correct comparative term.** **The child is able to recognise and describe patterns and notices them in the environment. The child makes patterns using a range of media and resources.** **The child notices and describes everyday objects and shapes using appropriate mathematical language.**	

(Adapted from Early Years Foundation Stage Profile Handbook, 1213, p: 28)

If we study closely table 3-2, we can see that the main objectives for the foundation year cover the basic concepts (numbers, shapes, spaces, and measures) which children need to deal effectively with their daily life situation and build positive attitudes towards mathematics and see it as part of everyday situations. Also, if we look at the explanatory note, we find that there is an emphasis on presenting mathematics knowledge and concepts as a part of children's everyday language and their surrounding environment. This structured curriculum will need teachers who can translate it successfully into reality. Williams (2008:61) emphasise that "…no matter how good the curriculum, it cannot benefit children in the absence of excellent teaching, which enables them to make as much progress as possible in the subject".

❖ ***The Early Years Mathematics curriculum in Saudi Arabia***

There is no specific mathematics curriculum for the early years of schooling in Saudi Arabia, which opens the door to teachers using personal interpretations – often without educational theories – to teach mathematics. It should also be borne in mind that most educators and teachers are not specialized in the early learning field (Al-Otaibi, 1997). Most pre-schools in SA include the following in their mathematics teaching:

- recognizing numbers (1-20);
- recognizing basic colures; and
- recognizing basic shapes.

However, some private schools also include additional mathematical concepts, such as adding, subtraction, grouping, and understanding and using positional words in their mathematics curriculum.

It could be said that the Ministry of Education and policy makers in Saudi Arabia could develop a standardized mathematics curriculum for the early years stage instead of having general objectives without specific aims. Developing this could improve teaching and learning quality, preparing children to move to the next stage successfully. Having a standardized curriculum could also help teachers to focus on preparing and adopting effective methods to present mathematical concepts to children.

3.6 Teaching Mathematics through Stories

The view that both literature and mathematics help us to organize and give order to the world around us has been supported by several authors. According to Griffiths and Clyne (1988, p: 4), literature and mathematics have some similarity. This can be explained as follows:

> *"One function of mathematics is to order the world around us. So does literature. Mathematics is concerned with classification. So is literature. Mathematics is concerned with problem solving. So is literature. Mathematics looks at relationships. So does literature. Mathematics involves patterns. So does literature. And mathematics and literature both have aesthetic appeal. Without taking this analogy too far, we contend that mathematics and literature have strong links, both in content and structure, and that these links should be explored to make more effective the understanding of both mathematics and literature".*

Moyer (2000) states that when language skills are embedded in meaningful contexts, they are easier and more enjoyable for children to learn. Perhaps as a result of the strong support, since the late 1980s/early 1990s, linking mathematics teaching to children's literature has become an increasingly popular topic of discussion (Clyne and Griffiths, 1991; Elia et al., 2010; Haury, 2001, Hellwig et al, 2000). For example, the National Council of Teachers of Mathematics in the USA (2000) states that numbers and other mathematics operations, when embedded in interesting and meaningful real-world situations, give children the opportunity to make sense of mathematics and to gain mathematical power and Shatzer (2008) highlights the importance of choosing literature that both constructs mathematical meaning and makes connections to children's lives.

The role of communication in helping children to learn mathematics as they develop their mathematical knowledge, as well as creating links between their informal notions and the abstract symbolism of mathematical ideas is supported by the National Council of Teachers of Mathematics (NCTM). “Many children's books present interesting problems and illustrate how other children solve them. Through these books, students see mathematics in a different context while they use reading as a form of communication" (National Council of Teachers of Mathematics, 1989, p: 27).

According to Diakiw, (1990, p: 297), “children’s literature is a powerful medium for understanding the world. Children’s literature adds excitement to learning”. As a result, picture books and other forms of children’s literature, such as songs and poems, have been used mostly to support an integrated approach to the early learning curriculum. Bosma and Guth (1995, p: 7) asserted that literature is the ‘thread that weaves’ the connected curriculum together. Also, reading picture books to children is considered of great significance for their development (Anderson et al., 2005; Heuvel-Panhuizen and Boogaard, 2008). Stories also support creative thinking among children and provide teachers with an insight into their thinking processes (Graham, 2000; Hellwig et al, 2000; Jennings and Terry, 1990), as well as making lessons more relevant (Heuvel-Panhuizen et al., 2009) and helping children to “better understand mathematical ideas and their application to real-world situations” (Whitin, 1992, p:28).

Children's literature, when regularly used in teaching, can contribute to the development of young children's cognitive *and* affective growth (Hong, 1996; Jennings et al., 1992; Moyer, 2000). As a source of support, children’s literature has been used for the social and emotional development of young children for some considerable time (Hong, 1996). It is argued that storybooks provide a sufficient range of situations that relate to daily life experiences that help children learn how to handle conflict, take responsibility, cooperate and help others (Hong, 1996). It has been acknowledged that literature can “motivate children to pose and investigate problems, and communicate their thinking” (Harland 1990, as cited in Elia et al., 2010, p: 277). In addition, it is suggested that stories not only link mathematics to their emotions (Griffiths and Clyne, 1991; Jennings et al., 1992), but also increase their interest (Hong, 1996; Jennings et al., 1992; Murphy, 2000).

In order to produce an integrated approach to the curriculum, efforts have been made to link mathematics with literature. This has provided a more meaningful context for solving mathematical problems (Schiro, 1997, etc). According to Casey et al. (2004), NCTEM in 1989 supported efforts to utilise children's books as a means of introducing mathematical ideas. Ginsburg (1989) proposed that young children gradually develop an intuitive and practical ability in their everyday life which they later will use to good effect and with confidence when solving problems.

The role of stories in human lives is well documented. For example, as human cognition is story based, there is a tendency to think in terms of stories. We understand the world in terms of stories that involve circumstances that are familiar. We learn by living and accepting new stories, and defining ourselves through the stories that we tell (Bruner 1990, 1996; Schank 1990). We "live most of our lives in a world constructed according to the rules and devices of narrative" (Bruner 1996:149), and our lives make greater sense when shaped into a narrative form (MacIntyre, 1984, p: 39). "There have always been stories, even in the earliest of times…it is through stories that we make and share meaning; it is the way we come to know and understand our world. It was that way *then,* and it is that way *now*" (Whitin and Wilde, 1995, p: ix). Smith (1988) cites that the knowledge that we store in the brain as part of our theory of the world is largely in the form of stories, which are far more easily remembered and recalled than sequences of unrelated facts. "…narrative is a natural way in which humans organise information, and storytelling is the most immediate (and fundamental) means by which that narrative is communicated" (Daniel, 2012, p: 3)

Hence, a number of authorities have suggested that children's literature can be utilized in a variety of ways for learning. These include providing a context for an activity with mathematical content; inspiring a creative mathematics experience for children; posing an interesting problem; developing and reviewing a mathematical concept or skill; demonstrating the use of mathematics; and introducing vocabulary associated with mathematical concepts (Griffiths and

Clyne, 1988; Hong, 1996). By incorporating children's storybooks into mathematics teaching, it is possible to include a focus on mathematical problem solving. This can then raise children's awareness of the relationship between mathematics and the imaginative ideas within the storybook, helping them to construct an appropriate view of their world (Burns, 1992; Hong, 1996; Karp, 1994).

In his study of the effectiveness of using children's literature in teaching mathematics, Hong (1996, p: 479) highlighted the importance of two theoretical constructs. "Firstly, research on memory and knowledge representation suggests that young children appear to find it easier to organize their experiences according to scripts rather than hierarchical taxonomic categories. Secondly, narrative forms of knowing develop much earlier than analytic forms of knowing". Seifert (1993) supports this idea by citing research on memory shows that young children often learn more easily when a task is presented in a story format rather than simply as a set of instructions. It has already been established that children learn more effectively with reference to familiar situations, thus using contexts that are meaningful to them (Burner, 1992; Hong, 1996). According to Whiten and Wilde (1992, 1995), literature provides the motivation for students to learn, as well as providing a meaningful context for maths, celebrating maths as a language, demonstrating the development of number sense, and integrating maths into other curriculum areas (Shatzer, 2008). In general, picture books can present children with an informal world of experiences which represents mathematical concepts and structures (Ginsburg and Seo, 1999).

3.6.1 The Importance of Stories as a Vehicle for Presenting Mathematical Concepts

There is a growing number of studies (Heuvel-Panhuizen and Elia, 2012; Hong, 1996; Jennings et al., 1992; O'Neill et al., 2004;) which provide evidence that the use of picture books in the early years of schooling can also contribute to the learning of mathematics. For example, Hong (1996) found that kindergarten learners, in a programme that integrated mathematics-related storybook reading, did better in number combination, classification and shape tasks. Picture book programmes often resulted in a more positive attitude to mathematics (Hong 1996; Jennings et al., 1992). The study by O'Neill et al. (2004) emphasised the relationship between children's early narrative ability and their later mathematics achievement.

Learning mathematics requires an environment that encourages children to think in mathematical terms. There are numerous situations, such as at home, in school, in the playground, and in shops, which support counting and comparing magnitudes, grouping and classification, exploring spatial relations, and recognizing patterns and shapes. Literature, in the form of story and picture books, also provides children with such an environment. In addition, they afford opportunities for problem solving and mathematical reasoning (Schiro, 1997; Whitin, 1992). Griffiths and Clyne (1991) believe in the role of children's literature to provide a model, illustrate a concept, pose a problem, and stimulate an investigation, which contribute to building a clear understanding of mathematical concepts and help children to build positive attitudes towards mathematics. Picture books provide contexts which enable mathematical concepts, patterns, problem solving and real-world contexts to be explored (Moyer, 2000). All these will help children to see mathematics as an important part of their daily experiences and provide them with a familiar structure to explore and apply mathematical ideas (Heuvel-Panhuizen and Boogaard, 2008; Moyer, 2000; Murphy, 2000). Indeed, this could encourage them to believe in the importance of mathematics and help to build confidence in their own mathematical abilities (Whitin, 1992). These observations from a range of authors suggest that picture books are powerful tools in mathematics teaching as they present mathematical concepts in a way that is relevant and meaningful for children, which in turn makes mathematics much easier to present for teachers and to be understood by children. They also provide teachers with an opportunity to support creativity, an essential component of successful teaching, and one which often results in enhanced student interest and achievement in the subject.

One of the founding principles of Realistic Mathematics Education (RME), the Dutch approach to mathematics education, is using a context that makes sense to children (Heuvel-Panhuizen, 2001; Treffers and Beishuizen, 1999). RME sees mathematics as an important part of human experience (Treffers and Beishuizen, 1999), which means that it can also be seen as an important part of the stories told in picture books. For that reason it is believed that the use of picture books is well-suited to this new approach to mathematics education (Heuvel-Panhuizen et al., 2009). Furthermore, children's literature can connect different mathematical ideas in an interesting and meaningful way, and such interconnected ideas enables deeper thinking in children (Elia et al., 2010).

Piaget (1974) claims that "conceptual knowledge stems from the inventive activities of the child, through actions on objects (including mental objects) rather than from transmission derived from teachers or others, and clearly supports the use of picture books for developing conceptual knowledge" (Heuvel-Panhuizen et al., 2009: 37).

As some previous studies have reported, there are a number of advantages in bringing mathematics and literature together. One of these advantages is that children's literature engages children to become actively involved in learning and exploring mathematical ideas (Whitin, 2002), such as using the many mathematics-related questions to interpreting the story events (Lachance, 2002). In this way, teachers move away from teaching by 'telling' to adopting an interactive approach which helps children to be constructivist learners. Another advantage of using stories is that they can present mathematical concepts to children visually (Murphy, 1999), which is considered as particularly supportive for children's understanding of abstract concepts and making these concepts more meaningful (Arnheim, 1993). This is supported by Elia et al.'s (2010) study, as they found that children discovered mathematics-related concepts based on the illustrations in the picture books without any intervention from the researcher. Picture books and stories also contribute to the development of positive attitudes toward mathematics in children. Picture books can demonstrate "the mathematical way of thinking: the triumph of ingenuity over cluelessness, of order over disorder” (Griffiths and Clyne, 1991, p: 42).

A further advantage of using picture books is that a connection can be made between the events in the stories on the one hand, and children’s own lives from the other hand (Columba et al, 2005; Whitin, 2002), as well as between the story events and the real world (Hellwig et al, 2000; Hunsader 2004), and between the story events and other curriculum areas (Griffiths and Clyne 1991; Whitin and Wilde 1992). Additionally, the picture and story events can function as ‘cognitive hooks’ which help children to be able to combine their previous experience and the new knowledge in order to build good understanding (Heuvel-Panhuizen et al., 2009; Lovitt and Clarke, 1992).
Halpern’s study in 1996, regarding the effects of adding explicit mathematical annotations to children’s stories books, found that both children and adults preferred storybooks that contained mathematical connotations than the ones without. This suggests how children’s storybooks containing mathematical concepts connect mathematics with children’s real-life experiences naturally without losing children’s enjoyment about the story events. Hong (1996) stated that “children’s literature can be used as an effective classroom vehicle for motivating children to persist at mathematical tasks and to reason mathematically and to make sense of their real world” (p: 480).

NCTM's Curriculum and Evaluation Standards for School Mathematics support the use of meaningful problem-solving contexts for children. This document states: "When mathematics evolves naturally from problem situations that have meaning to children and are regularly related to their environment, it becomes relevant and helps children link their knowledge to many kinds of situations" (National Council of Teachers of Mathematics, 1989, p: 23). Using stories that build on a problem-solving structure can act as a vehicle to motivate children because these stories mostly deal with situations that are really interesting to children and somehow relate to their experiences.

According to Heuvel-Panhuizen and Boogard (2008), the value of using picture books in the teaching of mathematics is supported by three theoretical perspectives for learning: a constructivist approach to learning, the position of contextualized learning and the importance of learning by interaction which is incorporated in the first two perspectives. All these three theoretical perspectives are important for the learning of mathematics (Elia et al., 2010).

According to the constructivist approach to learning, picture books support an environment in which children are able to construct mathematical knowledge (Elia et al., 2010; Phillips, 1995). From the constructivist approach perspective, children adopt the following steps to process the new information:

- children process the new information by connecting it to prior knowledge and by reflecting on it;
- children develop new ideas and structures, and achieve a higher level of understanding (Heuvel-Panhuizen and Boogaard, 2008).

The concept of constructivism is based on the work of Piaget, who considers the procedure described as indispensable to learning. Constructivism also incorporates a social perspective, based on the sociocultural theory of learning of Vygotsky. This perceives children's acquisition of knowledge as a result of social interaction, which encourages children to communicate knowledge and stimulates reflection (Elia et al., 2010; Ernest, 2000). The view of contextualized learning stresses that learning is influenced by the activity, the content and the culture in which it is developed and used (Elia et al., 2010).

To achieve good quality in teaching mathematics, teachers need to build on the informal knowledge that children have developed, and their teaching should utilise meaningful contexts. Using picture books is considered, by experts, as one of the effective options available to help teachers to achieve the effective and meaningful teaching of mathematics, as it provides the children with an informal world where they can construct the new knowledge.

To conclude then, based on the previous literature, there are significant advantages in using picture books to present and teach mathematics. Using picture books supports learning by:

- helping children to learn mathematics effectively;
- connecting mathematics to children's experiences, real life and other curriculum areas through problem-solving;
- helping children construct knowledge;
- validating abstract concepts;
- increasing children's positive attitudes towards mathematics.

3.7 Key Messages from the Literature Review

The importance of learning mathematics as a discipline and a school subject in the early years of schooling has been the subject of many debates and discussions over the past decades. The role of mathematics in helping children to make sense of the world around them and how their performance in mathematics can be a predictor of future learning and success is highlighted in a range of research literature and official mathematics teaching guidelines of developed countries such as the USA and the UK. In order to learn, use and apply mathematics effectively, it is important to be aware of the different components which interact in the teaching of the subject. These are outlined as facts, skills, concepts, conceptual structures, attitudes to mathematics and appreciation of the subject. A discussion of the various objectives of teaching specific to teaching younger children was presented. These included the importance of providing a variety of experiences, social interaction and a focus on language development. A teaching style which encourages children to experience multiple representation of concepts, learn by making connections to the real world and be involved in problem solving are recommended. It is suggested that such a style should lead to a constructivist approach to learning.

Teachers' subject knowledge, as well as their understanding of pedagogical issues, were described as key to effective teaching along with their own attitudes to mathematics as a subject. Lack of confidence in their subject knowledge, lack of adequate training and their own negative experiences as learners of mathematics may lead to mathematics anxiety, which in turn may impact on their teaching styles and children's learning. The challenge of having to teach mathematics which has no clear curriculum structure either in content or teaching, as is the case in Saudi Arabia where the study was conducted is also highlighted.

The final section of the literature review outlined a teaching approach which uses stories to teach mathematics to young children. A number of features which are listed as desirable in the effective teaching of mathematics to young children are reported to be present in this approach. For example, using stories should help children to relate concepts to the real world, help them with social interaction and language development, develop problem solving skills and support the active construction of mathematical understanding and, at the same time encourage motivation and enjoyment. All the key issues outlined in the literature review are taken into account in the development of the research and informed the intervention and the processes associated with the intervention. These also guide the process of data gathering and analysis as well as the presentation of findings, discussion and conclusions. This is illustrated in figure 3-2:

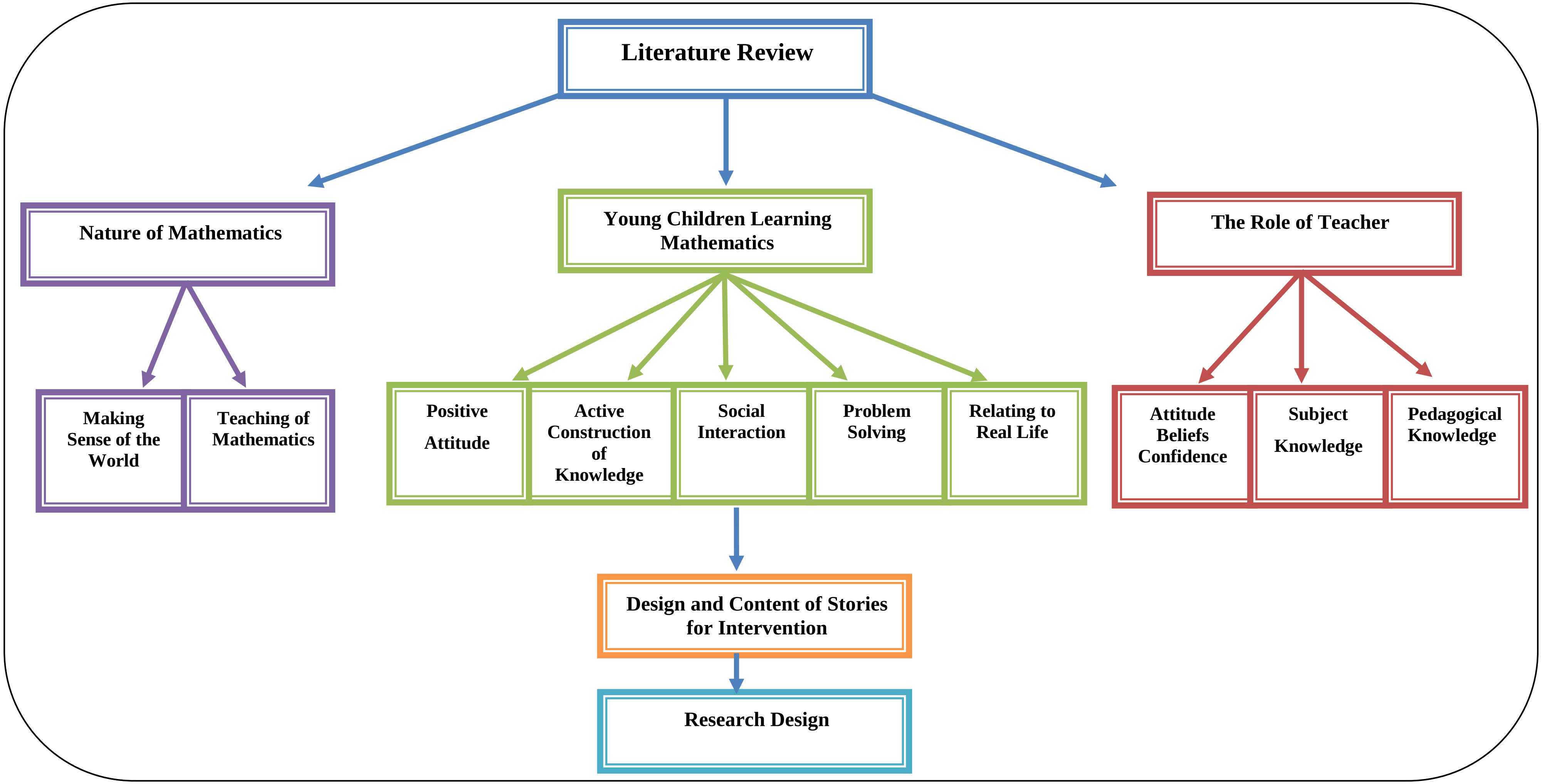


Figure 3-2: Framework for the Design of the Intervention

3.8 Preparing for the Intervention

Key strands from the review of pre-school education undertaken in Chapter Two along with key themes from the review of literature in this chapter were selected to prepare for the study and to shape the design of the intervention. The five stages of preparation and implementation of the intervention are discussed in detail in Chapter 5 but what follows is a reiteration of the central themes that have emerged thus far and how they have been used together to underpin the work with teachers in school.

In Chapter 2 it was established that pre-school settings need to be ‘fit for purpose’ not only in terms of physical space and facilities (Reggio’s ‘third teacher’) but also in terms of the curriculum to be followed. The diversity of provision (settings *and* curriculum) in Saudi Arabian pre-schools works against consistency in the provision of high quality teaching and learning for *all* children as does the lack of appropriate early years training for pre-school teachers. Hence, the need to address the training of pre-school practitioners in Saudi Arabia is informed by the discussion of teachers’ subject knowledge in this chapter. The evidence in the literature review establishes that the relationship between teachers’ mathematics subject knowledge and the effective teaching of mathematics remains problematic despite the significant research attention given to this topic since Shulman’s work in 1986. For the purposes of this study, teachers’ mathematics subject knowledge is classified as three inter-related yet distinct strands:

- academic mathematics subject knowledge (the discipline of mathematics);
- pedagogical knowledge (including the mathematics curriculum and representing key mathematical ideas and concepts);
- teachers’ attitudes, beliefs and confidence

The differences between the academic discipline of mathematics and the school mathematics curriculum were also considered in the literature review and it emerged that the choice of mathematics curriculum content is not as simple as translating the academic discipline of mathematics into the school context. The choice of content is a *reselection* underpinned by value systems and particular purposes (Ernest, 2000a) And so, the review of primary and early years mathematics curriculum policy and practice undertaken in this chapter helped to establish the importance of representing mathematical ideas to young children in an accessible way that supports them in constructing their own understanding. Stories were considered as one vehicle for helping children to talk about, reason, and make sense of mathematical ideas and the literature on integrating stories into the mathematics curriculum has been thoroughly rehearsed in this chapter (pp 116-124). At the same time, stories as a focus for mathematics teaching also became a central vehicle for the CPD intervention: enhancing teachers' pedagogical knowledge; raising their confidence levels and ensuring greater consistency of provision across settings.

The principles for planning the CPD provision were based upon the need to establish consistency of practice across pre-school settings in Saudi Arabia. To this end, it was essential to enhance pre-school teachers' pedagogic knowledge of:

- appropriate pre-school mathematics curriculum content
- ways of representing key facts, skills and concepts
- the importance of using and applying mathematics in the real world
- the usefulness of stories as a context for children's mathematical learning

At the same time, the CPD was planned to ensure that teachers' confidence levels in teaching mathematics were enhanced; their attitudes towards, and beliefs about mathematics were challenged, and that there were opportunities for teachers to discuss their practice.

3.9 Summary

In conclusion, the importance of teaching mathematics to children in the early years of schooling is considered to be a vital stage of a child's development and there is a very broad consensus on the importance of the early years and the need for effective practices in teaching during this stage (Williams, 2008). This importance is acknowledged by many researchers, as mathematics is considered to be an effective tool for interpreting the world, and a necessary part of living in this technological era. Most of the researchers cited in this review stress the importance of presenting new mathematical concepts to children by relating to their previous knowledge, as well as to their everyday life situation which should help them to construct their own knowledge and be able to apply it in different situations effectively. However, it is emphasised that teachers play a crucial role in improving the learning outcomes. Effective pre-service teachers' preparation programmes and in-service training programmes are seen as necessary steps to make sure that teachers gain all the knowledge and skills (such as being aware of learning theories, subject knowledge and pedagogy) to help them to teach children in a meaningful, enjoyable, and effective way. A teaching approach which uses stories to present mathematical concepts to young children has been supported by many researchers. It is suggested that using stories helps teachers to present mathematics in enjoyable and purposeful ways. It is claimed that learning through stories should enable children to better understand mathematical concepts by constructing their own knowledge, relating ideas to real life, becoming skilled problem solvers whilst, at the same time, developing positive attitudes to the subject.

The next chapter will describe the research design and methodology for the study.

Chapter 4: Methodology

4.1 Introduction

Firstly, this chapter revisits the purpose of the study and specifies the aim and two research questions to be addressed. A discussion of the research paradigm and the methodology used in the study is then presented. It also details the sampling, the research tools and the methods of data collection and analysis.

4.2 Purpose of the Study

This study aims to explore the impact of using stories as a strategy for teaching mathematics to young children (age 5-6 years) in Saudi Arabia. As part of the research process, the researcher wrote stories specifically for pre- school teachers to use in their mathematics sessions. Each story aims to help young children (5-6 years old) link mathematical ideas with their daily life experiences and, in so doing, begin to construct their own understanding of mathematical concepts. At the same time, the stories have been designed to promote interactive mathematics teaching and active learning approaches. Specifically, the following **two** research questions are addressed:

- What is the impact of teaching mathematics through fiction stories on pre-school *teacher practices*: subject knowledge, attitude and confidence, and classroom practice?
- What is the impact of teaching mathematics through fiction stories on pre-school children’s *learning*: engagement and enjoyment, understanding, application and thinking skills?

4.3 Methodology

The focus of this study is to understand the impact of introducing the use of story into the mathematics teaching of pre-school teachers in the Kingdom of Saudi Arabia (KSA). Consideration is given to the impact on the teachers and children in three private schools. In relation to the impact on teachers, the study explores teachers' confidence and enjoyment of teaching mathematics, their level of awareness of the importance of mathematics and their level of engagement in the teaching process pre- and post-intervention. At the same time, the study also explores (pre- and post-intervention) the impact on the children's attitudes towards mathematics; their enjoyment of mathematics; their awareness of the importance of mathematics; their thinking skills; their participation in mathematics lessons; their use of mathematical language and their ability to use and apply mathematics. The study also addresses the parental perspectives of a very small group of mothers (n=3).

The stories have been written by the researcher and take into account the need to address the cultural expectations of KSA alongside the mathematical imperative of exploring number and shape and their uses and application in everyday life.

4.3.1 The Research Paradigm

The theoretical perspective or paradigm can be seen as the framework for any research and as the foundation that the researcher's work is based on in order to understand and develop his or her knowledge of the phenomena under study. When any researcher starts to focus on what s/he is trying to find out in research s/he has to start to think about which paradigm should be adopted. Punch gives the following definition of paradigm:

> *" A set of assumptions about the social world,* and about what *constitutes proper techniques and topics for inquiring into that world; a set of basic beliefs, a world-view, a view of how science should be done (ontology, epistemology, methodology)".* (Punch, 2009, p 358)

Creswell (2009) chooses to call it *world view* instead of paradigms, epistemologies and ontologies, or other broadly conceived research methodologies whilst MacNaughton et al. (2007) defined paradigms as a way to see the world and organise it into a coherent whole - functioning in exactly the same way as a frame for a picture. So the choice of paradigm influences the exploration of the research topic. There are many different types of paradigm, for example, positivism, interpretative, constructivism, and pragmatic. Each one of these paradigms has a different way to see and frame knowledge in an attempt to understand it: different paradigms give us different perspectives on the world. MacNaughton provides the following clarification, *"each paradigm is a specific collection of beliefs about knowledge and about our relationships with knowledge, together with practices based upon those beliefs*" (MacNaughton *et al*., 2007, p: 32).

The researcher must be clear about the paradigm that s/he chooses to adopt because the phenomenon under study will be seen through that paradigm and the researcher will subsequently use the paradigm to try to explain and give meaning to the phenomenon.

In terms of ontology, my view is that the nature of reality is subjective and complex, particularly as I am interested in understanding the perceptions of the participants in the actual context. Epistemologically, I believe that in order to explore the impact of change in teachers' practice, the researcher (myself) needs to interact with the participants in order to gain insights into their perspectives including issues and concerns. Making sense of the views of the teachers, children and parents will enable me to understand the impact of using stories in maths teaching. The ontological and epistemological underpinnings of this study are revisited during the discussion of the research design and more specifically, the conceptual framework of the research design in section 4.3.3.1.2.

4.3.2 Methods of Inquiry

Educational researchers adopt different methodologies to achieve their research objectives and to reflect different research paradigms. Denzin and Lincoln (2000) identify two main methodological approaches: quantitative and qualitative which Creswell (2003) has categorised as research design of three distinct groups:

- Quantitative designs, focusing on testing theory and hypotheses.
- Qualitative designs, focusing on developing theory and generating knowledge.
- Mixed designs, which combine or mix the two designs.

It should be noted that the choice of research design depends not just on the type of study but also on its setting and goals. The design that is selected determines the strategy which will include the methods of data collection and the tools to use for data analysis.

There are advantages and disadvantages to both quantitative and qualitative approaches. According to Bulmer (1988, p: 160), "*different investigations may have different preferences and lean in one direction or another, but there are no general principles which can be adduced in favour of one or another style of research*". The two research methods, therefore, can be said to complement each other (see Table 4-1 and Table 4-2 for a comparison of each approach).

The methodology used in this study involves an interpretative approach to its subject matter (Cohen et al., 2007). Interpretative inquiry is sometimes referred to as qualitative or naturalistic inquiry (Lincoln and Guba, 1985). Qualitative research is concerned with studying a process and is generally used only when the researcher intends to gain in-depth knowledge of specific cases in order to understand how different factors piece together to influence the occurrence of the phenomena within each case. By studying only a small number of cases, the researcher can record all that takes place within each case. This approach would not be possible for exploring a larger number of cases. When studying many cases, the researcher is likely to be faced with unmanageable complexity (Ragin, 1987). Creswell (1994, p: 1) defines qualitative study as

> "*an inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words reporting detailed views of informants, and conducted in a natural setting".*

Edson (1988, p: 46) highlights the importance of context in qualitative research, *"qualitative research is context-specific, that is, it posits that ideas, people and events cannot be understood if isolated from their contexts."*

Conversely, the quantitative method, is often selected when researchers wish to generalise findings across different cases and situations. It is theory-oriented and its main concern is the assessment of the correspondence between relationships discernible across many cases and a broad theoretically-based interpretation of social phenomena. According to Ragin (1987, p: 2), investigators who use this approach focus their interest on testing hypotheses and propositions derived from theory. Thus, Creswell (1994, P: 1) defines the quantitative study as

> "*an enquiry into a social or human problem based on testing a theory composed of variables, measured with numbers, and analysed with statistical procedures in order to determine whether the predictive generalization of the theory holds".*

Qualitative research expresses the process and meaning of the data collected, whereas quantitative research experimentally examines the data collected in terms of quantity, amount and frequency (Denzin and Lincoln, 2000). Qualitative research is associated with non-mathematical analysis, resulting from data collected through interviews, conversations, books, articles and recordings, while the quantitative research focuses primarily on statistical numerical expressions (Creswell, 2003).

The objective of qualitative research is to understand and interpret social phenomena in a real life context and to consider people's reactions (Denzin and Lincoln, 2000). Quantitative research investigates common patterns in the targeted population statistically and mathematically, and tries to explain cause-and-effect relationships (Creswell, 2003). Most researchers recommend a multiple methods approach (Bickman and Rog, 1998; Creswell 2003) which helps to establish greater confidence in the results. Table 4-1 compares the quantitative and qualitative research approaches and Table 4-2 illustrates their advantages and disadvantages.

Table 4-1: Differences between Quantitative and Qualitative Research Approaches

Qualitative Research	Quantitative Research
• **Objective is to discover and summarize meanings once the researcher becomes wrapped up in the data.**	• Objective to test hypotheses that the researcher generates.
• **Concepts tend to be in the form of themes, patterns, generalizations, and taxonomies. However, the objective is still to generate concepts.**	• Concepts in the form of different variables.
• **Measures are more specific to the individual setting or researcher.**	• Measures are systematically created before data collection and standardized as far as possible.
• **Data are in the form of words from documents, observations, and transcripts. However, quantification is still used.**	• Data are in the form of numbers from accurate measurement.
• **Theory can be fundamental or non-fundamental, and is often inductive.**	• Theory is largely fundamental and is deductive.
• **Research procedures are particular and replication is difficult.**	• Procedures are standard and replication is assumed.
• **Analysis proceeds by extracting themes or generalizations from evidence and organizing data to present a coherent, consistent picture. These generalizations can then be used to generate hypotheses.**	• Analysis proceeds by using statistics, tables, or charts, and discussing how they relate to hypotheses.

Source: Adapted from Neuman (2000)

Table 4-2: Advantages and Disadvantages of Quantitative and Qualitative Research

Advantage of Quantitative Research	Disadvantage of Quantitative Research
• **Methods allow more accurate measure of variables** • **Methods are structures or standard** • **Statistical analysis** • **Generalizations are possible**	• Use of inflexible methods • Deterministic character • Disregard of some important factors • Miss subjective aspects of human existence • Assumption of an 'objective' truth • Generation of incomplete understanding • Inapplicable to some immeasurable phenomena
Advantage of Qualitative Research	**Disadvantage of Qualitative Research**
• **Methods enhance description/theory development** • **Describe theories and experience** • **Allow deep understanding and insight** • **Holistic and humanistic** • **Flexible methods** • **Value placed on participants' views and empowering participants** • **Subjective dimensions are explored**	• No hard data, no clear measuring • Subjective 'non-scientific' • Deep involvement of researchers increases risk of bias • Small samples • Generalization is limited to similar contexts and conditions

Source: Adapted from Neuman (2000)

Close inspection of the definitions as well as the advantages and disadvantages of the qualitative and quantitative approaches as outlined in Tables 4-1 and 4-2 indicated that a qualitative methodology was most appropriate for this study which focuses on exploring the reality of teaching mathematics to young children in the context of Saudi Arabian pre-schools. Numerical analysis would not have been supportive in my quest to analyse and look deeply at how teachers presented mathematical concepts to children; how teaching through stories helps to improve the teaching process and outcomes for children, and how the use of stories helps to enhance teachers' confidence in their mathematics teaching. At the same time, close consideration is given to the impact of the change in teaching practices and on children's enjoyment and achievements in mathematics. In other words, my overarching aim is to understand some of the complexities of pre-school mathematics teaching and learning *before* and *after* the use of stories and, as Ernest (1994, p: 25-26) identifies, "*the aim of the interpretative research paradigm is to explore in all its richness a particular which can serve as a paradigm or exemplar, illustrative of something much more general.*"

4.3.3 The Research Design

The research process involves identifying the main focus of the research and associated research questions. The researcher then has to consider the right approach, paradigm, strategy and methods that s/he will need to follow in order to address the research questions. This is a called a research design, and Punch explained it in the following way.

> "*The research design is the basic plan for a piece of research, and includes four main ideas. The first is the strategy. The second is the conceptual framework. The third is the question of who or what will be studied. The fourth concerns the tools and procedures to be used for collecting and analysing empirical materials.*" (Punch, 2009, p: 11)

In order to carry out this study, I adopted a qualitative, interpretive, constructivist technical action research approach. I used questionnaires (with teachers), interviews (with teachers, children, and parents) and observation in the classroom (maths lessons and play sessions) as tools to collect my data.

4.3.3.1 Research Design: Strategy

The research strategy establishes the key ideas and reasons that will guide the research process and procedures. It will encompass the decisions made from broad assumptions and direct these towards the detailed methods of data collection and analysis that will be used to achieve the objectives of the research. "*At the centre of the design of a study is its logic or rationale - the reasoning, or the set of ideas by which the study intends to proceed in order to answer its research questions*" (Punch, 2009, p: 113). Any such decisions will need to be taken methodically in order to ensure that the project follows a logical sequence. The research strategy is important because "*it drives the design or, put another way, behind the design lies a logical rationale for answering the research questions - this is the strategy*" (Punch, 2009). According to Cresswell (2009) the selection of the research design should "*be based on the nature of the study problem being addressed, the researcher's experience and the audiences of the study*". Furthermore, Punch (2009) proposes the significance of the extent of researcher involvement in manipulating the research situation. In other words,

> "*to what extent will the researcher intervene in the research situation, contriving it and constructing it for research purposes, as against studying it as it occurs? Qualitative research design is generally non-interventionist. Quantitative research design can vary from extremely interventionist to non-interventionist."* (p :113).

4.3.3.1.1 Using Action Research as a Research Strategy

Holly and Whitehead (1986) highlight the scope and usefulness of action research as it can be used in a wide variety of settings where a problem exists involving people, tasks and procedures. Action research identifies a focus for change and subsequently provides insights into the implementation of change as well as supporting and reviewing the change. Cohen et al. (2007) consider that action research is particularly useful in educational settings for individual teachers, groups of teachers or a school in general, with teachers and researchers working alongside one another. It is the "*combination of **action** and **research** [that] has contributed to its attraction to researchers, teachers and the academic and educational community alike".* Cohen et al. (2007, p: 298) provide examples of a range of ways that action research can be used in schools:

- *teaching methods*: replacing a traditional method by a discovery method;
- *learning strategies*: adopting an integrated approach to learning in preference to a single-subject style of teaching and learning;
- *evaluative procedures*: improving one's methods of continuous assessment;
- *attitudes and values*: encouraging more positive attitudes to work, or modifying pupils' value systems with regard to some aspect of life;

- *continuing professional development of teachers*: improving teaching skills, developing new methods of learning, increasing powers of analysis, of heightening self-awareness;
- *management and control:* the gradual introduction of the techniques of behaviour modification;
- *administration:* increasing the efficiency of some aspect of the administrative side of school life.

Since the main objective of this study was to consider the impact of a particular teaching method in order to enhance teachers' practice and lead to improvements in the teaching process itself (and therefore the teaching outcomes) it was felt that an action research approach would be a suitable strategy for this study.
In the following section, I will give a brief overview of action research and justify its application to this study.

4.3.3.1.1.1 Definition of Action Research

The term *action research* refers to practical ways of looking at existing working methods to determine their effectiveness. When action research is carried out by someone directly involved in the practices under review, it is often referred to as *practitioner-based research* and because it involves consideration of the researcher's own methods, it is often thought of as a form of *self-reflective* practice.
In traditional (or empirical) research, researchers investigate the actions and behaviours of other people and their lives. In action research, the research is carried out on the researchers themselves. The researcher reflects on aspects of their own life and work, involving questions concerning how and why things are done in a certain way. An action research report shows how things have been carried out and the reasons behind such actions. It will identify the processes that have been undertaken in an attempt to gain a fuller understanding of the researcher's self, allowing this to be used to further develop and improve personally and at work.

Action research has been described as *"a form of self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own practices, their understanding of these practices, and the situation in which the practices are carried out"* (Carr and Kemmis, 1986, p: 162). This definition combines the personal and political dimensions of action research (Noffke, 1997) showing that it focuses attention on classroom practice and the ways in which this practice reflects societal inadequacies. Arhar and Buck (2000, p:336) identify that in educational contexts, "*action research is a special form of research that may be carried out by teachers who are not only interested in* ***understanding****, but in* ***changi****ng their teaching to make it more in line with their values".* Thus, the *action* arising from systematic enquiry during action research is a crucial element, and distinguishes it from other forms of practitioner inquiry such as self-study research (Loughran and Russell, 2002; McNiff and Whitehead, 2006).

Action research is a more open-ended research approach – it is not based on any form of fixed hypothesis. Instead, it is formed from an initial idea that can be developed. The research process relies on the refinement of the initial idea to establish how effective it will be when reviewed against the intended aims of the idea and therefore, can be viewed as a type of self-evaluation process. This approach can be utilised in a work environment as part of an appraisal, self-assessment or mentoring system.

The key stages that form an action research plan are:

- Review of current practice
- Identification of the areas which are to be investigated
- Devise an intended plan of action towards a goal
- Implementation of a new idea
- Evaluation of outcomes
- Amend practice as a result of evaluation (Cohen et al, 2007, p: 305)

Once these stages have been implemented it is necessary to make appropriate changes in view of the observed outcomes and amend the process accordingly.

This will involve trying new practices to improve areas where progress has not been effectively achieved. These will, once again, be monitored and reviewed as part of an improved action research cycle.

Many models of action research have been reviewed in the literature. The majority of these regard practice as non-linear since people are often unpredictable and their actions do not always follow anticipated paths (McNiff, et al., 1996). In this respect, there are two main processes involved. These are the systematic actions that are taken and the learning processes experienced by the subject. Actions embody learning, and learning is informed by reflection on the actions taken. Thus, when the research results are made public it is necessary to state the actions of the research as well as the learning involved. Focusing only on actions and procedures will tend to lower the validity of the research.

The action research cycle generally evolves into other new action research cycles as new areas for investigation appear. Therefore, the whole process consists of a series of cycles all aimed at improving existing practice: one issue forms the foundation for the next, and as one question is answered, it may generate further research questions.

4.3.3.1.1.2 Types of Action Research

The concept of action research has been used to describe a related group of research methodologies that have shared aims including an emphasis on personal reflection. It has also been claimed that action research can lead to greater social justice for disempowered groups (McNiff,, 2013). Action research methodologies incorporate such approaches as developmental action research, practitioner research, participatory action research, collaborative inquiry, emancipatory research, action science, classroom action research, action learning, and critical action research (Noffke, 1997). It has been described as "*a form of self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own practices, their understanding of these* *practices, and the situation in which the practices are carried out*" (Carr and Kemmis, 1986, p: 162).

Carr and Kemmis (1986) propose three types of action research:

- *Technical* action research involves the development of *"efficient and effective practice, judged by reference to criteria which may not themselves be analysed in the course of the action research process"* (Carr and Kemmis, 1986, p: 202). This means that a technical action research project is developed not by the practitioners themselves but more by the others. It is often initiated by outside facilitators (Judah and Richardson, 2006). It may also be viewed as *"a type of research used for research purposes"* (Robertson, 2000). Thus, it does have a number of advantages as it may produce changes in practice and may support practitioners in the development of their capacity as researchers. However, it may not always be collaborative, which is an important quality for some (Carr and Kemmis, 1986).

- *Practical* action research takes place if the outside facilitators join together to form cooperative unions with practitioners, *"helping them to articulate their own concerns, plan strategic action for change, monitor the problems and effects of changes, and reflect on the value and consequences of the changes actually achieved"* (Carr and Kemmis, 1986, p: 203). This type of action research can be viewed as "action research for action purposes" (Robertson, 2000, p: 307). This is collaborative but it may not create "a self-reflective community" (Carr and Kemmis, 1986, p: 203) which is an important element as self-reflection is able to consider the practices and functions of education on a wider scale.

- The third type of action research is *emancipatory* action research. In this case, *"the practitioner group takes joint responsibility for the development of practice, understandings and situations, and sees these as socially-*

constructed in the interactive processes of educational life" (p: 203). It focuses on self-reflection through the development of a "self-critical and self-reflective community" (Carr and Kemmis, 1986, p: 205). As a tool for teachers to challenge the status of their own profession and educational practices, it has been recognised by Carr and Kemmis (1986) as a means of working together towards common goals. Emancipatory action research seeks to improve practice, the understanding of practice and the context in which it takes place. It also involves all those who are affected by these practices (Carr and Kemmis, 1986).

The type of action research used for this study is *technical action research*, where as the researcher, I am the outsider working with groups of teachers, helping them to identify and understand their own concerns. As a research approach it allows teachers to plan strategic action for change such as using stories to present mathematics; identify the problems and effects of any changes, and evaluate the effects of the changes made. The approach that I took also included some elements of the practical and emancipatory types of action research.

I was aware of the cautionary words from Carr and Kemmis (1986) that when outside facilitators work on teacher projects they may create circumstances whereby the control of the project does not remain with the teachers. To avoid the risk of being *inauthentic* (Carr and Kemmis 1986) for the practitioners involved, I continually consulted the teachers and sought their views so that any changes in their practices would be the result of greater understanding of the issues and more reflection on their existing practices.

4.3.3.1.1.3 Advantages of Using Action Research

Action research in the field of education has many advantages over other forms of research. McNiff (2013) describes it in the form of an underlying intent to help` people on a number of different levels. These include, among others: a decision to investigate what is being done with a view to improving it; an attempt to understand the situation more fully; and a change to the way of working in light of perceptions obtained; knowledge from colleagues, and knowledge for them.

Many of the advantages of Action research that Koshy (2010) identifies encouraged me to adopt action research as a methodology:

- Research can be set within a specific context or situation.
- Researchers can be participants – they don't have to be distant and detached from the situation.
- The process involves continuous evaluation, and modifications can be made as the project progresses.
- There are opportunities for theory to emerge from the research rather than always following a previously formulated theory.
- The study can lead to open-ended outcomes.
- Through action research, a researcher can bring a story to life.

In the education environment, Newton and Burgess (2008) suggest that there is a preference for research that is directly related to practice, and the outcomes of which provide clearly defined benefits to those involved. Brown and Jones (2001) comment on action research to pinpoint the critical nature of such an approach which,

> "*…has the potential to lead not to the unlocking of complexity but to the elucidation of rigid preconceptions which serve only to confirm injustices of the "found" world. Hitherto, action research has assumed a reality which can be uncovered and then altered in some way or improved upon for emancipatory purposes. This, however, begs key questions about where our ideas of what counts as "improvement" come from. How can the researcher both "observe" reality as well as being part of it and thus be implicated in its continual creation and recreation? These issues are much more complex than action research has acknowledged so far". (p:5)*

Feldman (2007, p: 24), suggests that

> "*there is much that is in an action research report that we can accept based on criteria such as credibility, persuasiveness and verisimilitude, but there are other claims, such as how and what to teach, for which I, for one, would like to see some evidence that it is an accurate representation".*

Action research, in all its variations, aims to improve practice and effect change, hence it provides a 'best fit' strategy for this study which explores the impact of change in teaching mathematics to pre-school children. Moreover, the technical action research approach most closely fits the researcher's intentions to investigate the impact of using stories to teach mathematics to pre-school children by considering teachers' practices and the impact on children's learning. Technical research is also viewed as a *type of research used for research purposes* Thus, it does produce changes in this research practice and support practitioners in the development of their capacity as researchers.

4.3.3.1.2 The Research Design: Conceptual Framework

Constructivism was the epistemology chosen as appropriate for this study thus fitting within the qualitative method of inquiry. This represents the theoretical position which best suits both practice and method. Qualitative researchers are particularly in favour of constructivism, which involves an interpretative, naturalistic approach to the world (Cohen et al., 2007; Crotty 1998). Issues regarding ontology and epistemology are seen to merge together and this convergence occurs in *construction of meaning* which refers to construction of meaningful reality. Realism is the ontological assumption, with reality being the product of individual consciousness in line with a theoretical approach that views knowledge as actively constructed. This supports the ontological position of being able to understand the world through interpretation by adopting an approach that is both exploratory and interpretive. Crotty (1998) also emphasizes that realism is an ontological notion implying that meaning exists outside the subjects and they need to engage in the world in order to make meaningful reality, (Crotty, 1998). Denzin and Lincoln (2000) state that the constructivist paradigm assumes a relativist ontology with multiple realities. This is known as subjectivist epistemology. There is the knower and the respondent, and understandings within the naturalistic methodological procedure. Green (1978), as cited in Bogdan and Biklen (2003), also emphasizes "*that multiple ways of interpreting experiences are available to each of us through interacting with others and it is the meaning* *of our experiences that constitutes reality" (*p: 23). Berger and Lukmann (1967), as cited in Bogdan and Biklen (2003), affirm that reality consequently is socially constructed, (p.23). Cresswell (2009) suggests a world view of constructivism that is composed of four main elements: understanding, multiple participant meanings, social and historic construction, and theory generation.

In the context of positivism, post-positivism, structural and post-structural constructivism is an epistemological position which makes meaning through the process of constructing knowledge in the world (context) we are interpreting (Crotty, 1998, p: 27). As Merleau Ponty wrote; *"the world and objects are undefined, they can be pregnant with potential meaning but actual meanings are constructed by human beings as they engage with the world they are interpreting"* (Crotty, 1998, p:43). The data collected from the participants (teachers, children, parents) at the three schools in this study were analysed and themes noted. These were essential in the generation of meaning for the study and provided a basis for the generation of the findings from the study.

A constructivist approach was used to investigate each participant's experiences. This involved exploring the way that the teachers viewed mathematics and adapted their teaching methods in mathematics lessons and also how the children subsequently used the mathematical knowledge. It was an empirical study because it took place within different school settings and was based on the collection of empirical material centred on the use of stories to improve the teaching process and the teaching outcome. Teachers were provided with opportunities (questionnaire and interview) to share their ways of viewing and teaching mathematics. At the same time, the children were provided with the opportunity to talk about their ways of viewing mathematics. This enabled me to understand the meanings constructed in particular contexts. As a researcher, I needed to see things through my participants' eyes to build a good and clear understanding of the phenomena under study.

Constructivism is the epistemological position of making meaning through the process of construction of knowledge as we engage in the world we are interpreting, (Robson, 2002). Interaction with the participants (teachers, children, and parents) in different school settings in Saudi Arabia provided the data which was later analysed to unravel the meaning of the phenomena of participants' experiences as expressed within the questionnaires and interviews, as well as observations from the different research settings.

4.3.3.1.3 The Research Design: the Research Sample

The sample used in this study comprises three schools, 10 teachers, 50 children and 3 parents. The style of this research is partly determined by the sample size. The theoretical basis of the sampling method chosen was 'purposive sampling' (Silverman, 2000). This is a non-probabilistic procedure but has the disadvantage that the findings cannot be generalised to a wider population because of the lack of representativeness. When using this type of sampling, researchers select the individuals to be included in the sample on the basis of their judgement and the typical nature of the cases. By doing so, it is possible to build up a sample that satisfactorily suits the specific needs of the research (Cohen *et al.*, 2000, p: 103). As stated by Denzin and Lincoln (2000), Silverman (2000) and Robson (2002), purposive sampling allows the researcher to choose a case in which s/he is interested. Therefore, I have chosen purposive sampling because of the time and resource limitations. I was trying to research an area in Saudi Arabia which still needed exploring; I expected to obtain meaningful data that would underpin further research in the future. Denzin and Lincoln (2000, p: 370) also state that "*many qualitative researchers employ purposive, and not random, sampling methods. They seek out groups, settings and individuals where … the purposes being studied are most likely to occur".*

I decided to conduct this study in private well-known schools in the city as these schools are:

- always seeking new ideas to adapt and they are open to change;
- considered as training centres for other private schools, which means if they adopt a new method then the other schools are more likely to adopt it as well;
- the schools have a large number of teachers, which means that there will be an acceptable number of teachers in one school for the research.

As an in depth investigation, the sample did not include a large number of participants: 10 pre-school teachers, 50 children, who were enrolled in the third kindergarten level (KG3), and 3 mothers. They were from the three chosen private pre-school in Jeddah City in KSA: 3 teachers, 14 children, and 2 mothers from school A, 2 teachers and 21 children from school B, and 5 teachers, 15 children, and 1 mother from school B.

Table 4-3: Research Sample

Label of School	Number of Teachers	Number of Children	Number of Mothers
A	3	14	2
B	2	21	________
C	5	15	1

4.3.3.1.4 The Research Design: Research Tools

Once the nature of the data required has been established, it is necessary to decide the most appropriate way of collecting the required information, within the scope of the selected research methodology and the theoretical framework (Yin, 2008). Sapsford and Jupp (2006) indicate that there is no single best way for data collection. However, the method selected depends on the nature of the research question and any other specific questions that need to be asked in order for the researcher to obtain valid and reliable data during their data collection.

While the decision to use technical action research was a relatively straightforward one, subsequently thinking about which research tools to incorporate into the action research remained much more complicated. To address the issue of validity, I used triangulation. Triangulation may be defined as the use of two or more methods of data collection in the study of an aspect of human behaviour (Cohen et al., 2007). What Yin (2008) and Robson (2002) agree upon is that procedures such as triangulation, reflexivity, and peer debriefing can be used to improve the reliability and validity of qualitative research. Law explains that the "*key to triangulation is to see the same thing from different perspectives and thus to be able to confirm or challenge the findings of one method with those of another'* (Bell, 2005 p: 116) or, as put by Scott and Morrison (2006), to *"provide a more holistic and rich account of that phenomenon"* (p: 252). Yin (2008) suggests that in order to ensure construct validity in a case study it is necessary to use multiple sources of evidence.

The three aspects of triangulation in this study are the questionnaire (teachers only), the interviews with teachers, children, and parents' pre-and post-intervention, and a classroom observation checklist. Different methods of data collection view situations from different angles according to the scope and limitations of the tools employed to collect the data. This enables comparisons and contrasts to be made. By using multiple methods, the researcher is able to "*to understand the topic in a more rounded and complete fashion than would be the case had the data been drawn from just one method"* (Denscombe, 2005, p: 132).

4.3.3.1.4.1 Designing the Questionnaire

Questionnaires are one type of data collection method that can be used in either qualitative or quantitative research. The use of questionnaires at the beginning of a study can prove very useful as they are able to gather a range of information with relative ease which can then be examined in detail when necessary (Koshy, 2010).

When the researcher needs to collect the data quickly and easily the questionnaire is a suitable tool for that purpose.

I started my data collection by using a biographical questionnaire with the teachers. The questionnaire was not one of my main data collection methods but it enabled me to collect background and baseline information quite easily to provide information that could then be followed up. Additionally, questionnaires are suitable for collecting initial information on attitude and perceptions. (Koshy, 2010)

In relation to my own study, I chose to use a number of items in the questionnaire with the teachers in order to:

- collect background information about teachers' careers and professional development;
- establish a non-threatening rapport with the teachers and to make them feel relaxed;
- inform and save time during the subsequent interviews as all the necessary background information would have already been logged.

I used closed questions in my questionnaire in order to elicit factual background information, for example, gathering information on the teachers' qualifications, years of teaching experience and how they were trained. (See appendix B.) The questionnaire was given to the teachers at the first formal introductory meeting with them. Ten teachers completed this questionnaire; three from school A, two from school B, and five from school C.

4.3.3.1.4.2 Designing the Interviews

Conducting semi-structured interviews was one of the main data collection methods employed in this study and, as such, is representative of the most significant data collection tool in qualitative research. Interviews provide an effective way of exploring people's perceptions, meaning, definitions of situations and constructions of reality. They are one of the most powerful ways available for understanding others. Jones (1985, p: 46) suggests that:

> *In order to understand other persons' constructions of reality, we would do well to ask them…and to ask them in such a way that they can tell us in their terms (rather than those imposed rigidly and priori by ourselves) and in a depth which addresses the rich context that is the substance of their meaning.*

According to Burns (2000, p: 467), interviews in case study research *"are essential, as most case studies are about people and their activities."* Similarly, there are arguments that support the use of interviews in qualitative research in general. For instance, Cohen et al. (2007, p: 349) argue that:

> *The interview is a flexible tool for data collection, enabling multi-sensory channels to be used: verbal, non-verbal, spoken and heard. The order of the interview may be controlled while still giving space for spontaneity, and the interviewer can press not only for complete answers but also for responses about complex and deep issues. In short, the interview is a powerful implement for researchers.*

There are different types of interviews: structured interviews (where all the respondents receive the same questions in the same order), unstructured interviews (where the interview questions and response categories are not pre-established (Punch, 2009), and those in the middle of these two which are the semi-structured (where the researcher prepares a set of questions but also prepares a set of sub-questions which can be used to probe ideas further and gather more information) (Koshy, 2010).

Although conducting interviews is a useful method to collect data, it has some limitations including the following:

- Conducting interviews is more time-consuming compared to using questionnaires.
- Typing the interview transcripts requires a significant amount of time.
- When dealing with children in research, interviewing may not always be a suitable method to use because they are not confident speakers and with language problems
- Video or tape recording may intimidate some students.
- The interviewer's presence may make interviewees nervous and bias any responses.

- The interviewer's presence may cause children to tell you what they think you want to hear. (Koshy,2010)

In order to design the interviews for the teachers, children and parents in this study, I returned to my main research objective and research questions many times to highlight the information and data that I needed to gather during my research. Semi-structured interviews were chosen as they represent a common form of qualitative method that allows the researcher the flexibility to adapt to the individual needs of the interviewee (Bell, 1999). Since the main emphasis of case studies is to give a 'voice' to the people in the case (Scott and Morrison, 2006), semi-structured interviews are particularly suitable because they allow the interviewee to articulate personal feelings about the topic and permit the interviewer to gain an in-depth understanding.

For this study, questions with 'purpose' were designed, aimed at inviting the interviewees' reflection and encouraging them to reveal their perceptions about the use of stories in teaching mathematics. Interviews were constructed for the three different groups (teachers, children and parents) and each will be explored in the following sections.

4.3.3.1.4.2.1 Teachers' Interview

The aim of the teachers' interviews was to determine teachers' beliefs and perceptions in relation to children's learning in general, and of mathematics in particular. By gaining an understanding of their beliefs, it would be possible to support the validity of the study outcomes with evidence of pedagogical approaches.

There were two interviews with the teachers: pre-intervention (exploring the teachers current way of teaching mathematics) and post-intervention (after the teachers had used the stories in their mathematics teaching) In order to develop the interview schedule, I referred back to the research questions and identified the key data that needed to be collected in order to address the research focus. The questions were then designed to elicit insights into the teachers' thinking about mathematics teaching and whether the use of stories in their mathematics teaching had any impact on their thinking. The interview questions were informed by established literature in the field alongside the main aim of the research. The interview was designed with four sections in order to pursue the:

- teachers' background and experience;
- teachers' philosophy of education (learning and teaching young children);
- teachers' practices and beliefs about teaching maths; and
- teachers' beliefs about the use of story in teaching.

Interview questions included consideration of the teachers' feelings about being pre-school teachers; their belief about the importance of this stage for preparing children for the next stage of schooling; the teaching approach they used; how they taught the mathematics sessions; the maths curriculum used in school; the resources used to present maths, and the use of stories. (See appendix B)

Once the interview was completed, the next important step was the translation of the interview questions into Arabic. The questions were given to a translator to be converted from English into Arabic. In order to ensure that this translation was correct and clear, a third person translated the Arabic copy into English again to find out if it had retained the original meaning.

Seeking reliability, I adopted the same organisational procedures to make sure that all the teachers were exposed to the same process in each school. In School A, all the interviews took place with each of the three teachers in the secretary's office. In School B, the interviews with each of the two teachers took place in a spare empty classroom. In School C, the interviews with each of the five teachers took place in the teachers' meeting room. All of the interviews were conducted during normal school hours.

At the outset of each interview, the teachers were reminded of the aim of the research, and assurance was given that all the information generated from the interview would be treated in confidence and used for research purposes only, and the identities of the teachers and the schools would be kept anonymous. As a participant, each teacher had the right to withdraw from the study at any time during the interview. Various interviewing strategies were used throughout the interviews including silence, repeating or rewording the questions as prompts and probes in order to clarify any information that was unclear. On occasions a summary of the interviewee's thoughts was made to confirm the views expressed. On completion of the interview, the interviewees were also given an opportunity to raise any additional points which were felt to be important.

Table 4-4 summarises all the information about the pre-intervention interviews, including the number of teachers, the duration, and the place where the interviews took place.

Table 4-4: Pre- implementation Teachers' Interviews

Teacher's Number	Teacher Qualification	Teacher Experience in years	Label of School	Duration of the interview (minutes)	Place of the interview
1	High school	11	A	43	Secretary's office
2	Bachelor degree in art	7	A	35	Secretary's office
3	Diploma in early learning	13	A	45	Secretary's office
4	Bachelor in early learning	5	B	40	Teacher's classroom
5	High school	9	B	40	Teacher's classroom
6	Diploma in early learning	16	C	65	Teachers' meeting room
7	Bachelor in agriculture engineering	11	C	40	Teachers' meeting room
8	Bachelor in early learning	7	C	40	Teachers' meeting room
9	Diploma in computer	19	C	45	Teachers' meeting room
10	High school	10	C	36	Teachers' meeting room

Table 4-5 illustrates all the information about the post-intervention interviews, including the number of teachers, the duration, and the place where the interviews took place.

Table 4-5: Post- implementation Teachers' Interviews

Teacher's Number	Teacher Qualification	Teacher Experience in Years	Label of School	Duration of the interview (minutes)	Place of the Interview
1	High school	11	A	30	Secretary's office
2	Bachelor degree in art	7	A	35	Secretary's office
3	Diploma in early learning	13	A	40	Secretary's office
4	Bachelor in early learning	5	B	35	Teacher's classroom
5	High school	9	B	45	Teacher's classroom
6	Diploma in early learning	16	C	30	Teachers' meeting room
7	Bachelor in agriculture engineering	11	C	28	Teachers' meeting room
8	Bachelor in early learning	7	C	30	Teachers' meeting room
9	Diploma in computer	19	C	35	Teachers' meeting room
10	High school	10	C	29	Teachers' meeting room

4.3.3.1.4.2.2 Children's Interview

The main purpose of the children's interview was to find out whether the teachers' use of stories in the mathematics sessions had had any impact on the children's engagement with mathematics. More specifically, whether there was any impact on the children's ability to see mathematical concepts around them in their daily lives and to apply mathematical ideas more readily both in the classroom and at home. Just as with the teachers' interviews, the children's interviews were conducted on two separate occasions: pre-intervention (teacher following normal teaching routine) and post-intervention (teacher using stories in their mathematics teaching.)

The interview questions were informed by reference to established literature in the field alongside the main aim of the research. The questionnaire was designed with three sections in order to pursue the children's attitudes to:

- school and the daily programme;
- mathematics, and
- stories.

The children's interview schedule focused on areas related to the children's feelings about their school, their enjoyment of school with their friends, their favourite period of the day, any relation between maths and their daily life, and what story means to them and how much they enjoy it. (See appendix B.)

The translation procedures that had been followed to translate the teachers' interview questions was replicated in the translation of the children's interview questions (i.e. giving it to the first person to translate it into Arabic then giving it to another person to translate back to English) to make sure that the two versions mirrored the same meaning. For reliability, the same procedures were adopted to ensure that children underwent the same process in each school.

The interviews were conducted in the schools during normal school hours with the children whose parents agreed to accompany them. All the interviews were conducted in the same place in each school. For example, in School A, the interview with each child took place in the assembly hall, in School B the interview took place in a spare classroom, and in School C the interviews took place in the skills' classroom. The total number of children I interviewed was 50 from across the three schools. Each interview was carried out in a welcoming and friendly manner, and the conversation began with an introduction to the researcher and provided the children with an overview of the interview and its contents so that they could have a grasp of the topics under discussion. The actual interview began with some initial questions which addressed general issues about the school and their friends to allow them to warm up. Table 4-6 provides a summary of the organisational features for the children interviews.

Table 4-6: Information about Children's Interviews

Label of School	Numbers of Children	Duration of the Interview	Place of the Interview
A	14	In all three schools the interview took between 10 and 15 minutes	Assembly hall
B	21		Spare classroom
C	15		Skills' classroom

4.3.3.1.4.2.3 Mothers' Interview

The educational system in Saudi Arabia is segregated for male and females. The pre-school stage is the only stage where boys and girls study together with female teachers. Males are not allowed access into girls' schools or pre-schools as they are managed by female staff. As a researcher, it is easy arrange interviews with mothers only especially as mothers are responsible for taking care of pre-school children in this stage in Saudi Arabia. The main purpose of interviewing the mothers was to explore the mothers' beliefs about the importance of:

- early learning in general;
- learning mathematics at this stage;
- mathematics in general in daily life.

I wanted to gain insights into, for example, the importance of the pre-school stage to the parents; parental help in their children's studies; parents' attitudes towards mathematics as a subject; problems learning mathematics; their beliefs about stories, and whether they read stories to their children. (See appendix B)

Before giving out the consent letter to the teachers to send home with the children to their mothers, I asked the teachers about the best way to ensure a response from the mothers. The teachers' advice was to send the letter to all the children in each class. I sent the consent letter to 137 mothers and waited for their response. Only three mothers out of 137 responded; two from School A and one from School C. There are several possible reasons for this lack of response from the mothers:

- all three schools are private and most of the children in these schools are dropped off and picked up by the nannies, which makes it difficult to be in direct contact with the mothers to talk about the study and its importance;
- most mothers are working as teachers, doctors, lecturers or in other professional jobs, making it difficult for them to be interviewed during the school time;
- mothers might not be interested in mathematics as a subject or may have felt anxious to be interviewed.

Although only a very small sample of mothers responded to the invitation to be involved in the research I continued with the plan to interview the mothers in order to gain an indication of how mothers see early learning in general, their perceptions of learning mathematics at this stage, and the use of mathematics in their daily life. Additionally, the time constraints on carrying out this research limited me from getting more approval from other schools or more mothers to participate.

For reliability, I adopted the same procedures to make sure that all of the mothers experienced the same process in each school. In School A the interviews took place in the assembly hall and in School C the interviews with the mothers took place in the skills' classroom. At the outset of each interview, I explained the aim of the study emphasising that all of the information generated from the interview would be treated in confidence and used for research purposes only. The mothers were assured that the name of their child as well as their own name would remain anonymous and that they had the right to withdraw from the study at any time.

As with the teachers' interview, I used interviewing techniques such as silence, repeating or re-wording the questions as prompts and probes to clarify any information that was not clear and on occasion, summarised the mothers' thoughts to confirm the views expressed by them. At the end of the interview, I gave the interviewees the opportunity to raise any additional points that they felt relevant. Table 4-7 provides a summary of the background information for the mothers' interviews.

Table 4-7: Information about Mothers' Interviews

Mother's Number	Level of Education	Number of Children	Label of School	Mother's Career	Duration of the Interview in minutes
One	Bachelor	One boy and one girl	A	Housewife	30
Two	High school	Three boys and two girls	A	Housewife	25
Three	Bachelor	One boy and one girl	C	Accountant	40

4.3.3.1.4.3 Designing the Observation Checklist

Observation was the other main method I used for data collection. Observation is used by researchers as a method to gain a deeper understanding of social phenomena not obtained by other methods. Observation is a powerful tool for obtaining insights into classroom situations (Cohen et al., 2000). Unlike interviews, the observation of lessons provides an opportunity of seeing things as they actually happen in real time. As Cohen et al. (2000) note:

> *Observational data are attractive as they afford the researcher the opportunity to gather 'live' data from 'live' situations. The researcher is given the opportunity to look at what is taking place in situ rather than at second hand (p:305).*

The observational data provided me with the opportunity to examine closely how the mathematics sessions and free play periods operated within each of the research schools. Although I have experience of many years in school settings as a

teacher, I had never considered analysing the actions and behaviours of people as a researcher. As an observer, the opportunity of watching people in their natural settings was very useful experience for me, allowing me to describe and study what I saw. Making observations for research purposes helped me to understand better what teachers and children actually do rather than what they say they do. Apart from being an empirical method for first hand data collection observation allows the researcher to witness things as they take place, providing that the presence of the observer has a minimal effect on the naturalness of the setting.
The observations took place in two different periods in the school day: the maths session and the free play period.

However, observation as a data collection tool has a few limitations such as:

- the researcher may end up with too much information that may pose a challenge at the time of analysis. Selecting what to observe during observation may become difficult;
- the behaviour of the person being observed may be affected;
- organizational problems may stand in the way;
- the researcher may miss important data if any background noise and disruption exist;
- due to shortage of time, there may be a temptation to skip over details if they do not fit with the items on a pre-prepared checklist of what to observe.(Koshy,2010)

4.3.3.1.4.3.1 Mathematics session observation

I chose observation to be one of the main tools to collect data because I wanted to look closely into how teachers teach and how children interact and respond to each other and the teacher. The observation checklist included information such as how the teachers structured the lesson (the lesson plan); the resources used to teach new concepts; children’s motivation - are the children involved in the learning process - the relationship between the mathematical concepts and the children’s everyday life; the nature of the children’s responses and the children’s enjoyment.

The first page of the observation schedule provided an opportunity for a brief record of the main points that describe the lesson. This included general information (date, school, teacher and time), lesson plan, type of activity and materials. The following pages were organized into two columns; teacher columns and children’s columns (See appendix B).This allowed space for writing continuous detailed running records of what was happening during the lessons.

- **Observation of mathematics sessions : pre-intervention**

I attended each teacher’s mathematics session to observe the teaching method that each teacher used to present mathematical concepts. Each teacher was observed teaching mathematics on 2, 3 or 4 occasions. The variation in observations was due to teachers 7 and 8 and teachers 9 and 10 sharing the teaching of the class. Additionally, teacher 3 at school B was absent for one observation session and the researcher had to deliver the session. Finally, as the school inspector wanted to attend the session to see the new method applied, the researcher was requested by an inspector to deliver the session (more details about the observation during the intervention can be found in chapter 5). It was also possible to observe the interaction between the teacher and the children and determine whether the teaching strategy that the teacher used helped the children to learn and, at the same time, make them connect the new concept with their daily activities.
In each observation, I sat at the back of the class where I was able to observe everything going on and fill out my checklist record of anything catching my attention that could be related to my research. I tried to observe and record as much as I could.
Table 4-8 summarises the organisational information for the pre-intervention observations of the maths sessions in the three schools, for example, the number of teachers observed, the number of observed sessions and the duration of the observation.

Table 4-8: Pre-implementation Mathematics Session Observation

Teacher's Number	Number of Children in the Class	Duration of the Observation in minutes	Observation Day of the Week	The Number of Sessions Observed	Topics Covered in The Sessions
Teacher 1 School A	19	60	Sunday	4	Shapes concepts, colours concepts, and numbers concepts from 1-3.
Teacher 2 School A	18	60	Sunday	4	Shapes concepts, colours concepts, and numbers concepts from 1-3.
Teacher 3 School A	18	60	Sunday	4	Shapes concepts, colours concepts, and numbers concepts from 1-3.
Teacher 4 School B	14	60	Tuesday	4	Shapes concepts, colours concepts, and numbers concepts from 1-3.
Teacher 5 School B	14	60	Tuesday	4	Shapes concepts, colours concepts, and numbers concepts from 1-3.
Teacher 6 School C	18	60	Wednesday	4	Shapes concepts, colours concepts, and numbers concepts from 1-3.
Teacher 7 School C	18	60	Wednesday	2	Shapes concepts, colours concepts, and numbers concepts from 1-3.
Teacher 8 School C	18	60	Wednesday	2	Shapes concepts, colours concepts, and numbers concepts from 1-3.
Teacher 9 School C	18	60	Wednesday	2	Shapes concepts, colours concepts, and numbers concepts from 1-3.
Teacher 10 School C	13	60	Wednesday	2	Shapes concepts, colours concepts, and numbers concepts from 1-3.

- ### Observation of mathematics sessions : post intervention

I attended each teacher's mathematics sessions to observe them using stories to teach mathematical concepts. As explained in the previous section, I observed the children's responses to the use of stories in the maths lessons and the interactions between the teachers and the children. I conducted either 2, 3 or 4 observations in the teachers' classrooms.

Table 4-9 summarises the organisational information for the post-intervention observations in the three schools, for example, the number of teachers observed, the number of sessions and the duration of the observations.

Table 4-9: Post- implementation Mathematics Session Observation

Teacher's Number	School	Number of Observers	Duration of the Observation in minutes	Number of Sessions Observed	Stories Covered on this Session
1	A	Myself, teacher 2, teacher 3, and one time English section's teachers	60	4	Sharing is useful, My mum's surprise, Our new house and Lesson I will not forget.
2	A	Myself, Teacher 1,Teacher 3	60	4	Sharing is useful, My mum's surprise, Our new house and Lesson I will not forget.
3	A	Myself, Teacher 1,Teacher 2	60	3	Sharing is useful, My mum's surprise, and Lesson I will not forget.
4	B	Myself, Teacher 5, KG1 and KG2's teachers	60	4	Sharing is useful, My mum's surprise, Our new house and Lesson I will not forget.
5	B	Myself, Teacher 4, KG1 and KG2's teachers	60	4	Sharing is useful, My mum's surprise, Our new house and Lesson I will not forget.
6	C	Myself, Teacher 7, Teacher 10, and Head teacher assistant.	60	3	Sharing is useful, My mum's surprise, and Our new house.
7	C	Myself, Teacher 6,Teacher 8,Teacher 10,Head teacher assistant	60	2	Sharing is useful Our new house.
8	C	Myself, Teacher 7,Teacher 9, Head teacher assistant	60	2	My mum's surprise and Lesson I will not forget.
9	C	Myself, Teacher 6, Teacher 10, Head teacher assistant	60	2	Sharing is useful Our new house.
10	C	Myself, Teacher 7, Teacher 9, Head teacher assistant	60	2	My mum's surprise and Lesson I will not forget.

- **Observation of 'free play' session**

This observation was included to identify any maths-related ideas that the children might use during their free choice play. I was able to determine whether any of these activities were planned to facilitate mathematics learning and observe the children's actions and interactions. In addition, it provided an opportunity to explore children's interests in practising and initiating maths-related activities, if any.

Table number 4-10 illustrates the organisational information about the free play observations.

Table 4-10: General Information about Free Play Observation

Class Number	Number of Children	Duration of the Observation in minutes	Observation Day of the Week	Number of Periods Observed
One	19	45	Sunday	4
Two	18	45	Sunday	4
Three	18	45	Sunday	4
Four	14	45	Tuesday	4
Five	14	45	Tuesday	4
Six	18	45	Wednesday	4
Seven	18	45	Wednesday	4
Eight	13	45	Wednesday	4

4.4 Biases, Errors and Quality of Data

As an essential part of qualitative research, the researcher needs to clearly identify such things as personal values, experiences, assumptions and biases that might influence the research outcomes. As far as possible in this study, I have tried to remain objective throughout, removing biases and errors that might have any influence on the way that the data is collected and interpreted.

In the questionnaire and during the interviews, all questions were stated precisely and in an unambiguous way. During lesson observations, data was collected in a reliable fashion avoiding any subjective opinion, where possible. Detailed descriptions of events, the settings and other relevant information relating to the research questions were obtained (Robson, 2002).

It is important in any research that all bias is eliminated; however this is very challenging due to the nature of observational research. However, as data in this study is collected from multiple sources (children, teachers and parents) the effects of bias can be assumed to be minimised and the quality of the data collected ensured (Cresswell, 2003). In any form of technical action research there is a risk of 'observer effect' as it involves the researcher being on site for an extended period of time and the subjects of the research may be conscious of being 'under the microscope' (Denscombe, 2005; Wellington, 2000). Prior to starting formal data collection, I spent some time in the setting so that the participants became accustomed to my presence and I became, at least to some extent, 'part of the furniture' in the setting, having minimal interaction with the participants (Denscombe, 2005). I would arrive in the class five minutes before the start of the lessons and sit at the back of the classroom, focusing my attention on selective sets of phenomena. Sitting at the back provided a vantage position which allowed me to see what was happening during the lessons. After each observation of lessons, I discussed with the teachers any pertinent issues which I felt required further clarification.

4.5 Establishment of Data Dependability

All quantitative researchers seek to show validity and reliability in their studies. Conversely, qualitative researchers strive to establish credibility within their research. Credibility is a form of internal validation that refers to trustworthiness or good measurement of findings (Bickman and Rog 2009).

Bickman and Rog (2009) suggest the following ways that credibility can be determined:

- the research design should support definitive conclusions and desired recommendation;
- credibility depends on who is judging it;
- the methods should be a reflection of the paradigm and the research question.

A number of techniques exist to establish credibility in qualitative research. These include prolonged engagement, triangulation, peer debriefing and member checks. For the purposes of this study, triangulation was initially used, and alongside member checks assisted with establishing research credibility. The uses of both strategies are briefly discussed in the next section.

4.5.1 Triangulation

In most forms of social research, it is common to use triangulation as a means of establishing credibility and developing a deep understanding of a specific social phenomenom. This is achieved by the use of multiple theories, methods, and viewpoints of observers. (Neuman 2000, p: 521) suggests that “looking at something from several different points gives a more accurate view of it”.

Denzin (1978) identified four triangulation applications: theory triangulation, methodological triangulation, data triangulation, and investigator triangulation.

Theory triangulation interprets findings of single phenomena by using a variety of theoretical perspectives. Methodological triangulation involves the use of a variety of qualitative methods to collect data, including in-depth interviewing, participant observation, and focus groups. It is possible to combine a range of qualitative and quantitative methods. For data triangulation, researchers use different data sources or viewpoints within the same study, whilst investigator triangulation uses two or more observers or interviewers to analyse the same phenomenon.

Flick (2004) states that triangulation seeks to enhance understanding of a phenomenon by a combination of different methods, study groups, local and temporal settings, and different theoretical perspectives. Consequently, I found that methodological triangulation (multiple methods) and data triangulation (multiple data sets) could be used both to answer my research question and to strengthen my results.

Aware of the strengths and weaknesses of each type of triangulation, I have chosen methodological triangulation to plug any gaps developed by the different methods. One advantages of using multiple methods is that each method assists in the development or strengthening of the other (Creswell, 2009). Further to establishing credibility for this study, triangulation also provides a significant benefit for this research by:

- reducing any methodological gap that may appear;
- providing breadth and depth in viewpoints and background knowledge;
- developing frameworks for methods;
- breaking down initial understanding about my participants (i.e. teachers, children and parents); and
- providing the opportunity to switch between stages in order to investigate newly-developed questions, ideas or gaps.

4.5.2 Member Checks

Member checking is a strategy often used to determine credibility. In order to eliminate evidence that is disconfirming, this technique can be used by the researcher to obtain feedback about data and conclusions from participants within the study (Maxwell 2009; Merriam 2009; Miller and Crabtree 2005). Such feedback can be used to resolve the researcher's misinterpretations (Maxwell 2009). Furthermore, it allows a researcher the opportunity to identify biases of their own. The results of the qualitative research can only be viewed as credible from the perspectives of the participants. Following each interview in this study, the interview transcript was returned to the participant for checking and approval.
At the end of the lessons (or next visit), I discussed my observations informally with the teachers thereby confirming or developing a consensus between the researcher and the teachers for the credibility of the data collected. This also enabled me to probe into the teachers' thoughts about their own actions and behaviours. The interviews with the children provided a further way of ensuring that the responses of the teachers were impartial. After writing up my notes, I met

the teachers and read the notes to them to check the accuracy of whatever I had recorded during the observations of lessons and the interviews.

4.6 Reliability in Qualitative Research

Reliability in quantitative research is a measure of its consistency and replicability over time, over instruments and over groups of respondents in terms of precision and accuracy (Cohen et al., 2000). If the research is carried out on another similar group of respondents in a similar context using the same method it would be expected that similar results would be obtained. However, this is not always easy and reliability in qualitative research is harder to establish. It may be unworkable as qualitative research is concerned with naturalistic studies which include the "uniqueness and idiosyncrasy of situations such that the study cannot be replicated" (Cohen et al., 2000, p: 119). This concept of uniqueness can be viewed as a strength rather than a weakness of qualitative research. However, reliability in qualitative research can be problematic as human behaviour is rarely ever the same for different individuals - the experiences of one person rarely match those of another. Therefore, qualitative research does not always yield the same results each time it is replicated but the data collected should be 'consistent' with the results and 'dependable' (Lincoln and Guba, 1985, p: 288). The researcher is the primary instrument of the data collection and analysis, and s/he can improve their reliability by training and practice. I kept a research journal and analytic field notes throughout the research, capturing my thoughts and reflections about various issues arising. Triangulation is a strategy that enhances the reliability of data. I concentrated on using the same procedures with all participants during the interviews and the observations. The same questions were used in the three schools and thus the data were obtained in the same manner, thereby ensuring a high level of consistency throughout the project.

4.7 Data Analysis Procedures

Data analysis is an integral part of the research cycle and should not be considered as a discrete phase near the end of a research plan (Corbin and Strauss, 2008; Dowling and Brown, 2010). It has to begin early in the research in order to influence emerging issues or even aspects of the design. It is, therefore, a formative rather than merely a summative process.

By its nature, qualitative research often produces a large amount of data, often quite verbose, and therefore the analysis of the data can be a lengthy process. As Creswell (2009) has suggested, "*the analysis of the data in qualitative research is an ongoing process involving continual reflection about the data, asking analytic questions, and writing memos throughout the study ... the researcher collects qualitative data, analyzes it for themes or perspectives, and reports 4–5 themes.*" (Creswell, 2009, p: 184). This procedure for data analysis is illustrated in Figure 4-1.

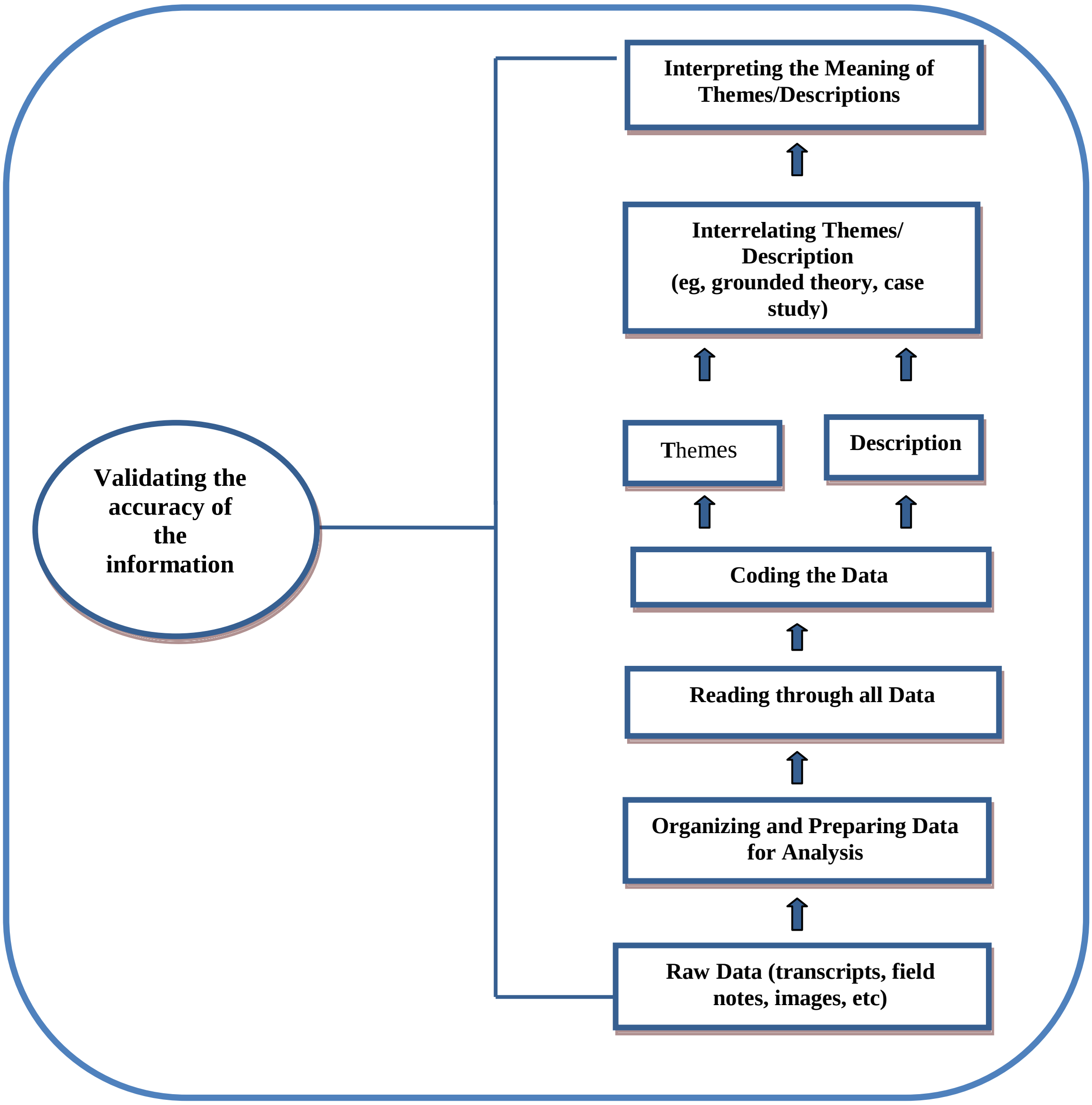


Figure 4-1: Creswell's Data Analysis in Qualitative Research

Source: Creswell (2009, p. 185)

This procedure is achieved in this study through the use of interviews, listening to tapes and reading transcripts, and at the same time going through the observation check lists and field notes. Thematic analysis gathers threads of ideas from the texts. It has been argued that all qualitative studies include some form of thematic analysis, utilising a search for patterns, groups or categories of arising themes, (Bogdan and Biklen, 2003; Powney and Watts, 1987). Boyatzis (1998) defines thematic analysis as a method for identifying, analysing and reporting patterns within data. Braun and Clarke (2006) propose a six-phase analysis process:

- familiarisation with data
- generation of initial codes
- search for themes
- review of themes
- definition and nomenclature of themes
- report production.

During the observations of lessons and also during the interviews, I made detailed descriptions of the situation in field notes and transcripts. Categories and codes were used to organise the data in discrete sectors, according to their characteristics. A thorough reading and review of the observational data and interview transcripts helped me to get an understanding of the data and identify the key categories, sub-categories and concepts which would help to make some sense of the particular situation. During the data collection process I regularly went through my data, reviewed my observation check lists, transcribed interviews, and tried to identify and describe patterns and themes by coding them and rearranging the categories and reviewing them regularly.

4.8 My role as a researcher

In qualitative research, it is important for the researcher to clearly identify the items that may influence research outcomes such as personal values, previous experience, assumption and bias as a teacher. In this study, I tried to be objective and focus on the purpose of the research and avoid any bias that could influence the participants' response to the research process (interviews, questionnaires, and observation). The potential for bias has been acknowledged in the research literature (Bell, 2005; Creswell, 2009) but following a clear, organised system of research minimises the occurrence of bias.

In order to do this I followed several steps to limit any potential influence on the research participants regarding how research data was collected and interpreted, as follows:

- During the first meeting with the teachers, I emphasised to the participant's teachers that my role was not to evaluate or write a report on how they teach, but that I needed their help to complete this research.
- During interviews and meetings with the participants, my role was mainly to listen and focus all the time on the research aims without participating in the discussion. Also, I tried not to ask any leading questions.
- To avoid influencing the teaching style of the participants, I did not tell them about any of my views of how maths should be taught.

4.9 Ethical Considerations

The main ethical considerations in this research study involved a number of stages. The study first gained ethical approval from the Brunel University Ethics Committee. Next, participants' consent for the 10 pre-school teachers, 50 children, and three mothers at the three schools was sought. An appropriate consent form was used to explain the procedures in the study, promised confidentiality, and informed participants that they could withdraw from the study at any time. The purpose of the study was described in detail on the form. This was carefully reviewed with each participant before conducting the interviews. (See appendix D).

No real names of teachers, children, mothers or schools are used. In their places, labels are used to maintain the participants' privacy and confidentiality. Furthermore, it was explained not only on the consent form but also in discussion that the researcher would be readily available to discuss any concerns and questions that might arise from the participants.

4.10 Summary

This chapter explains the plan of the study and the methodology used; details the theoretical model and methodological considerations and offers a justification for the choice of the constructivist paradigm and action research as frameworks for the study. In addition, it presents the various data collection methods (biographical questionnaire, semi-structured interviews and observations); the sampling approach (purposive sampling) and the data analysis (thematic analysis) for each data collection method. The advantages and limitations of each method are considered and an explanation of credibility and reliability in qualitative research is given along with the ethical considerations for this study.

The key features of the research design are illustrated in figure 4-2 below:

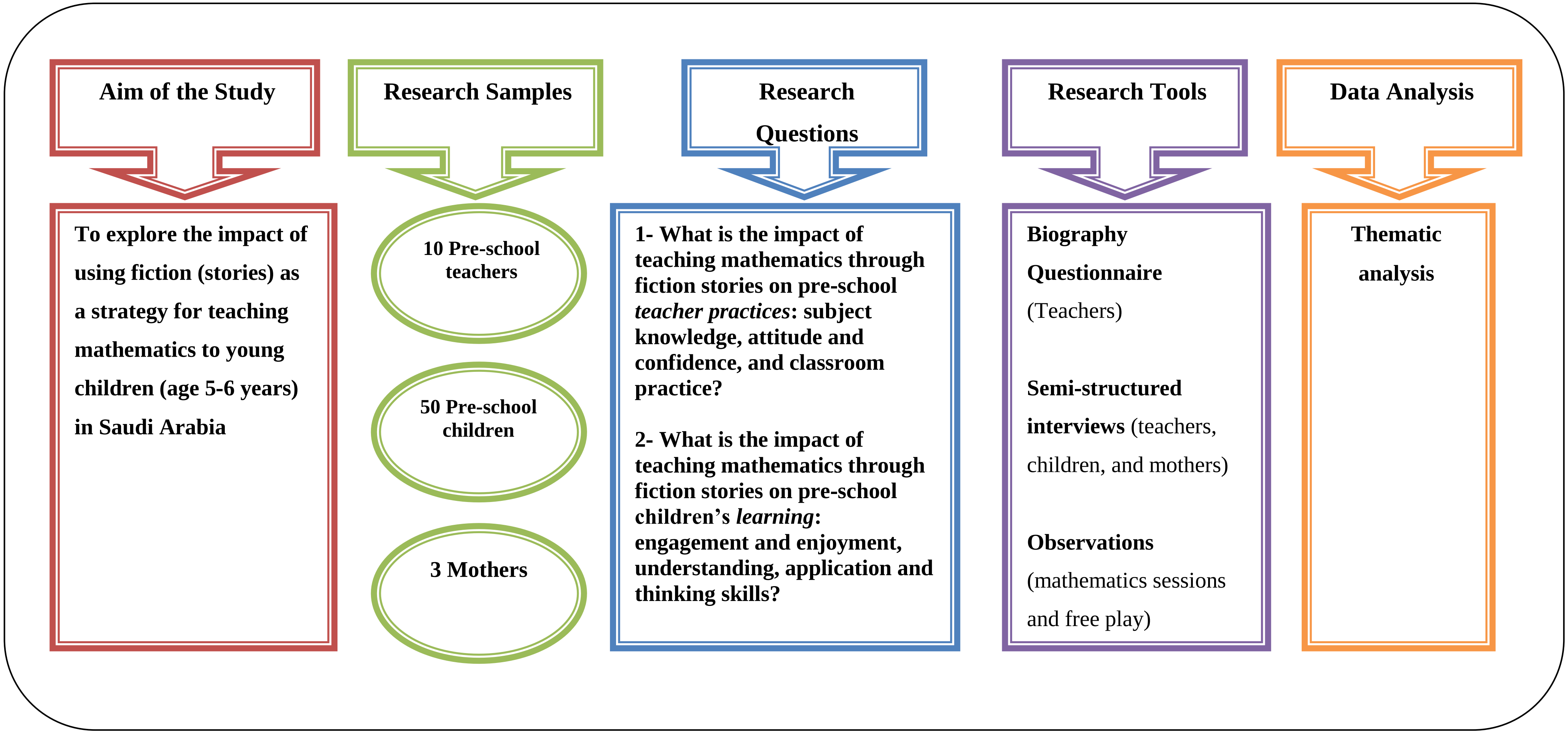


Figure 4-2: Summary of Research Design

Chapter 5: The Research Intervention

5.1 Introduction

Given that the aim of the research is to explore the impact of using stories as an approach to teaching mathematics to young children in Saudi Arabia, the research intervention was designed to engage pre-school teachers in using stories as a basis for teaching mathematics to their 5-6 year old pupils. Each section of this chapter rehearses one of the five stages of the intervention from preparation through to implementation. These stages are diagrammatically represented in figure 5-1 later in this section and will be described chronologically.

The first *Preparation Stage,* involved recruiting the three research intervention schools; arranging a programme of visits for each school; an initial meeting with each school to introduce myself as the researcher and the focus of the study; distributing the initial questionnaire to the participating teachers and posting out the consent letters to mothers to conduct interviews with them and their children. The first three stories were also devised and written by me during this stage.

Implementation Stage 1 included undertaking an initial observation of the teachers' classroom practice; observing the children in mathematics sessions and during 'free' play; and conducting the pre-intervention interviews with teachers, mothers and children. A preliminary analysis of the data was also undertaken at this time in order to identify the initial issues arising and to inform the next stages.

The fourth story and the teachers' workshop were developed during the second *Preparation Stage* in readiness for *Implementation Stage* 2 which involved conducting a workshop (for teachers and inspectors) and the presentation (by the researcher) of the first story to the pre-school classes in all three schools whilst the teachers observed. The second implementation stage also involved a post-observation evaluation meeting with the teachers.

The final *Implementation Stage 3* of the intervention study involved gathering data by observing the teachers using the new approach to teaching mathematics. A post-intervention evaluation meeting was held with the teachers and post-implementation interviews were conducted with the teachers and children. At the same time, a fifth story was devised with the help of the teachers. Finally, at the request of one of the school's Inspectors, a second workshop for Inspectors and a number of teachers from the public sector was conducted in one of the public schools.

Figure 5-1 provides an overview of the five stages of preparation and implementation of the intervention.

Stages of Preparation and Implementation of the Intervention

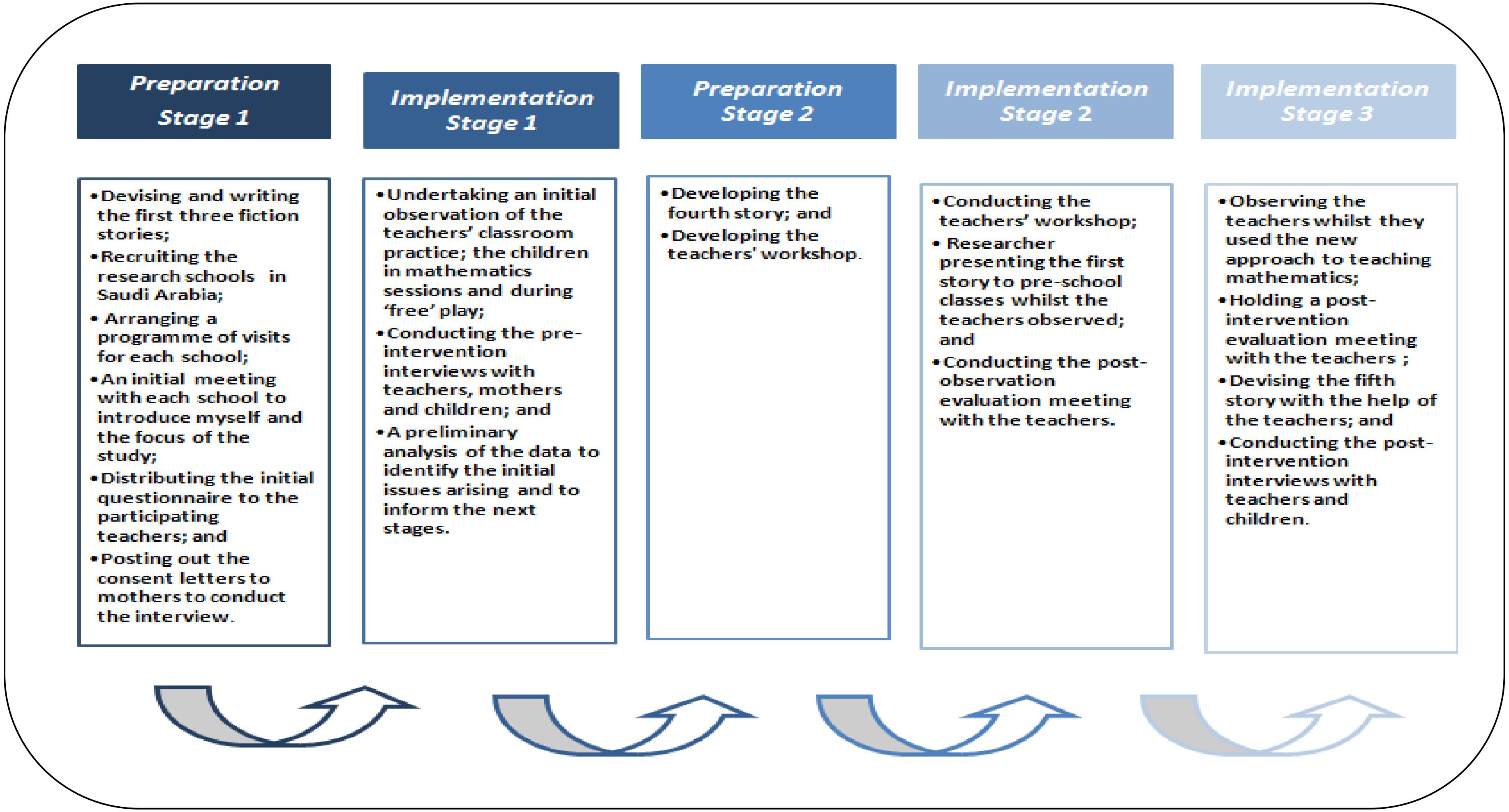


Figure 5-1: Stages of Preparation and Implementation of the Intervention

5.2 Preparation and Implementation of the Intervention

5.2.1 Preparation Stage 1

5.2.1.1 Background to Writing the Stories

Previous research studies exploring the use of stories as part of a teaching approach (Heuvel-Panhuizen et al., 2009; Heuvel-Panhuizen and Boogaard, 2008; Hong, 1996; Jennings et al., 1992; Keat and Wilburne, 2009) involved stories that were not designed specifically for presenting mathematical concepts. Since my research was concerned with the impact of using fiction in teaching mathematics to very young children, I decided to develop my own stories. My aim was to present early mathematical concepts in contexts that would be very familiar to the children's everyday life with easily recognisable characters from a similar cultural background. Moreover, each story would include a problem to be solved. In this way, children could be actively engaged in thinking through the solution to the problem at the same time as acquiring new knowledge.

Initially, I planned to develop three stories each with a different concept: shape, size and number. However, after reviewing the private schools' mathematics curriculum and reflecting on my own previous teaching experience, I noticed that *number* was the predominant focus and so, for this reason I decided to include number in each story.

When I started to develop the first story about number, I knew that I would begin to collect data at the beginning of the school year and during that time the teachers would be covering the numbers 1 to 10 in their teaching. I decided to focus on the number eight (which the teachers would not be teaching immediately) in order to create sufficient time for me to:

- collect data about the current way of teaching before the intervention began;

- conduct interviews with the research participants (the teachers, children, and mothers) and complete some observations before starting the intervention.

Once the intervention began, I wanted it to continue for the whole term and so a sufficient number of stories had to be designed to cover this timeframe. If the teachers found the new approach useful and wanted to continue to teach in that way, then there also needed to be sufficient time for them to develop their own stories and material. Brief descriptions of the stories along with a list of objectives are given in the following section. A greater level of detail is given for the development of the first story as an exemplar.

5.2.1.1.1 The First Story: *Sharing is Useful*

All of the stories have the same main characters: father, mother, and two daughters. The oldest daughter is called Maha, the youngest is called Reema - who always complains and gets herself in trouble!

When I started writing the first story, I found it very difficult and really challenging because of the importance of the first story in relation to the future success of the intervention. The teachers' and children's first impressions of the first story would affect their views about the whole approach and the subsequent stories. The first story needed to catch their attention and engage them so that they would be keen and motivated to carry on with the new approach.

For this reason, I decided to choose a familiar topic that most children would respond to and one that would be straightforward for the teachers to present. My first topic was about having a party. Most children like parties, enjoy party food and like to talk about and describe the decorations at the party.

I called the first story *Sharing is Useful*. Maha and Reema invite their friends to their party. They have to prepare for the party and so, with the help of their father, they buy the decorations and other party items: balloons, party hats, bubbles for the eight girls who will be at the party: six guests plus Maha and Reema. At home, mum prepares the food but has to leave the house for an emergency. When dad and the girls return home, they find that mum has not prepared enough food and this then becomes the problem that they need to solve. (See appendix C). Although the main focus of the story is *counting to 8*, in solving the problem of not enough food, Maha and Reema are introduced to increasing (*doubling*) the quantity of food by cutting each pizza, sandwich and chocolate bar into *two equal halves* and therefore *sharing* the food originally intended for four children amongst the eight children at the party.

For each of the stories I listed the main objectives addressed in the story in terms of mathematics teaching. Although each story had a focus on a particular strand of mathematics, for example, number or shape, the stories also contained teaching points and themes from other content areas in mathematics. The list of the objectives for the first story is provided as an illustrative example in table 5-1 and the same process was repeated for all other stories. Ernest's (2000b) framework of objectives for mathematics teaching (outlined previously in chapter 3) was used to create the list of teaching objectives for each story.

Table 5-1: Story 1: Main Teaching Objective, Facts, Skills, Concepts, Attitudes, and Appreciation

Main Objective	Facts	Skills	Concepts	Attitudes	Appreciation
The main objective was to introduce the number 8 in a meaningful and interesting context.	• Recognise number 8 in words and as a symbol (8) • Read number 8 • Number 8 comes after 7 and before 9	• Practise counting to 8 • Write numbers up to 8 • Understand the order in which numbers 1 to 8 appear on a number line • What numbers come before and after number 8 • Practise counting sets of different objects to make up a set of number 8	• Knowing that a size of a number in a set is given by the last number in the count • Knowing that number 8 can be made up in different ways using different combinations of numbers • Some understanding of differences. For example, you need 3 more than 5 to make the number 8 • Compare the sizes of numbers	• Develop positive attitudes towards mathematics • View mathematics as an enjoyable subject and not just as a set of rules and procedures • Develop confidence in using and applying mathematics	• Understanding that mathematics is used in everyday life • Mathematics involved practical and real life problem solving • Mathematical concepts are inter-related • The importance of communicating and problem solving as integral to mathematics teaching

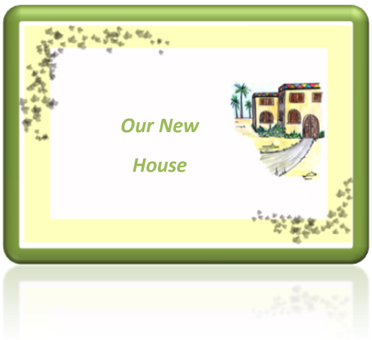
Other mathematical content such as the concepts of time, shape, fractions, sharing, position and measures are also present in each of the stories and these will be highlighted when opportunities arise. The storyline also provided an opportunity to address the inter-relationship of the different concepts at this early stage.

5.2.1.1.2 The Second Story: *My Mum's Surprise*

The main objective for the second story was to present the concept of ordering by size with a secondary focus on the number nine. I called this story *My Mum's Surprise*. Maha and Reema go with their dad to bring their cousin Lena to spend the night with them to celebrate together the Muslim celebration of Eid in the morning. Mum asks them not to be late because she has prepared a surprise for them.

When the girls arrive home, they call their mum but she does not answer and so they go up to her room without her permission and discover her surprise: three new sets of clothes for each of the girls in different sizes to wear for celebrating Eid. In her excitement, Reema muddles the clothes up leaving the problem to be solved before mum returns. (See appendix C)

5.2.1.1.3 The Third Story: *Our New House*



The main objective of the third story was to introduce the concept of a triangle and at the same time the number ten. This story is called *Our New House.*

Maha and Reema's family are moving to a new house. Everyone is excited! The girls go to see their new bedroom but Reema does not like it as she does not like the shapes (triangles) decorating the room. Reema's mother has to solve the problem of helping her daughter discover the usefulness of the triangle shape in her daily life and liking her new bedroom! (See appendix C)

In summary, the first three stories were designed with the following features in common:

- early mathematical concepts are embedded in the events of each story to support the children in constructing their own understanding;
- the story theme links to everyday life situations and includes a problem to be solved to encourage children to be problem solvers;
- the central characters remain constant in each story and the family is from a familiar cultural context

5.2.1.2 Recruiting the Research Schools in Saudi Arabia

In order to recruit the schools for the intervention, I decided to travel to Saudi Arabia. Before travelling, I contacted my sponsors to provide me with a letter outlining my status as one of the Higher Education PhD students sponsored by the Ministry of Higher Education in Saudi Arabia and requesting that the schools help me to finish my study (See appendix D). I also needed a second letter from Brunel University confirming my status as a PhD student registered in the institution. (See appendix D)

After obtaining the required ethical approvals as indicated in section 4.9 (Ethical Considerations), I decided to conduct the intervention in private, well-known schools in the city because these schools:

- are always seeking new ideas to adapt their practice and they are open to change;
- are considered as training centres for other private schools hence if they adopt a new teaching approach then other schools are likely to adopt it as well; and
- employ larger numbers of staff which meant an acceptable number of teachers in one school would be available as research participants, see section 4.3.3.1.3 (The Research Design: the Research Sample).

I visited a number of schools in the hope of recruiting them for the intervention. In School A I met the pre-school's head teacher, introduced myself and explained the aim of my study. Mrs F was immediately interested and asked her secretary to type up the approval letter for me to conduct the research.

I followed the same steps in School C, but the head teacher said that she was unable to make any decision without referring back to the school's owner. The school's owner was concerned about changing the curriculum but I reassured her that my focus was on teaching approaches and not directly with the curriculum and so she agreed. The head teacher of School B was more than happy to welcome me and provided the approval letter.

To inform the aim of the research and gain more knowledge of the current situation, I also went to the school where I used to work. This was done by attending some mathematics classes and asking teachers about their way of teaching mathematics, the materials they used, the curriculum content, and the problems facing them when teaching mathematics.

5.2.1.2.1 Contextual Information for Schools A-C

- **School A**

School **A** offers different stages of education from pre-school to high school and each department has its own facilities with separate management. The pre-school building consists of two floors, where the first floor consists of the reception; assembly hall; free time play corners; video corner; and canteen. The second floor consists of the Arabic section head teacher's office, the English section head teacher's office, the classes (three for KG3 with 20 children in each class, one for KG2 with 19 children, and one for KG1with 15 children), a dining hall and a library.

The space in each classroom is divided into educational areas for art, reading, drama, blocks, discovery, and cognitive games. In addition, there is a sitting area or circle time area where teachers and children meet on the carpet. Each classroom also has a number of tables and chairs for children to use in Arabic literacy, English and maths session. Teachers use a regular white board and overhead projectors for presentations.

Each class has one Arabic teacher with her assistant to teach different sessions in Arabic (circle time, free play, Arabic literacy and mathematics), and one English teacher with her assistant to teach different sessions in English (literacy, science and mathematics) which means the pre-school has ten Arabic teachers and assistants and ten English teachers and assistants to teach English session. The sessions are divided among them but not equally. English has more sessions with the future aim of transforming the school into an international school.

This school focuses more on literacy and English than mathematics because of the parents' preference to have more attention given to literacy and English sessions. Every day the children have one hour of Arabic literacy (reading, writing, and spelling), three hours of English (literacy, science, and maths) but they only have mathematics (in Arabic) for one hour weekly.
For the mathematics curriculum, the school has developed its own workbook based on the year one national curriculum. The workbook introduces:

- basic colours (red, yellow, blue, green, and orange);
- basic shapes (circle, triangle, square, and rectangle);
- numbers from one to twenty;
- addition (at the end of the second semester).

❖ School B

School **B** is considered to be the first private pre-school in SA and was opened in 1960. As with School A, this school includes the different stages of education from pre-school to high school and each department has its own facilities with separate management. The pre-school is placed on the ground floor, which contains the reception office, head teacher's office, indoor free time play area, swimming pool, dining area and five classrooms (KG1 with 15 children, KG2 with 20 children, two for KG3 with 14 children in each class and one empty classroom)

The classrooms in School B also provide educational areas for art, reading, drama, blocks, cognitive games and a number of tables and chairs for children to use for written work. The active board (IWB) is used in this school.

School B teaches Arabic literacy (reading, writing, and spelling) for one hour daily, English for one and half hours daily, music once a week, computer once a week, French once a week, swimming once a week and mathematics for one hour twice a week.

This school has also developed its own workbook curriculum based on the year one national curriculum and introduces:

- basic colours (red blue, yellow, orange, and green);
- basic shapes (circle, triangle, square, and rectangle);
- numbers from one to twenty;
- the use of arithmetic (counting up to 20);
- the concept of addition.

❖ School C

Similar to Schools **A** and **B**, this school includes the different stages of education from pre-school to high school with each department having their own facilities and separate management. The pre-school section is located on the first floor with the head teacher's office, teachers' room, free play area, indoor play area, five classrooms (KG1 with 18 children, KG2 with 17 children, and three classes for KG3 with 13 to 18 children in each class), the skills' room, and canteen.

The classrooms in this school follow the same arrangement as in Schools A and B, with educational areas for art, reading, drama, blocks, discovery, and cognitive games. Also there is circle time area, and a number of table and chairs for children to sit when they need to do written work.

Each class has one main teacher who teaches the five basic periods plus Arabic literacy and maths, one English teacher for all classes, one Islamic study teacher, and one teacher to teach them in the skills' room. Two of the KG3 classes have two main teachers and the responsibility of each teacher changes weekly. For example, in the first week the first teacher's responsibility is teaching children in circle time (as explained in Chapter 2) and the end of the day meeting, whilst the second teacher's responsibility is teaching literacy and mathematics. In the remaining periods (free play at corners, outdoor free play, and meal time) they share the responsibility. In the second week they swap responsibilities and this pattern continues throughout the term. This approach has been adopted because the number of children in these two classes (18 children for each class), is more than the third one (13 children).
School C focuses more on Arabic literacy (reading, writing, and spelling) where children have one session for one hour four days a week; English is taught daily for one hour and Islamic studies one hour daily. Mathematics is taught once a week for one hour.

The curriculum used in this school is a ready- to use book designed and published by one of the Arabic countries as a textbook, and the teachers at School C has developed a workbook related to the textbook. The textbook contains the following concepts:

- basic colours (red, yellow, blue, green, and orange);
- basic shapes (circle, triangle, square, and rectangular);
- numbers from one to twenty;
- grouping;
- positional concepts;
- addition (at the end of the second semester).

Table 5-2 provides an overview of the key contextual information for the intervention Schools A, B and C.

Table 5-2: Key Contextual Information for the Intervention Schools

Label of School	No. of Teachers	No. of Classes	No. of Children	Curriculum Subjects	How often Taught	Mathematical Concepts
A	Five Arabic with their assistants. Five English with their assistants.	KG1 KG2 KG3 KG3 KG3	15 19 20 20 20	Arabic literacy. English (Literacy, Mathematics and Science). Mathematics in Arabic.	x4 each week. x1 daily. x1 each week	Colour Shapes Number 1 to 20 Addition
B	Four Arabic Two English one for KG1 and KG2, The other teacher for the two classes of KG3. One French teacher. One PE teacher. One music teacher.	KG1 KG2 KG3 KG3 KG3	18 17 13 18 18	Arabic Literacy. English (Literacy, Mathematics and Science). Mathematics in Arabic. Music. PE. French	x 4 each week. x 5 each week. x 2 each week. x 1 each week. x 1 each week. x 1 each week.	Colour. Shapes. Numbers 1 to 20 Addition Use of counter arithmetic
C	Seven Arabic. One English teacher for all classes. One Islamic teacher for all classes. One teacher for the skills' room for all classes.	KG1 KG2 KG3 KG3 KG3	18 17 13 18 18	Arabic Literacy. Islamic study. English (Literacy, Mathematics and Science). Mathematics in Arabic.	x 4 each week x 5 each week x 5 each week x 1 each week	Colour. Shapes Numbers 1 to 20 Addition Grouping. Positional.

5.2.1.3 Introducing the Intervention to the Schools: Practical Arrangements

My data was to be collected from three schools and so it was very important to arrange a schedule of visits for each school particularly as mathematics was taught only once a week which meant that I had to be in the school on the day the teachers were teaching mathematics. I arranged a meeting with the head teacher of School A who was very cooperative. Mrs F was happy to be flexible and with sufficient prior notice (especially as she had three KG3 classes in her school) could fit in with any arrangements that might be necessary in the light of the mathematics time-tabling in Schools B and C. School B's mathematics sessions were on Tuesday and Wednesday and School C time-tabled their mathematics for Wednesdays.

Table 5-3 details the final weekly schedule for my intervention visits.

Table 5-3: Weekly schedule for my intervention visits to schools A-C

Label of School	Day of the Week	Time
A	Sunday	7.30 – 2.30
B	Tuesday	7.30 – 2.30
C	Wednesday	7.30 – 2.30

All three schools informed me that no mathematics sessions would be time-tabled in the first two weeks of the term as this time is designated as an induction period to give teachers time to build good relationships with the children and at the same time help children to get used to the school environment and routine. It was also a good opportunity for me to build good informal relationships with the children as well as the teachers prior to the formal observation sessions. Some of the steps that I followed to make myself familiar to the children and teachers included:

- being with the teachers in the hall in the morning in case they needed help with any child refusing to be in school;
- offering some help to the teachers in preparing and decorating the educational areas in the class room with materials to attract the children and make them happy;
- presenting stories to the children in circle time;
- being around the children in free playtime to help them explore the new equipment.

The two weeks induction period helped me to gain the teachers' and children's trust which was helpful when I re-visited the classes for the research observations.

5.2.1.4 Initial Meeting with Teachers

Formally introducing myself as a researcher to the teachers was an important step in the intervention process because the teachers' perceptions of me and the intervention study would be based on that meeting which in turn would affect their level of co-operation and engagement with the intervention.

The three head teachers identified a suitable time for the teachers to attend the introductory meeting and I hoped that the time chosen would enable them to be relaxed and fully involved. The head teachers in all three schools chose a time when the children had left the school and the teachers were free until the end of the working day as the most appropriate time for the initial meetings (1.30-2.30). In each school, the meeting started with a brief introduction from the head teacher before I introduced myself and explained the topic of my research focusing on the following points:

- my personal profile, the focus of my PhD research, aims and intentions;
- the rationale and purposes of the study;
- outlining their role in the study and emphasising how much I needed their help to complete the study.

I distributed the consent letters to the teachers and I also gave them the children's consent letters for their parents' approval. And finally, I gave out the initial questionnaire to the teachers and requested that it should be completed as soon as possible. (See section 4.9 for Ethical Consideration and appendix D for teachers consent)

5.2.2 Implementation Stage 1

This section will describe the initial observation process, getting the questionnaires back, and conducting the interview with the teachers, children and mothers. The section concludes with the process of developing the fourth story.

5.2.2.1 Initial Observations of the Teachers' Classroom Practice

Two weeks after visiting the schools, the basic schedule was settled and regular classes started which meant that I could start attending the classes to start my initial observation phase. The observations took place during two different curriculum activities: the mathematics sessions and during free play time.

For more information about the observation procedure; the number of teachers observed; the number of children in each class; the duration of the observation; and the mathematical concepts covered during the observation period, see page 160-162 and table 4-8 at page 163. As I mentioned earlier, one school has two classes with two teachers instead of one. These two teachers exchange the sessions between each other weekly, which means that two teachers teach the same children.

I observed four sessions for 4 teachers (teachers 1, 2, 4, and 5), three session for teachers 3 and 6, and two sessions for 4 teachers (teachers 7, 8, 9, and 10). For each observation, I positioned myself at one end of the classroom where I could observe all of the activities and record as much detail as possible on the observation checklist.

The second aspect of the initial classroom observations was to observe the children in their free playtime. The reasons for conducting these observations was

to find out if, and how, the children used mathematical concepts during their play; whether they made any connections between what they had learned in class and the games they played, and whether they used what they learned to solve any problems that arose during their play. The purpose of this observation was to identify any mathematics related activities children might practise during free play time and at the same time be close to the children to record their reactions and attitudes.
For more information about the free play observations, see table 4-10 at page 165.

5.2.2.2 Conducting the Pre-intervention Interviews

The interviews with the teachers, parents and children were designed to provide me with essential information about all of the participants in the study. The interviews were divided into three: one with the teachers, one with the children and one with the parents.

5.2.2.2.1 Teachers' Interview

The purpose of the semi-structured interview with teachers was to explore their beliefs and theories about teaching pre-school children in general and about teaching and learning mathematics in particular. My aim was to gain insights into the teachers' current way of teaching, how the teachers met their targets, the teachers' opinions and beliefs about the mathematics curriculum and the materials they used in their teaching. For more information about the teachers' interview, see page 152-156.

5.2.2.2.2 Children's Interviews

The main purpose of interviewing the children was to gain insights into their mathematical knowledge and understanding and to discover if very young children can apply their knowledge and are aware of mathematical concepts in their daily lives. For more information about the children's interview see page 156-158.

5.2.2.2.3 Mothers' Interviews

The main purpose of interviewing the mothers was to explore and find out about the mothers' *beliefs* about the importance of:

- early learning in general;
- learning mathematics at the pre-school stage;
- mathematics in general and its uses in daily life.

See page 158-160 for more information about Mothers' interview.

5.2.3 Preparation Stage 2

After observing the classes (during the mathematics and free play sessions) and conducting the interviews with the teachers, the children and their mothers, some interesting issues and potential challenges to pre-school mathematics teaching and learning emerged. Some of the barriers to the effective teaching of mathematics were related to the teachers themselves and to the teaching process, and some were linked to the school management. For the children I interviewed, the main issue arising was that most of the children only saw mathematics as a subject taught in school and as homework to be done. They seemed to gain some knowledge from the mathematics sessions but from the way they answered the interview questions as well as my observations during their free play, it seemed that they were not able to apply the knowledge.
Although based on a sample of just 3, the mothers underestimated the value of mathematics compared to literacy and other subjects and they did not seem to appreciate the importance of mathematics in everyday situations.

With this data in mind, I began the second stage of preparation and developed the fourth story and the teachers' workshop.

5.2.3.1 Developing the Fourth Story: *I Know…but…*

After conducting the interviews with the children and mothers, I found that the way mathematics is taught did not help children see mathematics anywhere other than the classroom where they had to write in the workbook with the help of the teacher and complete the homework at home. Only two children out of fifty gave me some examples about using numbers in their daily life.

I developed the fourth story with this in mind. The main objective of this story is to present the different topics which will be covered in the whole year, and to raise awareness that mathematics is a valuable subject and a useful discipline in everyday situations. In this story I focused on the following:

- presenting mathematics in a real life situation;
- using numbers to count different objects; thinking about size, colours, time and simple geometric shapes;
- the importance of using mathematical concepts to solve everyday problems;
- integrating different mathematical concepts together in a real life situation.

For story number 4, I also made a doll of cork which was the same size as a child and represented Reema, the main character of the story, wearing a special dress that had many pockets. Each pocket was designed to link with one of the mathematical concepts. For example, number, shape and ordering by size. See appendix C.

The aim behind making a concrete representation of Reema (Reema's model) was to provide a visual and concrete tool to help the children to make the necessary connection between mathematics as a subject and as a discipline used in everyday situations.

5.2.3.2 Devising the Teachers' Workshop

With the teachers' responses to the initial questionnaire in mind, as well as the data from the pre-observation interviews and classroom observations, I developed the content of the workshop to be delivered to the teachers in Schools A, B and C which included:

- the importance of mathematics in daily life;
- mathematics as knowledge in the holy Quran;
- the relationship between mathematics as a discipline and other disciplines;
- the impact of teachers' beliefs about the learning process, the importance of the subject and their own subject knowledge on the teaching process;
- common errors in teaching and learning mathematics;
- theories related to teaching mathematics (Piaget, Vygotsky and Bruner);
- the facts, concepts, skills, attitudes, appreciation, and conceptual structures framework;
- the importance of story in general and as a teaching method in particular;
- the importance of using fiction story as a method to present mathematical ideas;
- presenting one of the stories as an example.

The three head teachers were involved in identifying the most appropriate time for conducting each workshop. All of the head teachers were generous in rescheduling their normal school timings and staffing in order to allocate three hours for the workshop during school time. Each workshop started at 11:30am and ended at 2:30 pm.

5.2.4 Implementation Stage 2

There were three aspects to the second implementation stage for the intervention. Firstly, presenting the workshop to the teachers in Schools A, B & C. Secondly, presenting the first story to the children by myself based on requests from the teachers in all three schools. And finally, at the request of an Inspector from

School A, presenting the workshop on a fourth occasion to a number of inspectors and other private school teachers.

5.2.4.1 Conducting the Teachers' Workshop

By rearranging staffing responsibilities for the day, the head teachers ensured that all of the staff involved in the intervention were available to attend the workshops. In School B, the head teacher requested that the teachers of the other stages also attend the workshop (KG1 and KG2 teachers). In each of the teacher's workshops, I presented the background information to the workshop content as outlined previously (pp190) followed by an open discussion to stimulate the teachers and get them engaged. A total of seventeen professionals attended the three workshops as summarised in Table 5-4.

Table 5-4: Number of the Staff Attending Intervention Workshop

School Label	Number of Teachers	Total Number Attending (including H/T and other staff)
A	3	4
B	4	6
C	5	7

A number of key concerns and questions arose during the workshop discussions with the teachers which I endeavoured to address and respond to:

- **Question:** is it easy to manage the class when using this method?
- **Concern:** it is going to be difficult to manage the class if I follow this method.
- **Researcher's Response:** it should be easy to manage the class if you catch the children' attention and enchant them with the events of the story

- **Question:** how I am going to manage helping children to understand the difference between the rules of regular story sessions and the mathematical story sessions?
- **Concern:** the rule of story time that we follow is "*I am looking with my eyes, listening with my ears, and zipping my mouth"* but the rule for this approach is completely different from the example which was presented in the work shop (the story of *Sharing is useful*).
- **Researcher's response:** if the children get used to this approach, they will not disturb the class unless there is something they do not understand and they need clarification.

- **Question:** what if this way of teaching takes more time and children do not have the time to write in the workbook?
- **Concern:** I am so afraid that this method will take more time than the way we are using at present.
- **Headteachers' response:** At the end of the workshop, the headteacher in School A discussed with the teachers about their concern regarding the inadequate time for the mathematics session. The head teacher in School A decided to take five minutes teaching time from other sessions (for example, circle time) to extend the maths session to help the teachers to teach without thinking about the time and at the same time give more time to the children to enjoy the session. In school C the teachers had the same concern. I informed the headteacher about the decision taken by the headteacher in School A about the same issue. The headteacher in school C agreed to adopt the same procedure.

5.2.4.2 Presenting the First Story

Table 5-5: Overview of the Practical Arrangement for the Observation of Researcher's Teaching Session

School	Observation Setting	Technical Support to present the Story	Number of Observers	Number of Sessions Observed	Organisation of Children
A	Class room	Overhead projector	Head teacher Three KG3 teachers	3	Sitting on chairs and tables
B	Class room	Active board	Head teacher One KG1 teacher. One KG2 teacher. Two KG3 teachers.	2	Sitting at the floor on the circle carpet facing the active board.
C	Skills room	Overhead projector	Head teacher Head teacher's assistant Five KG3 teachers.	3	Sitting at the floor on the skills' room.

As can be seen in table 5-5 in School A, I presented the Sharing is Useful story to three different classes and the head teacher observed one workshop. At the end of each workshop the teachers asked me to present the first story to their classes to model effective practice for the new approach. In each school, I presented the session and the teachers observed me on three occasions. The head teacher and the teachers of KG1, KG2, and KG3 in School B had the opportunity to observe two sessions. And finally, in School C, the head teacher, her assistant, and five teachers observed me. I presented the story in this school during three sessions. The head teacher observed for one sessions and her assistant and the five teachers observed on three occasions.

In all three schools all the head teachers and teachers observed from one end of the classroom so as not to distract the children. In Schools A and C, I used the overhead projector to present the story whereas in School B I used the interactive white board. In Schools A and B the observation session took place in the classrooms whereas in School C, the session took place in the skills room in order to take advantage of the overhead projector.

As can be seen in table 5-5, all teachers in the three schools had the opportunity to observe more than one session. This seems to have supported them in:

- gaining an overview about the new method;
- familiarising them with the new method;
- addressing and reducing their worries;
- realising that different children from different classes responded in similar (positive) ways to the new method thereby making them feel more comfortable and confident.

5.2.4.3 Meeting with Teachers Post Observation of Researcher

At the end of each day in Schools A, B and C, I met with the teachers to gather feedback about their observations of the presentation, their perceptions of the advantages and disadvantages of the new method and their views about using this approach to teaching mathematical concepts. The teachers' feedback about the new approach was very positive. They liked the way the story presents mathematical concepts in a familiar context; they viewed the interaction between myself and the children as positive and more especially, they liked the children's responses when I started asking them about the solutions for the characters' problems in the story. One criticism in their feedback was in relation to the lack of concrete materials to accompany the story and for the children to work with as expressed by one teacher, "*after this perfect method of teaching it is really disappointing not to have material that the children can work with.*" In the light of this particular feedback, we decided to develop together some concrete materials linked to the events in the story. When asked, most of the teachers expressed willingness to try and teach using the new method.

5.2.4.4 Conducting the Inspectors' Workshop 1

After hearing mostly positive feedback from the head teacher of School C the school's Inspector asked to have a meeting with me. We discussed the new method and my objectives behind the use of this method, and how this approach may improve the teaching and learning of mathematics. The Inspector then requested that I present my work to other Inspectors and a group of private pre-school teachers.

This workshop was a good opportunity to let more people hear about the intervention project. I felt that gaining the support of the Inspectors would support me in future presentations, for example, to officials at the Ministry of Education in order to gain approval to implement this method across all pre-schools.

I presented the new method of teaching to nine Inspectors and sixty teachers from different schools. The content of this workshop was similar to the one I presented to the staff in Schools A-C. After the workshop all of the comments and feedback from all the Inspectors were positive. They wanted to have copies of the stories and, moreover, commented that this approach was the way that they wished all teachers should teach mathematics.

As a result of this event, an owner of one of the schools invited me to present the new method in her school to different groups of Inspectors and teachers.

5.2.5 Implementation Stage 3

This stage outlines the processes followed to support the pre-school teachers at the beginning of their journey in applying the new approach to teaching mathematical concepts; the development of the fifth story and finally, conducting the interview with the teachers and children post- intervention.

There was a level of excitement amongst the teachers once I had introduced the idea of using stories to them. I then needed to ensure that the teachers were supported and fully prepared for using stories in their teaching sessions and so on a practical level, I photocopied the first three stories along with the objectives for each story in order to help them to:

- look closely at each story and to familiarise themselves with the story events to ensure an effective presentation;
- identify and understand the objectives and think about the best way to present these objectives;
- highlight all the questions that will encourage active learning and high quality interactions between the teacher and the children based on the story events which, in turn, would help the children to construct their own knowledge and understanding.

5.2.5.1 Observing the Teachers: Schools A-C

I attended each teacher's mathematics sessions to observe them using the new story-based approach. At the same time, I wanted to monitor the children's responses and record the teacher-pupil interactions.

In each school, other members of staff joined me for the observation sessions, on some occasions it was the other KG3 participating teachers and on other occasions it was staff from other year groups and on one occasion, staff from the English section. The variety of people observing motivated the teachers to show their best teaching and also enriched the follow-up discussion that took place after each session.

In School C, the school's Inspector requested that I taught the class instead of Teacher 6. The Inspector was so keen to attend to see how the story would be presented and the children's reactions. It was a good opportunity to have someone from the Ministry of Education see the process in practice. The Inspector was satisfied and asked if it would be possible to send teachers from other schools for training. It was impossible to agree at that time because in the research timeframe there was only one week left to present the final story. I also presented one of the stories in School A because Teacher 3 was absent.

For more information about the number of observations, observation duration, numbers of sessions observe and stories covered on the sessions see table 4-9 at page 164.

5.2.5.2 Post-intervention Feedback Meetings with Teachers

I conducted a feedback meeting with the participating teachers and observers at the three schools (A, B, and C) after each observation session. We focussed on the issues arising from the session in general; the children's responses, and whether it was possible to identify anything to add to the approach to make it more effective. Some teachers suggested different ways of presenting the stories to motivate the children, others suggested designing concrete materials to support the story development. Teachers in School A wanted to collaborate in the development of another story with a focus on number 11.

5.2.5.3 Developing the Fifth Story: *A Lesson I will not Forget*

The teachers' feedback after trialling the new approach was overwhelmingly positive both in relation to themselves as teachers and the impact on children's learning. Teacher 1 noticed a difference in her teaching in that using the stories allowed her to be fully engaged with the children and with the teaching process which impacted on her enjoyment and confidence as she said the following

> *"…using story made maths lessons interesting and full of joy…I am really enjoying my discussion with the children during the lesson…* I wish *we could have number 11's story because I cannot imagine myself going back to the old way…"*

Teacher 3 added the following

> *"…why don't we develop a story to present number 11 at least we can work together which will help us to practise that while you are here with us…"*

As a result of this conversation, we decided to work together to develop the new story with a focus on the number 11 because the teachers needed to extend the number curriculum for the children. Each teacher suggested a theme for the story and after several discussions; we picked up the theme and developed the story events. The fifth story, *The lesson I will not forget* was developed with the same main characters as previously: father, mother, and their two daughters Maha and Reema, See appendix C.

5.2.5.4 Post-implementation Interviews: Teachers and Children

Conducting interviews with the participating teachers and children was the last step in the intervention process. A semi-structured interview was held with the teachers in order to find out about their experiences and perspectives on the new approach and to gain fresh insights into this way of teaching. All of the interviews were conducted in school within the normal school day. Table 4-5 at page 156, provides an overview of the interview schedule: the number of teachers interviewed, the interview place, the schools, and the duration of the interview.

The main objective of interviewing the children at this stage was to find out if they could apply and see mathematical concepts around them in their daily life after they had experienced the story-based approach to teaching and learning. All of the interviews were conducted in the school within school time and with the same children.

5.2.5.5 Conducting the Inspectors workshop 2

After finishing the first half of my research journey and collecting data for analysis from the participating teachers and children, I received a request from an inspector to conduct another workshop for a group of Inspectors and about 25 public school teachers. It was a good opportunity for me to present my work to public schools and to a different group of Inspectors.

The content of the workshop was the same as already presented (see page 196) with the addition of a section which shared the preliminary findings on the advantages of the new approach based on an initial analysis of the data collected from the classroom observations as well as the interviews with the teachers and children.

5.3 Summary

This chapter rehearsed the five stages of the preparation and implementation of the research intervention. The elements of the first stage (*Preparation 1*) included writing the first three stories, recruiting the research schools, an initial meeting with the participants at each school to introduce the focus of the study and distributing the initial questionnaire to the participating teachers. The second stage (*Implementation1)* involved conducting the pre-intervention observations, and conducting the pre-intervention interviews with teachers, mothers, and children.
The third stage (*Preparation2*) focused on developing the fourth story as well as developing the teachers' workshop whilst the fourth stage (*Implementation2*) focused on conducting the teachers' workshop and presenting the first story by the researcher. And finally, the last stage (*Implementation3*) involved observing the teachers whilst using the new approach, developing the fifth story and conducting the post intervention interviews with the teachers and children.

An analysis of the teachers' questionnaire, pre-and post intervention interviews with teachers, mothers, and children as well as pre and post- intervention maths class observations will follow in Chapter 6.

Chapter 6: Analysis and Commentary

6.1 Introduction

Chapter four focused on the methodology and the research methods that were followed to gather the data for this study and chapter 5 detailed the development of the research intervention. This chapter will present the results and analysis of the research data in three sections and provide relevant commentaries. The first section will present the teachers' biographical details from their responses to a short questionnaire; the second section will shed light on the interviews with the teachers, children, and mothers and finally, the third section will focus on an analysis of the observation of the mathematics sessions and free play periods. Interviews and observations were used as the principle methods of data collection in order to obtain deeper insights into the teaching and learning practices that were being investigated. A short questionnaire was used only to collect background information about the teachers. All these data were analysed by using thematic analysis hence this chapter includes the details of this process and the steps that were followed to complete the analysis.

6.2 Thematic Analysis

It has been argued that all qualitative studies include some form of thematic analysis, utilising a search for patterns, groups or categories of arising themes, (Bogdan and Biklen, 2003; Powney and Watts, 1987). As outlined in the methodology chapter, thematic analysis is concerned with the identification of themes and patterns hence I used in-depth, line-by-line reading, thinking, naming and taking notes to inform and complete the analysis process. This approach to analysis was not easy as it was exactly like someone lost in a dark complicated maze and s/he has to find her/his way out. I read and re-read the data many times to help myself understand and create a clear picture about the analysis process. I adopted the following four steps as explained by Green et al. (2007):

i. *Data immersion* by reading, listing and re-reading the interview transcripts and observation checklists to gain a clearer picture about the issues that were being investigated. This step made the data more manageable and ready for coding.
ii. *Coding* the data by using different colour markers to sort and tag the data. During this step, there was a lot of moving to and fro through the transcripts for coding and re-coding; returning to the research aim and questions; looking in depth and finding the right connection between the complete data set and individual data; and looking at the research questions in order to identify the correct coding.
iii. *Creating categories* by reviewing all the coding and trying to find connections or relationships to fit them perfectly as much as possible together under one category. It took time to find the right connections between the coding and to categorise them correctly.
iv. *Identifying key themes.* For this step, I worked on all the different categories that I had generated from my data to ensure that all of the categories had connections to each other under an identified theme.

At the end of these four steps, the data analysis process was complete and the results were ready to be written up.

Figure 6-1 provides an example of the data analysis process and illustrates the steps that I followed to complete the process with one teacher's responses to questions 1 and 2 in the teaching mathematics section of the teacher's interview.

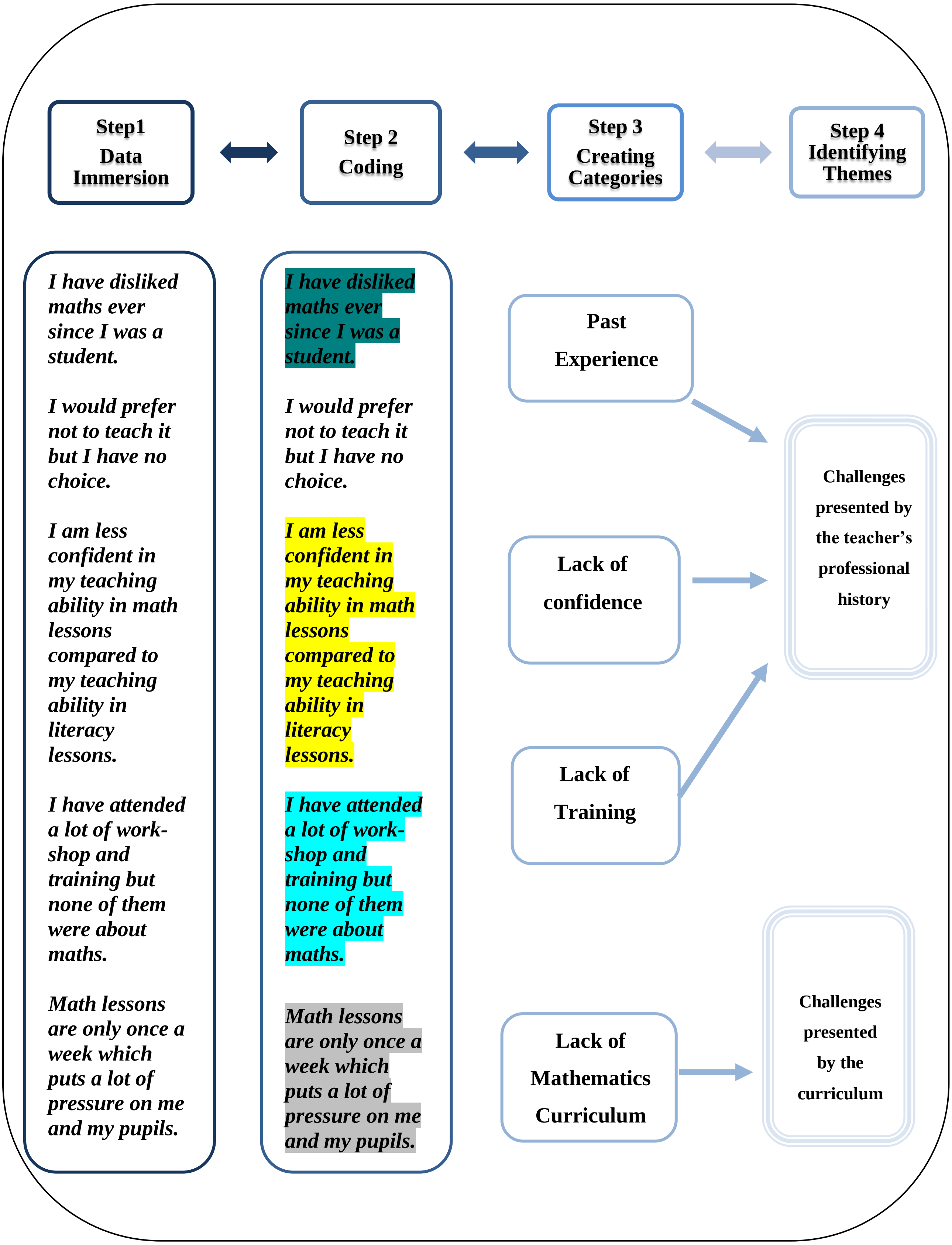


Figure 6-1: Example of the Data Analysis Process

The following sections will revisit each data collection method, provide a summary of the reasons for using each method already detailed in chapter 4; and provide an analysis of the data generated by each method pre- and post intervention.

6.2.1 Data Analysis Part 1: Teachers' Professional Histories

I started my data collection by using a short biographical questionnaire with the teachers. The questionnaire contained a total of nine questions aimed at gaining insights into the teachers' professional histories. Questions 1-4 focused on the teachers' qualifications and experience in early years education while questions 6-9 asked the teachers about their feelings about maths and their approach to teaching maths in particular. The reasons for using the questionnaire can be summarised as follows:

- to collect background information about the teachers' professional experience and to help them feel more relaxed about the process;
- to save time at the later interviewing stage by not needing to ask questions that I could collect more quickly and efficiently through a questionnaire.

The first five questions of the questionnaire provided me with insights into the teachers' professional background prior to beginning the interviews. In this way, it enabled me to start the interviews with insights into each teacher's training and qualifications as well as their teaching experience (number of years). A total of ten teachers filled out the initial questionnaire, three teachers from school A, two teachers from school B, and five teachers from school C. I received all of the completed questionnaires one week prior to my next visit to the schools.

Table 6-1 summarises the teachers' biographical information collated from the initial questionnaire

Table 6-1: Summary of Teachers' Biographical Details

Teacher Number	Teacher Qualification	Teacher Experience in years	Training and Professional Courses Attended
1	High school	11	• Opening sessions. • Corner time periods • How to become a successful teacher • Integrating thinking skills in the daily program. • Computers
2	Bachelor degree in art	7	• Opening session. • Ending session. • Psychological problems in children. • Corner time period. • Farewell and reception unit.
3	Diploma in early learning	13	• Opening session. • Ending session. • Psychological problems in children.
4	Bachelor in early learning	5	• Brainstorming. • Learning difficulties. • Psychological problems in children.
5	High school	9	• Opening session. • Corner time period. • Psychological problems in children. • Farewell and reception unit.
6	Diploma in early learning	16	• Corner time period. • Psychological problems in children. • Creating educational methods (stories and cognitive games)
7	Bachelor in agriculture engineering	12	• Three general courses for pre-school teachers
8	Bachelor in early learning	7	• Opening session. • Corner time period.
9	Diploma in computer	19	• More than one course in teaching methods. • Brainstorming. • Learning difficulties.
10	High school	10	• Two general courses for pre-school teachers. • How to make a story and present it.

As can be seen from table 6-1, two teachers held Bachelor degrees in early childhood studies, two held diplomas for teaching in pre-school, three had high school certificates, one held a Bachelor degree in agriculture engineering, and one held a diploma in computing. This meant that only four out of the ten teachers were trained specialists in early years teaching and learning. Their experience as pre-school teachers ranged between 5 and 19 years. Most of them had attended between 2 and 5 courses related to teaching and dealing with pre-school children but none of these courses were related to literacy or mathematics learning.

The latter questions in the questionnaire (Q 6-9) asked the teachers to share their perspectives in relation to teaching maths. When asked whether they found maths teaching *interesting, acceptable or challenging* (question 6), six out of the ten teachers responded that they found teaching mathematics to be challenging for both themselves and for the children whilst the remaining four teachers found maths teaching 'satisfactory'. Those teachers who found mathematics teaching challenging suggested that mathematics is:

- an inflexible subject;
- difficult to make attractive because it is all about numbers;
- ' boring' and they have to follow the same steps in each lesson; and
- difficult to find appropriate materials.

All of the teachers listed interactive teaching as the strategy they adopted to teach the children in the mathematics sessions (Question 7). Different support tools and materials to present and teach mathematical ideas to the children were identified by the teachers, for example whiteboards, pictures, concrete materials, books, and, in School B they used an interactive white board (Question 8). In response to question 9, *Do you use children's literature in any way other than for teaching language?* all of the teachers used stories for different purposes but mostly for teaching literacy, presenting good manners and dealing with bad behaviour and poor attitudes. No one reported using stories to teach mathematics.

The teachers' responses to the initial biographical questionnaires provided essential background information on each teacher which facilitated a relaxed and focused start to the subsequent interviews.

6.2.2 Data Analysis part 2: Interviews with Teachers, Mothers and Children.

Semi-structured interviews were chosen as one of the main data collection methods for this study because they supported an in-depth probing of the participants' responses thus helping to inform the research questions. There were three separate semi-structured interviews, one for each group of participants: teachers, mothers and children. (See Appendix B)

- The interview process with the ten teachers was divided into two stages: *pre-intervention* (where the teachers used their current way of teaching) and post-*intervention* (where the teachers applied and used the new method). It needs to be noted at this stage that the researcher is aware that on some occasions, the number of teachers' responses cited is sometimes very small. However, one of the purposes of utilising the semi-structured interview approach was to provide opportunities for the teachers to focus on the most important issues and concerns for them. Hence, not all of the teachers responded equally to all of the questions but shared more of their thinking in relation to the questions that provided most scope to reflect on their personal preoccupations or perspectives.
- There was only one *pre-intervention* interview with the three mothers (two mothers from School A and one mother from School C).
- The interview with 50 children (15 children from School A, 21 children from school B and 14 children from school C) followed the same pattern as the interview with the teachers and was divided into *pre-* and *post-intervention* phases.

It needs to be noted at this stage that in this analysis and comparison of pre- and post intervention data, the researcher identifies *significant* changes to the teachers' practices and the children's engagement but in the context of this study the researcher is not making a claim of *statistical significance* but is using the term to *signify important* changes.

Figure 6-2 provides an overview of the substantive content of the interviews with teachers, children, and mothers

Teachers' Interviews

- ***Pre- intervention***
- Teacher background and experience;
- Teacher philosophy of education (teaching, learning and teaching young children);
- Teaching maths;
- Use of stories.
- ***Post - intervention***
- Teaching mathematics after using stories;

Mothers' Interviews

- ***Pre- intervention***
- Mothers' beliefs about the importance of early learning in general;
- Mothers' beliefs about the importance of learning in general; and
- Mothers' beliefs about the importance of learning mathematics at this stage.

Chidren's Interviews

- ***Pre- intervention***
- Attitudes towards school and daily programs;
- Attitudes towards mathematics; and
- Attitudes towards stories.
- ***Post- intervention***
- Attitudes towards school and daily programmes;
- Attitudes towards mathematics; and
- Attitudes towards stories.

Figure 6-2: Substantive Content of the Teachers', Children's and Mothers' Interviews

The following sections provide a detailed analysis of the themes emerging from the data gathered from the interviews with the teachers, the mothers and the children.

6.2.2.1 Interviews with Teachers: Pre- intervention

The prime purpose of the pre-intervention interviews was to examine the possible challenges and obstacles that the teachers experienced whilst teaching mathematical concepts to pre-school children. At the same time, the interviews explored the kinds of activities and resources that the teachers used to reinforce mathematical concepts including whether the teachers were relating the mathematical concepts to 'real world' situations. Finally, the interviews were designed to gain insights into the teachers' attitudes and understanding toward mathematics.

It became clear during the analysis of the data from the pre-intervention phase interview that the teachers encountered some challenges whilst teaching mathematics to pre-school children in Saudi Arabia. The challenges are of three distinct yet inter-related kinds: those that relate to the teachers themselves; others that are linked to the requirements of the teaching process; and finally, those challenges that relate to the overarching management of teaching and learning including the school administration, inspectors, and parents. Each of the different kinds of challenge affected the way that the teachers presented and taught mathematics to children in the early years and will be explored more fully in the subsequent sections of this chapter. Elements from the analysis of the research data will be used to illustrate the connection between my research questions and my primary findings. Firstly, I will focus on the challenges that relate to the teachers' professional histories: past experiences, attitudes towards maths and levels of confidence in teaching maths. I will then move to the challenges presented by the teaching process requirements. And finally, I will present the challenges that emerged from the management of teaching and learning.

Figure 6-3 illustrates the findings from the analysis of the pre-intervention teachers' interviews.

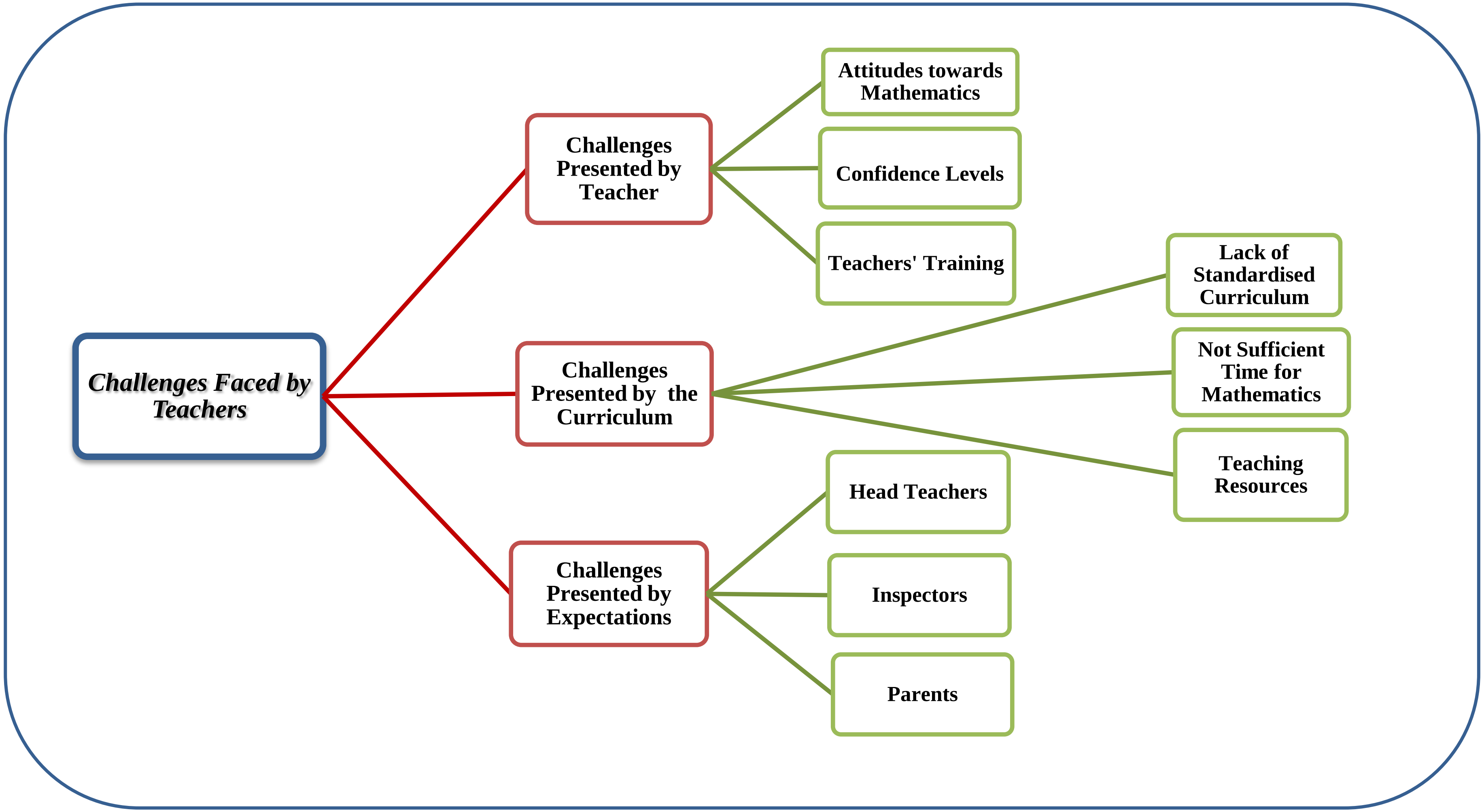


Figure 6-3: Main Themes from the Analysis of the Pre-intervention Teachers' Interviews

6.2.2.1.1 The Challenges Presented by the Teachers' Professional Histories

As highlighted previously in table 6-1, the ten participating teachers had different professional qualifications (ranging from high school certificates through to diplomas and bachelor degrees) as well as different levels of classroom experience between 5 and 19 years. Only four out of the ten teachers held a certificate or qualification that can be said to have provided specialist insights into early education (two teachers had diplomas in early learning and two teachers had bachelor degrees in early learning), whilst the remaining six teachers had either lower qualifications or degree level qualifications in subjects not related to the early years classroom. In effect, this meant that only four of the teachers had both theoretical and practical expertise whilst the remaining six teachers had only the practical expertise. Inevitably, a lack of both theoretical *and* practical expertise would affect their classroom practice as both theoretical knowledge and practical expertise are essential for teachers to be successful in their teaching. It is possible that a teacher who at least has some theoretical knowledge might find it easier to acquire and develop teaching skills based on her knowledge and information about learning theory, pedagogy, and teaching methods. However, those professionals who lack the fundamental knowledge and information about learning theory, pedagogy, and teaching methods may develop the skills but may have a lack of awareness of different ways of teaching and understanding early learning which in turn, could make them less confident than teachers who have both theoretical and practical expertise.

The pre-intervention interview data with the teachers revealed three key aspects to the challenges presented by their professional histories:

- the teachers' attitudes towards mathematics;
- the teachers' confidence level in teaching mathematics;
- level of teacher training

6.2.2.1.1.1 Teachers' Attitude towards Mathematics

The first challenge emerging from the teachers' professional histories was the impact of their past experiences on their present attitude. Generally, human attitudes are shaped by their past or current experiences; a good experience normally leads to a positive attitude whilst bad experiences can lead to a negative attitude. It is possible then, to say the same thing about teachers' attitudes towards any subject that they have to teach: past experiences could affect teachers either positively or negatively. The way a teacher experiences particular subjects as a learner will have impacted on her own learning and, in turn, will impact on the way she will present or teach the subject to her own pupils potentially dictating the way that her pupils will perceive the subject. This view is supported by Buxton (1981) as he claimed that the relationship with mathematics for many primary teachers is full of anxiety, which relates to their negative experiences as a student of school mathematics.

In response to Question 1 in the teaching mathematics section of the teachers' interview, "*What do you think about the mathematics subject in general? How do you find it?"* Teachers 1, 3, 5, and 10 provided some starkly negative emotional responses:

> Teacher 1: '*….Maths as a subject I do not like it…it is difficult and very dull…. Ever since I was in the primary school my teacher was very strict and at home no one helped me…*'

> Teacher 3: '*….I did not like maths when I was student, I would prefer not to teach it but I have no choice…..*'

> Teacher 5: *'I dislike it…throughout my whole life I cannot see the reason why we learn and teach maths…'*

> Teacher 10: '*….to be honest I hated maths ever since I was a student …. Until now I have negative attitude toward maths … it is very boring and dull subject….'*

Even if a teacher believes in the importance of mathematics, her past experiences could still affect her feelings and attitudes toward the subject as in the case of Teacher 4 who commented:

> '*…I believe that mathematics is a very important subject, but still I do not like it. My feeling about mathematics in general is that it's a useless or unfruitful subject…'*

Nevertheless, three teachers in the study, (Teachers 6, 8, and 9) showed a positive attitude toward mathematics stemming from the time they were students themselves.

> Teacher 6: '…*Maths is one of my favourite subjects ever since I was a student …. I am that kind of a person who prefers to understand things instead of memorizing them. That is exactly the way in maths…'*

> Teacher 8: *'…In general I like maths as a subject. From being a student I don't remember having any problem with it….'*

> Teacher 9: '*I love maths as a subject….. Many people say it's difficult but for me it's ok I never faced any problems when I was student…'*

One of the main aims of teaching is for the teacher to introduce new ideas and concepts to her pupils and to help them achieve a good understanding of the ideas under consideration The teacher plays an important role to create the best learning conditions and to plan interventions in pupils' learning to support their progress through their personal Zone of Proximal Development (ZPD) (Vygotsky 1978). Moreover, the teacher's role in the learning process also involves helping students to use and apply their new knowledge and understanding in everyday situations. It is important therefore, that teachers have sufficient knowledge and understanding of the subjects that they will be teaching. According to Vygotsky (1978) the ZPD theory involves an expert (teacher or adult) and novice (student) and through the interaction between the expert and the novice, the novice enhances their understanding and knowledge. In order to act as the expert, teachers can only help students to learn things that they themselves understand and value. The questionnaire responses of Teachers 1, 4, 5 and 10 (as presented above) provided clear evidence that they did not appreciate the purpose of maths or its place in the everyday world, for example, '*it's a useless or unfruitful subject…'(T4), '…I cannot see the reason why we learn and teach maths…'(T5).*

It is possible that the teachers' negative images of mathematics could unintentionally filter into their teaching with unhelpful consequences for her pupils. Bennett (1993) and Bennett and Carre (1993) emphasised the importance of teachers' subject knowledge because it has an effect on teachers' practices from many perspectives, such as being able to diagnose children's schemas, planning appropriate tasks, presenting quality explanations and demonstrations and making curricular choices. Teachers' subject knowledge affects teachers' understanding, teachers' practices, and teachers' confidence. I believe that pupils' understanding is a reflection of their teachers' values and beliefs. If the teacher has a good understanding of the subject and believes in its value, the pupils are more likely to develop the same positive understanding and values whereas if the teacher lacks a good understanding of the subject and does not believe in its value, the pupils are likely to develop the same negative understanding and beliefs. Teacher 6 highlighted both the importance of having positive feelings towards mathematics and in believing in its importance in order to understand it and be successful in teaching it. She said:

> '*…I always hear complaints from my colleagues about maths …Sometimes they say it is useless, other times they are complaining that they could not find activities or materials to help them in teaching it… I told them many times if they want to fully understand and be successful in teaching maths they must love it and believe in its importance…'.*

6.2.2.1.1.2 Teachers' Confidence Level in Teaching Mathematics

Further analysis of the interview data revealed that some teachers were challenged by a lack of confidence in their ability to teach maths. Teacher 3 held an early learning diploma and had been teaching pre-school children for 11 years. She also had been chosen by the school's administration to be responsible for professional development in the school; for example, training teachers, giving them model lessons, and leading them in any school events. In response to Question 2 in the teaching mathematics section of the teachers' interview, "*What do you think about the mathematics period? How do you find it*? Teacher 3 said,

> '*…..I am less confident in my teaching ability in maths lessons compared to my teaching ability in literacy lessons…. I try to do my best but I know that I have a long way to go….'*

Given that Teacher 3 acknowledges her own lack of confidence in her maths teaching ability, the question arises as to what extent she could provide an effective maths training program for the staff in her school. The lack of confidence reported by Teacher 3 could be the result of her lack of subject knowledge. In other words, if the teacher has a good understanding of the subject that she teaches, why she teaches it, and how she is going to teach it then this should result in a fully confident teacher with the ability to teach in a meaningful and creative way. In turn, this should result in knowledgeable and capable pupils full of confidence and with a positive attitude towards the subject.

Teacher 5 also reported a lack of confidence in her ability to teach maths despite her high school certificate and nine years of teaching experience. She mentioned (while she was talking about the mathematics teaching method that she used in her teaching) *'...I will tell you something that I have never said to any one before; I feel that I am failing as a maths teacher…' (*Q7). Up until this point in time it would have been difficult for Teacher 5 to openly admit her difficulties with mathematics teaching as she would have felt that discussing or admitting her failure or nervousness to the head teacher might result in her losing her job (Teacher 5 worked in a private school). The first step to solve any problem effectively is to admit that we are facing a problem. After admitting in the pre-intervention interview that she was facing a problem with her level of confidence in teaching mathematics, Teacher 5 became fully engaged with the research intervention. She was very keen to know about the best ways of teaching mathematics; the latest information that could improve her subject knowledge and what resources she could use to become a creative teacher. By the end of the project, she showed all the signs of being more confident in her teaching abilities with reference to mathematics.

6.2.2.1.1.3 Teacher Training Programmes

High level learning outcomes for pupils cannot happen without the contribution of a well-trained teacher who can motivate the pupils and help them to build a positive attitude toward their studies (Koshy and Murray, 2011). The aim of any training programme is to improve teacher knowledge and the skills that are going to help her to improve her teaching methods and skills. The interview data revealed that none of the teachers had ever attended any workshops or training programmes for mathematics even if we take into account the teachers' qualifications (only 4 out of 10 teachers held certificates in early learning teaching).

All the teachers were agreed about their need for workshops or training programmes for teaching mathematical concepts to pre-school children. Teacher 2, who holds a bachelors degree in art, commented that *'….There are no workshops or training programmes in maths that are available for the teachers…."* This was echoed and expanded by other teachers, for example, Teacher 4 who held a bachelor degree in early learning:

> *'….I wish I could find any workshop or training programmes that I could attend to help me to improve my teaching……. I do believe that maths is very important, but what makes me see it as a useless subject is my poor knowledge about how I can present it and make it attractive for me and the children……..'.*

Teacher 5, who had been teaching for 9 years, commented:

> *'...I have only a high school certificate and because of that I attended lots of training programmes. However, I would be a liar if I said one of them was about maths….'*

Teacher 8, a bachelor in early learning had been teaching for seven years,

> *'….The last time I learned about maths was when I was studying at university…. I graduated seven years ago and since that time I have never attended any workshop or training programmes that are related to maths… I wish to find one because I and many other teachers need to know what is going on, the newest way of teaching maths, especially as we are in a technology era now….'*

The teachers were clearly willing to attend training to improve their mathematics teaching but unlike other countries, for example, the UK and USA, no mathematics national programme for training pre-school teachers or expectation for continuing professional development existed at that time in Saudi Arabia only school based in-house training opportunities.

6.2.2.1.2 The Challenges Presented by the Curriculum Arrangement

Successful mathematics teaching not only relies on teachers being well trained in effective teaching strategies but it also relies on an appropriate mathematics curriculum for younger children; sufficient mathematics teaching time in the school day, and the availability of a variety of teaching materials and resources. A shortage of any one of these could adversely affect the teaching practices and the learning outcomes.

The interview data provided evidence of the following challenges facing the teachers in relation to:

- curriculum design;
- curriculum time for mathematics;
- teaching resources.

6.2.2.1.2.1 Curriculum Design

The mathematics curriculum in each of the three pre-schools (A-C) differed as each school followed its own strategy for developing their mathematics curriculum. Two schools (A and B) developed their curriculum based on the Year 1 curriculum. There were some similarities in the curriculum for School A and School B, but also some differences, for example, School A teaches only addition whereas School B teaches addition and subtraction. School C followed a text book which comes from the UAE. School C focused more on addition and grouping.

Nine teachers mentioned that their school did not have a standardised curriculum. Teachers 2, 3, 4, and 5 said that they developed their mathematics curriculum based on the Year 1 curriculum.

> Teacher 2: '*...In our curriculum, we start with teaching colours then shape; circle, triangle, square, and rectangle. After that we move to the numbers up to twenty. Finally, we finish with addition….. All these we have developed based on the Year 1 curriculum…'*

> Teacher 3: *'...from school to school the curriculum is different…Our curriculum is good because it is based on Year 1's curriculum….'*

Teacher 4: '*…there is no standardised curriculum or at least objectives to follow …. Each school works to develop its own curriculum…'*

Teacher 5: '*…There is no curriculum from the Ministry of Education that we have to follow… We developed our curriculum…. It was not an easy job to do... What we did is go back to Year 1's curriculum and put together our curriculum in the light of that…'*

School C adopted a mathematics text book from the Lebanon, '*…this year we are using a book that has been published in Lebanon. It is much better than the one that we used to teach last year….' (Teacher 6)* Although Teacher 7 also reported that the curriculum was much better she also commented about the repetitiveness of each lesson:

Teacher 7: '*If you mean the curriculum as curriculum, we have been changing the book many times. For me the book that we are using now is better than the one we used before but it is still boring, following the same steps in each lesson, the same exercises have to be repeated…'.*

Teacher 8 was unhappy with the continual changing of the curriculum:

'*…. For the pre-school stage as you know we do not have a certain set curriculum to follow… This year we are using a different book to the one we had used last year….. If we keep changing the book like this that will put all teachers under pressure, also it will not help them to concentrate on improving their teaching method….'*

The responses from all of the teachers interviewed made it clear that the schools and the teachers had the responsibility for developing the maths curriculum and that there were similarities and differences in the way that each school approached the task. The lack of a standardised curriculum for all pre-schools was challenging for the schools as the teachers were required to invest time in developing the curriculum without any checks on its appropriateness for pre-school pupils. A set of clear objectives or a standardised curriculum from the Ministry of Education could act as a framework for teachers and they could then concentrate on how to teach, the methods to be used, and the types of materials that should be prepared in order to teach in an active, effective, productive, and enjoyable way. A standardised curriculum would provide teachers with a clear vision of the expectations for the content of the pre-school curriculum along with the objectives that the pupils must achieve by the end of the year.

It is possible to conclude then, that a lack of objectives and a standardised curriculum could lead to teachers not having clear expected learning outcomes and standards in pre-schools in Saudi Arabia.

6.2.2.1.2.2 Curriculum Time for Mathematics

As part of the teaching process, teachers need sufficient time to teach effectively, to try new ideas, apply practical activities, and give pupils time to work at their own pace. The entire process can only be done effectively if teachers have time. However, what would be the outcome if teachers feel that they are short of time to teach mathematics? Evidence from the interview responses of Teachers 2, 3 and 7 from Schools A and C indicate that a lack of mathematics curriculum time has a significant impact on teaching style and on the pressure felt by both teachers and pupils.

> Teacher 2 (BA in Art): '*...Maths lessons are only once a week, which makes me teach in a didactic way……"*
>
> Teacher 3 (Early Learning Diploma): *'...Maths lessons are only once a week which is causing a lot of pressure on me and my pupils…'*
>
> Teacher 7 (with a bachelor degree in agriculture engineering): *'We have a maths session only once a week…. And maths as a subject is very dull which means that we do not have enough time to present it to children in the right way…. Sometimes, I feel that I put a lot of pressure on myself and my pupils…'*

From the teachers' perspectives, it seems that they did not have sufficient mathematics curriculum time to teach, apply practical activities, try different methods and work with each pupil according to his/ her ability. Insufficient mathematics curriculum time results in the teachers adopting a didactic approach to their teaching. Additionally, more pressure is put on the teacher as she has a curriculum that needs to be covered and consequently pupils are likely to experience maths as boring, irrelevant, unattractive, and lacking in purpose.

However, at School B the situation was different as mathematics sessions were timetabled for twice a week with small numbers of children in each class (Teacher 4 = 15 children and Teacher 5 = 14 children).

> Teacher 4: '…*In this school the head teacher cares about everything, she wants everything to be perfect. Every year we have to add some new things in every curriculum. And this year she added one more session when we complained about the time last year, now I have plenty of time I do not know how to use it effectively…'*
>
> Teacher 5: *'...believe me I tried my best but it is not easy to find attractive material, which make the same steps repeated each session. After the head teacher made it two sessions a week, I have plenty of time I do not know what I can do with it…'*

Ironically, once the head teacher had extended the mathematics sessions to two per week, the teachers now complained about the extra time and it was evident that they did not know how to use it effectively. Tracing back to previous interview responses from Teachers 4 and 5 it is possible to suggest that they were unable to make effective use of the additional curriculum time owing to their previous experiences of maths and their attitudes towards it:

> '*….My feeling about mathematics in general it's a useless or unfruitful subject...' (T4)*
>
> *'...In my whole life I cannot see the reason why we learn and teach maths...' (T5).*

At the same time, a lack of confidence in teaching mathematics stemming from a lack of adequate training programmes may also have led to the teachers' inability to make good use of the extra curriculum time.

> '*….I wish I could find any workshop or training programmes that I could attend to help me to improve my teaching…. I do believe that maths is very important, but what makes me see it as a useless subject is my poor knowledge about how can I present it and make it attractive for me and the children…'* (T4)
>
> '*…I have only a high school certificate. Because of that I attended lots of training programmes. However, I would be liar if I said one of them was about maths….'* (T5).

6.2.2.1.2.3 Teaching Resources

There are many reasons for using materials and resources as part of the teaching process including supporting the teacher in:

- presenting and explaining new concepts;
- making new knowledge more meaningful and relevant including demonstrating its application and importance in everyday life;
- motivating the pupils and engaging their attention;
- helping pupils to practise new ideas and skills.

Using suitable materials and resources in teaching is very important to both teachers and students and adds to the success of the learning process by helping the teacher to represent key ideas in a variety of ways. A teaching approach that uses multiple representations supports pupils in constructing their own conceptual understanding and moves away from the more traditional approach of children learning by rote.

With the exception of Teacher 6 in School C all of the teachers interviewed in Schools A-C were unhappy with the materials that they had been using during mathematics sessions and they faced considerable difficulty in finding appropriate and attractive materials. However, Teacher 6 commented

> '*…For me, because I love teaching this subject I do not care what I use, I will use anything as long as it is going to help me to introduce or explain my new concept for my students….To teach maths, I think it is good idea for the teacher and the student to use materials that come from the surrounding environment which is going to help students to see maths as something relevant to their daily life….'*

From the beginning, Teacher 6, who held a Diploma in Early Learning and had been teaching for 16 years, showed a positive attitude toward mathematics and believed it was an important subject. Her positive attitude may be linked to her own positive past experiences as a student or from her Diploma in Early Learning training but as a pre-school colleague she certainly tried very hard to support her colleagues in developing the same positive attitude.

Evidence from the interview responses from the other teachers in Schools A-C highlighted a lack of good mathematical resources especially when they compared the materials for the mathematics lessons with the materials that they used in the Arabic literacy sessions.

> Teacher 4: '*As I told you before, I am suffering in maths lesson especially when I compare it with the material that we have in literacy sessions…. For example, in literacy we start the session with a story, then we move to a game, and then finish it with a song, but in maths we had nothing only the work book…'*

> Teacher 7: *'... If I compare the materials that we are using in literacy with the materials that we are using in maths I can say there is a big gap between them… In literacy we have at the beginning a story to help the children to figure out the new letter, then different activities, finally we finish with a song… In maths we only have the book. For me some times I used materials from the corners that's the best thing I can do...'*

> Teacher 9: '*... I use the book in school only for children to write in and complete the exercises… To present the new concept I try to use materials that we already have it in our class like some coloured pencils, cups, blocks; I mean anything that is going to help me to make children count… In maths, we have the book only and we have to think about the material that we are going to use to present the concept, not like literacy we have the whole package from a to z ….'*

It is apparent that the teachers at all three schools suffer from a lack of good and attractive materials especially when compared with the materials that they have for literacy. Again, this gap could be related to the teachers' lack of any workshops or training programmes for mathematics that might help them to improve their teaching methods and develop their own teaching materials.

6.2.2.1.3 The Challenges Presented by the Expectations of Managers and Parents

The interviews with the teachers revealed a final set of challenges emerging from the expectations of the head teachers, inspectors and parents. The expectation of the head teacher and inspectors seemed to affect the teachers' work directly, whilst parents' expectations affected the teachers' work indirectly.

6.2.2.1.3.1 Headteachers

The head teacher's perspective on the pre-school curriculum and the mathematics curriculum in particular, is crucial in the context of this study. Eight out of the ten teachers interviewed highlighted that the head teacher in their school did not care for mathematics in the same way they valued literacy and other subjects. The following teachers' responses from School A and School C illustrate the curriculum imbalance as perceived by the teachers.

> Teacher 3: '*…They do not care about maths sessions the same way that they do care about other session such as literacy and English...'*

> Teacher 6: *'...As I said before, no one gives this subject the importance that they should give… To prove it, go and ask them why we have to teach literacy four times a week and maths only once a week... From their answer you will figure out if they do care about maths or not...'*

> Teacher 8: *'In general, maths is less important than other subjects for everyone… Many times we asked the administration to add one more maths session but they refused …they said there are more important subjects and that we need to concentrate on them...'*

It is clear from these views that mathematics does not attract the same care and attention as literacy and other subjects. This might be because of a lack of understanding on the part of the head teachers about the importance of mathematics as a subject providing skills and abilities to solve everyday life situations. Alternatively, it may be because the schools are private schools and the head teachers are endeavouring to prioritise parental expectations.

However, the situation in school B was different. Teacher 4 and Teacher 5 reported that their head teacher cared about everything in her school from the curriculum subjects to the practicalities of session times.

> Teacher 4: '*…In this school the head teacher cares about everything, she wants everything to be perfect…. Every year we have to add some things new in every curriculum…. in this year she adds one more session when we complained about the time last year….'*

> Teacher 5: '*…Our head teacher is very strict with anything related to the pupils and the curriculum…. She always encourages us to search for new ideas especially as we are using the internet and smart board in school... Every year we have to add new things or develop what we already have… She is always attending sessions to evaluate my work and to see if I need any more training...'*

The head teacher of School B clearly wants the best for her school which might be because of her school's standing as a very high achieving private school in Saudi Arabia therefore she is always seeking more effective ways to be at the educational forefront. It is evident that the head teacher in School B listens to her teachers (she allocated more maths curriculum time in response to the teachers) and rigorously evaluates the quality of teaching in her school. The challenge for the teachers in School B is to maintain the on-going development of the curriculum and their teaching practices.

6.2.2.1.3.2 Inspectors

The role of the inspectors in pre-school education is to evaluate teachers' work during the main five periods of the day (circle time, eating time, area or corner time, outside play time, and meeting time) commenting on the strengths and weaknesses of each teacher and helping the teachers to overcome any weaknesses by advising them to attend appropriate workshops or training programmes.

As previously highlighted (Chapter 2), private schools have more teaching and learning periods than public schools. In private schools they teach literacy four times a week and mathematics once a week whilst public schools present literacy and mathematics once a week during circle time period. Head teachers in private schools endeavour to meet parental expectations for the curriculum which may include additional sessions, for example for the Quran, literacy, mathematics, English and computer studies. Any curriculum content for these extra periods must have the approval of the Ministry of Education but the inspectors only evaluate the teaching that is relevant to the five main periods of study. Some inspectors attend some of these extra periods because they have a professional interest in them. In general, each inspector is responsible for a number of schools which means there is only time to observe one or two teaching periods for some teachers throughout the whole semester whilst other teachers may only be observed once in a semester.

During the interviews with the teachers, they were asked to comment on the inspectors' attitudes towards the mathematics sessions. Teachers 2 and 7 offered the following:

> Teacher 2: '…*For the inspector, she never came to evaluate my teaching in maths or literacy … she usually came to evaluate my work on the main five periods that are compulsory from the Ministry of Education…'*

> Teacher 7: '*… The education inspector only comes to evaluate my work in the main five periods …but for the other extra periods she does not. Because of that, I am not sure about her attitude or opinion about maths...'*

However, the responses from Teachers 4 and 9 indicated that there were individual differences in the inspectors' approaches and evidence of developing practice amongst the inspectors themselves. Teacher 4 maintained that her inspector attended one of the literacy sessions, not to evaluate her work but to see the school's approach to teaching literacy whilst Teacher 9 highlighted the inspector's interest and commitment to mathematics teaching.

> Teacher 4: '*…For the inspector, once she was keen to attend the literacy lesson not to evaluate my work, but maybe because she wants to be up to date about our way of teaching, but she never ever asked to attend a maths session...'*
> Teacher 9: '*…The inspector, who we have now, asked me about what we are teaching in maths, then I asked her if she is encouraging teaching mathematics … she said that she is going to fight for it...'*

It is evident that the inspectors are required to carry out a set of duties in relation to the five main periods of the official curriculum which (combined with a heavy workload) might be one of the main reasons that they are unable to take an interest in mathematics or the other extra periods that private schools provide. If the inspectors are unable to give any or sufficient attention to the mathematics curriculum then the teachers are faced with the challenge of maintaining and improving their mathematics teaching without the benefit of the inspectors' observation, feedback and support.

However, the inspectors of School A and School C showed a high level of interest in mathematics after I met them and told them about my project. The inspector of School A asked me to present a workshop similar to the one I had given to the teachers, to other Ministry of Education inspectors and some other private school teachers. After the workshop, all the inspectors who attended the workshop came and thanked me for providing all the new and valuable information. One inspector commented, *'...that is the missing part that we are looking for to start correctly and present mathematical concepts in pre-school…'*

6.2.2.1.3.3 Parents

My personal experience shows that parental expectations affect the work of schools and teachers particularly in the private sector. Schools A-C are all private schools which means that the satisfaction of the parents is at the top of the management's priorities as they pay fees for education. If the parents are satisfied with the quality of the teaching and learning provision then the children will continue to attend the school, otherwise, the parents will move their children to other schools.

All ten teachers in Schools A-C commented that parents did not care about mathematics in the same way that they cared about the Quran, literacy, and English.

> Teacher 1: '*…It's less important for them than literacy... As you know on the next stage reading and writing are the main subjects and everyone concentrates on them… The first question parents ask when they come to register their kids is "how strong are your literacy and English curriculums"... but no one asks about the maths curriculum…'*

> Teacher 2: '*...From my experience, they [parents] do not care about it [maths]... Maybe because literacy skill is something very obvious for parents to see if their children are improving or not…. But for maths, especially in the first semester and the first half of the second semester when they learn about number and counting something, it is not so important because their kids already know how to count even before they start the school…'*

Parental expectations indirectly affect the work of teachers as parents are very concerned about literacy and English teaching in the early years of schooling and so due emphasis has to be given to these areas. Furthermore, in the private schools, the indirect effect of parental expectations is potentially even more damaging as the school management tends towards satisfying the parents' demands at the expense of a broad and balanced age-appropriate curriculum as the parents' satisfaction is very important to ensure that they will continue to bring their children to the school.

If the parents had a better understanding of mathematics and its relationship to other subjects, such as Science, History, Geography and Art, they might be more likely to register their children in a school that really cares about mathematics. As stated by Teacher 6:

> '*…To be honest with you no one gives this subject the importance they should give to it... Everyone gives attention to literacy, English but not maths… If the parents and the schools' owners have enough or the right knowledge about the importance of this subject for the other subjects, then they for sure will give more attention to this subject. Parents will be keen to put their children in schools that care about maths the same way they do care about literacy….'*

6.2.2.2 Interviews with Teachers: Post-intervention Teachers' Interviews

As outlined in Chapter 5, the teachers were introduced to the intervention via a workshop in which I gave a detailed presentation on how to use stories in teaching mathematics to pre-school children. I suggested how this approach could help both the teachers and the children to see mathematics differently including its application in the everyday world. At the teachers' request, I also taught a demonstration lesson for them to observe how the new approach worked in practice. A follow up meeting provided the teachers with an opportunity to raise any questions or concerns about using stories in their maths teaching before they began to integrate the stories into their own mathematics sessions.

For a period of five weeks the teachers introduced the stories into their maths teaching and once this intervention phase was completed, I carried out semi-structured post-intervention interviews to find out the teachers' perspectives on:

- the mathematics sessions;
- using stories as a method to teach mathematics;
- children's attitudes toward mathematics session after using stories, and
- building new knowledge based on previous knowledge and relating to children's daily life through using stories to present mathematical concepts.

It is evident from the post-intervention interviews with the teachers that using stories to present and teach mathematics had a significant impact for the teachers and children and the teaching and learning processes.

Figure 6-4 illustrates the findings from the post-intervention interviews with teachers.

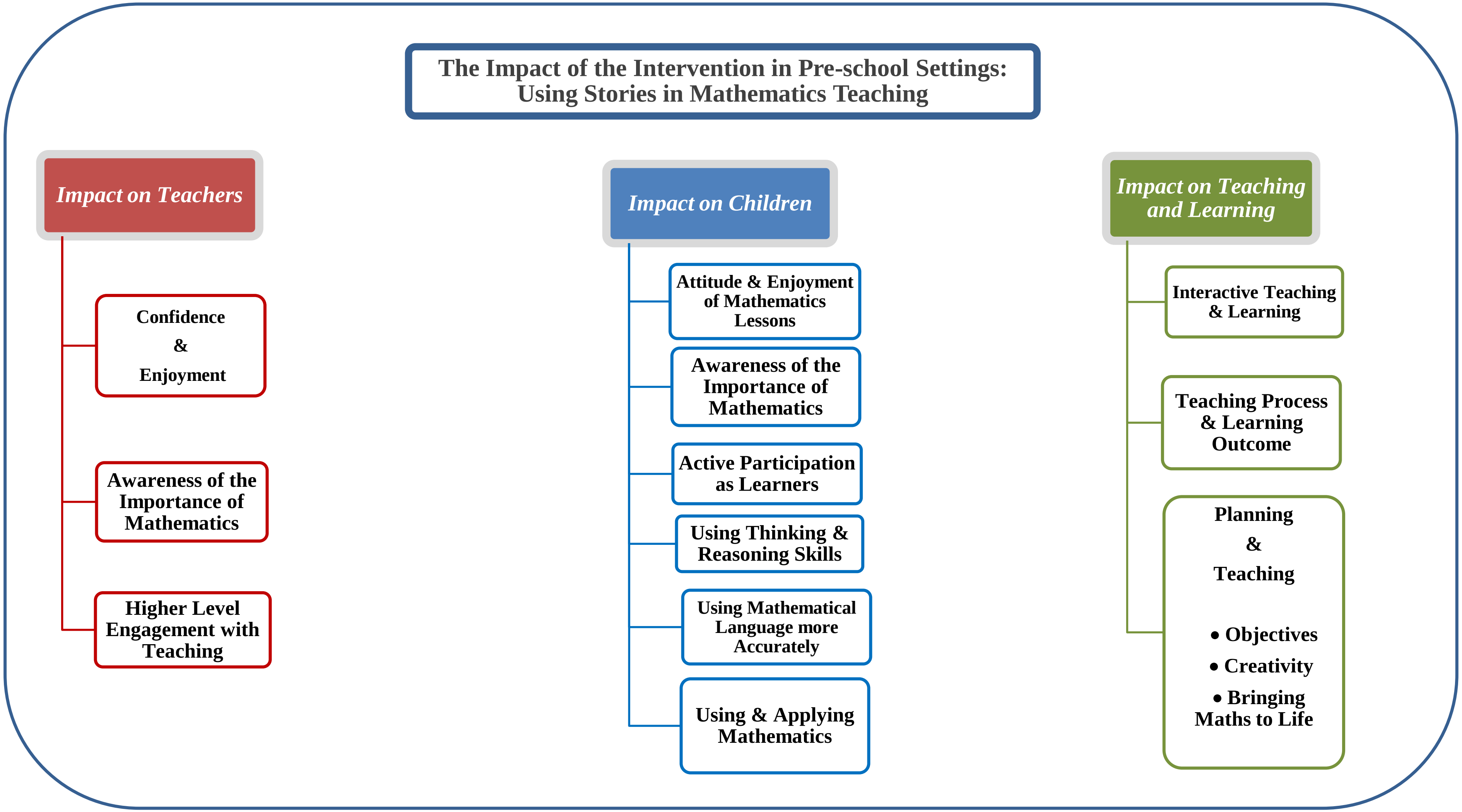


Figure 6-4: Main Findings of the Post-intervention Teachers' Interviews

As we can see from figure 6-4, the analysis of the data from the interviews with the teachers revealed that using stories to teach mathematics had a positive impact on teachers' enjoyment and confidence as well as their awareness of the importance of mathematics, and engagement with teaching. Using stories in the mathematics sessions also impacted positively on the children and the teaching and learning processes. In the following sections, an analysis of the data from the post-intervention interviews with the teachers will be presented to illustrate in detail the impact of using stories on the teachers, the children and the teaching and learning process.

6.2.2.2.1 The Impact of the Intervention on Teachers

The pre-intervention interviews with the teachers in Schools A-C, presented earlier, highlighted some of the challenges affecting their teaching negatively including a lack of early years training opportunities; limited mathematics curriculum time and teaching materials and overall lack of confidence in teaching mathematics to young children.

Once the teachers had participated in the research intervention and used stories to present mathematical ideas and concepts, the post-intervention interviews with the teachers revealed the positive impact of the intervention in relation to the teachers' thinking about maths and their teaching practices. The following section will use data from the post-intervention interviews to illustrate the impact on the teachers':

- confidence and enjoyment;
- awareness of the importance of mathematics;
- level of engagement with teaching.

6.2.2.2.1.1 Teachers' Confidence and Enjoyment

Some of the responses from the teachers during the pre-intervention interviews indicated that the teachers were suffering from a lack of confidence in their mathematics teaching abilities compared to their teaching abilities in other subjects, such as literacy, Quran, and presenting circle time. As highlighted previously (pp 219), this lack of confidence could be a result of the teachers' past experiences or it might be related to the teachers' understanding of the importance of the subject, (or both) plus a lack of training programmes. Any of these reasons could affect teaching abilities, which could also impact negatively on teacher confidence.

At the post-intervention interviews, the teachers responded quite differently as seven teachers said they were now more confident about their abilities to teach mathematics.

> Teacher 1: '…*every time I used a story I found myself more productive and confident in my teaching ability …this way helped me a lot to teach in an enjoyable way for me and for children …"*

This teacher, who had a high school certificate but had not attended any training programme or workshops in relation to teaching mathematics, found herself more confident in her teaching abilities and felt it made her teaching more enjoyable.

Teacher 3 reported herself to be not only more confident in her teaching but also more able to deal effectively with any difficulties that she might face in her teaching,

> '*… my confidence in teaching mathematics increased after I used this way, and I believe whatever the difficulties that I might face in my teaching, this way will make it very easy…'*

Teacher 4 highlighted the relationship between confidence and enjoyment of teaching,

> '*…you cannot imagine how much this way increased my confidence and my teaching abilities which as a result increased my happiness and enjoyment while I am teaching … there is a big difference between my teaching before and after using the stories…'*
> Teacher 5: '*…before using stories maths lessons for me were boring and I really hated maths and children had the same feeling too and they really used to give me a hard time because of their naughty behaviour…but the new method was completely different as it increased my confidence, made me enjoy teaching maths, and most importantly catching children's attention …'*

Using stories in her teaching enhanced Teacher 5's confidence which in turn enhanced her enjoyment of teaching, and more importantly, her ability to capture the children's attention and involve them more fully in the learning process and improve the learning outcome. Capturing children's attention was also highlighted by Teacher 6:

> *'…My confidence in my teaching abilities has increased because I know that my method [using stories] is very attractive for children and it will grip their attention very easily …I remember the first story that you [researcher] presented; we were chanting the same way as the children, everything was beautiful and nice - I mean the story's events, the children's interactions, the questions that you asked them, and the different concepts that you presented. It was more than perfect …from that day I felt more confident and able to present mathematical concepts correctly…'*

As well as identifying the attractiveness of using the new story materials, Teacher 6 also commented on how this approach provided more opportunities for interactive learning and allowed the teacher to present more than one concept at a time.

Before the implementation, six teachers said that mathematics as a subject was boring and difficult for them to teach which in turn affected their teaching and their enjoyment of teaching maths. The teachers considered mathematics to be a dull and lifeless subject which made it difficult to make the lessons enjoyable for the children and the teachers. However, the situation completely changed post-intervention with nine teachers saying they liked the mathematics lessons and enjoyed teaching it.

> Teacher 1: '*…Firstly, my productivity as a teacher differed entirely… I mean after using stories to present mathematical concepts, my teaching became much easier and more enjoyable… I have materials ready to use and I did not need to look and search for attractive and enjoyable ways to present and teach the mathematical concepts to the children because this method already provided that for me …'*

Teacher 1 (high school certificate) made a connection between the *ready availability* of new and attractive materials and an increase in her enjoyment of teaching maths whilst Teacher 4 identified the increase in her enjoyment of teaching with the everyday relevance and familiarity of the *content* of the stories which helped to capture the children's attention very easily:

> *'…Maths lesson became so enjoyable and interesting for me and for the children at the same time…it is full of interesting, enjoyable and relevant events that help me to catch the children's attention very easily…'*

Teacher 6 who firmly believed in the importance of the mathematics (and tried her best to transfer that belief to others) also highlighted the positive impact for both children and teachers by using the stories:

> *'…After using the new method I was really happy and enjoying mathematics lessons …before and a long time ago I believed in the importance of mathematics and I tried my best to make other teachers see that but I did not have much success…. but by using stories everyone got excited and mathematics lesson became very enjoyable for everyone-children and teachers…'*

Teacher 8 commented on the increased interaction between herself and the children,

> '*…Mathematics lessons became very enjoyable…before it was the shortest and most boring lesson but now it is full of interactive discussion between me and the children which makes it very interesting for all of us …'*

In summary, the evidence revealed by the teachers' interview responses highlighted that the key reasons for maths teaching becoming *more enjoyable* was the extent to which using stories helped to:

- catch children's attention very easily particularly as the content was relevant to their everyday experiences;
- provide teachers with attractive and enjoyable materials – particularly important for some teachers who were not very highly qualified in mathematics themselves;
- promote the link between enjoyment and learning;
- encourage more discussion between teachers and children, making it very interesting for everyone

6.2.2.2.1.2 Teachers' Beliefs about Mathematics

In the pre-implementation interviews, some teachers showed a lack of awareness about the nature of mathematics and its importance as a subject and as a discipline which in turn negatively affected their teaching quality. To teach the subject effectively and productively, teachers must be aware of the importance of the subject and have a positive attitude toward it. However, some of the teachers in Schools A-C were completely the opposite as they described mathematic as useless, boring, and an impenetrable and dull subject.

In the interviews following the intervention, seven teachers mentioned that they were more aware of, and believed in, the importance of mathematics and as a consequence their way of teaching mathematics had completely changed.

> Teacher 3: '*...now I really believe in the importance of mathematics in our daily life and I know it will help to make our life much easier...'*

Teacher 3 stressed the importance of mathematics to help to make life easier. Teachers' beliefs about the subject they teach will inevitably impact on the success or otherwise of the learning process. Teacher 4 agreed with Teacher 3's view on the importance of mathematics as a solution for many everyday life problems and she also explained how she used to view maths:

> *'…Now I have strong beliefs about the importance of mathematics in our daily life ... I teach maths now based on that. Before, I used to see mathematics as numbers but now I see it as a solution for many problems that we are facing in our daily life…. Reema's stories helped me as a teacher to believe in the importance of the subject that I teach…'*

Teacher 4, like others, used to see mathematics as *numbers* which might be the reason behind the description of mathematics as a boring, useless and impenetrable subject. Reema's stories helped Teacher 4 to believe in the importance of mathematics. Teachers 7 and 5 also mentioned the stories as the reason behind the change in their beliefs about maths. Along with the stories, Teacher 7 emphasised the importance of the training workshop as instrumental in her change of beliefs:

> *'…now I am teaching maths because I believe in it is importance in our life…after the workshop that you presented to us everything relating to mathematics in my head completely changed from negative to positive and after you presented the first story everything became so clear in my head …'*

Teacher 5 commented on the importance of the everyday life content of the Reema stories in changing her opinion and beliefs not only in her professional life as a teacher but also as a mother:

> *'… All the stories were based on everyday situations and children see it [maths] every day in their daily life …for me as a teacher now, when I tell my children to look at the clock when it is bedtime, immediately I remember Reemas' story and I tell myself how this story has changed my opinion and belief about mathematics …before I used to see it as a dull subject but now I see it as a very interesting subject…if that has happened to me, what about the children ….'*

Teacher 9 also identified a change in her own attitudes and, post-intervention, teaches mathematics because she believes in the importance of the subject in daily life and she has also started to see mathematics concepts everywhere:

> *'…I enjoy teaching mathematics more than ever ….the more important thing is I am teaching because I believe in its importance in our daily life …my view of the importance of mathematics completely changed…now I can see mathematics around us every day…'*

Teachers' awareness of the importance of the subject can affect their teaching positively or negatively (Aubrey, 1995; Ball et al.; Bennett & Carre, 1993; Lee, 2010; Shulman, 1986). A high level of awareness of the importance of mathematics is more likely to have a positive effect on the teaching process and outcome whilst a low level of awareness is more likely to have a negative effect. Teachers who believe in the importance of the subject will work to help their pupils develop a positive attitude toward the subject as well.

6.2.2.2.1.3 Teachers' Higher Level of Engagement with Teaching

Evidence from the pre-intervention interviews with the teachers established that six teachers thought of mathematics as a dull and irrelevant subject, and that teaching mathematics for them was very boring. On the other hand, four teachers found mathematics acceptable but they faced problems in teaching, either because of the lack of training programmes or suitable and attractive materials with clear curriculum objectives.

By comparison, the post-intervention interview data revealed that seven teachers were now more fully engaged with their mathematics teaching. Teacher 4 felt that she had very little to say to the children during her pre-intervention maths teaching but that once she began to integrate stories into her teaching everything changed and she found herself and her pupils fully engaged in the learning process

> *'…even for me, I am fully engaged with teaching process …before I wanted mathematics lessons to end quickly because I did not have much to say ...but now I do not mind if I teach for two lesson without stopping because I know that I and my children will be fully engaged on the learning process….'(Teacher 4).*

This change in attitude is likely to be the result of one or more reasons, for example, an increased awareness of the importance of mathematics or an increased confidence in teaching abilities, or increased enjoyment and therefore a higher level of engagement with the teaching process as represented by Teacher 7 and Teacher 9:

> '*…This method [using stories] helped me in many ways ... first of all it helped me to teach in a meaningful and enjoyable way …secondly, it helped me to teach without stress and engaging in my teaching more effectively …it saved the time that I used to spend to find suitable and interesting materials and many times I found myself stuck, which affected my teaching negatively…'*

> Teacher 9 *'…I do not think any of the teachers who use this method will complain about mathematics being dull, irrelevant, and meaningless anymore because this method helped to overcome many challenges that we used to face …. It really helps us to engage in the teaching process and make sure that I am teaching through a meaningful and enjoyable method for me and for children …'*

Higher level engagement with teaching cannot happen if the teacher lacks an awareness of the importance of the subject or if the teaching seems lacking in purpose. If the teacher has the right level of awareness this could increase her confidence and enjoyment, and ultimately all these will lead to a higher level engagement with teaching.

6.2.2.2.2 The Impact of the Intervention on Children

Many of the teachers' responses in the pre-intervention interviews highlighted that the children found mathematics lessons 'boring' compared to other daily periods. Once the teachers in Schools A-C had introduced the new approach using stories, the data from the post-implementation interviews revealed that the teachers had far more to say about the children's attitudes and participation in maths lessons. The intervention had a positive impact on the children's:

- attitudes and enjoyment of mathematics lessons;
- awareness of the importance of mathematics;
- active participation as learners;
- use of thinking and reasoning skills;
- more accurate use of mathematical language;
- using and applying mathematics.

The following sections will illustrate more fully the teachers' perceptions of the impact of using stories in their maths teaching on the children's learning.

6.2.2.2.2.1 Children's Attitudes and Enjoyment of Mathematics Lessons

Children's attitudes toward any subject will affect their engagement with the learning process and the learning outcome. A positive attitude is more likely to lead to a higher level of engagement with the learning process which is then likely to enhance the quality of the learning outcome whereas a negative attitude is more likely to lead to a low level of engagement and less chance of a positive learning outcome.

In the post-implementation interviews, eight teachers pointed out that the children showed positive attitudes toward mathematics lesson. For example, Teacher 3:

> *'....This way of teaching is completely perfect...it changed our thinking and attitude about mathematics. Children are more than interested, they are looking forward to the maths lessons and keep asking about when the next maths lesson will be…'*

Using stories in her maths teaching changed Teacher 3's own attitude and thinking about mathematics which in turn could have prompted the children's changed attitudes towards maths as a subject. At the same time, the children's enhanced positive attitudes may have been prompted by the children's enjoyment and love of the stories and the strong connection that they developed with the Reema and Maha characters.

> Teacher 4: '*…they [the children] are looking forward to attending mathematics lesson… they keep asking when the maths lesson will be…… I never saw children chanting for anything in the way they chant for the mathematics stories…they really like it and are so keen to attend mathematics lessons…'*

> Teacher 9: *'...the children are really enthusiastic to go to mathematics lessons ... Reema and Maha's stories became very important to them ... they were waiting for the maths lessons to know what the new problem that Reema and Maha were going to face and how they were going to solve it .... This method helped children to build a positive attitude to mathematics…'*

The comments from Teacher 4 and Teacher 9 illustrate that using stories to teach mathematics to pre-school children helped to change and improve the children's attitudes toward mathematics and made them enthusiastic towards the subject. Teacher 8 revealed the extent of the children's enthusiasm,

> '*…they are waiting for the maths lesson with passion… when we want to encourage them to do something [not necessarily maths] we promise to tell them one of the mathematics stories later…'*

Clearly the stories are a strong motivational tool for the teachers to use with the children to gain their co-operation for other task(s) in exchange for one of the stories. This really shows the extent of the children's love for the mathematics stories and what they will do to listen to one of them!

Enjoyment is an important element in the learning process. Although learning is not enjoyable all of the time, a lack of enjoyment could affect children's motivation and engagement with the learning process.

In the pre-intervention interviews, six teachers said mathematics lessons were boring and uninteresting for them and for their children. As suggested previously, this attitude could be as a result of the teachers' lack of confidence or knowledge of the subject or a lack of training in the early years leading to an inability on the part of the teacher to provide stimulating learning experiences and activities for the children.

The post-intervention interview responses from the teachers highlighted a significant change in the teachers' and children's enjoyment of maths with eight teachers commenting that the children enjoyed mathematics a lot. Teachers 1, 2, 3, 4, 8 and 10 agreed that children enjoyed mathematics lessons more than ever after using the stories over a period of time,

> '*…I never saw children so enjoying and being interested in any lesson in the same way they do in the mathematics lessons after using the stories….'* (Teacher 8)

This enjoyment could be as a result of the children's more positive attitude towards mathematics prompted by the teachers' higher level of engagement with teaching which, in turn, helped them to teach in a more effective and enjoyable way addressing the need for children to enjoy their learning. Moreover, stories are considered as a suitable method to teach children at this age, especially when all the stories' events are related to children's everyday life and the pictures are very familiar and clear to them. Teacher 5 commented:

> '*…At story number ten, some children were counting without using their fingers to point out… you only see their eyes moving around the picture …it is really big difference in children's interest, enjoyment, and motivation before and after using the new method…all this familiarity in the stories' events and the pictures helped to increase children's involvement and helped them to be interactive learners…'*

Teacher 5 connected the children's increased enjoyment, participation and interactions to the attractiveness of the illustrations and the familiar context and content of each story which motivated the children to be more involved in the learning process. Teacher 6 also related the children's enjoyment to their love and engagement with the stories which caught their attention from the beginning of the lesson until the end:

'...children are more than enjoying mathematics lesson… they really love the stories .... From the beginning of the story until the end, children were fully engaged and active ... not only in my class but in all other teachers' classes .... I saw that with my own eyes when I attended to observe them while they were teaching using the stories ...this approach will fill up any gap that the teacher faces in teaching mathematics…'

The teachers' responses in the post-intervention interviews indicated that using stories to present the mathematical concepts helped to increase the children's enjoyment of maths at the same time as encouraging the children to engage with the story 'problem' which in turn reflected positively on the learning process and outcomes.

6.2.2.2.2.2 Children's Awareness of the Importance of Mathematics

During the pre-implementation interviews, the teachers did not comment on the children's awareness of the importance of mathematics. However, in the post-implementation interviews, five teachers talked about an increase in the children's awareness of the importance of mathematic. For example, Teacher 2:

'….children have now started to be aware of the importance of mathematics …if we continue using stories to present maths for sure they will make a strong connection between maths and their life and start to see mathematical concepts very easily at home, school, and in other subjects…especially as these stories build on an everyday life experience with a problem solving base …'

Teacher 7 noted the change in the children's awareness of the importance of mathematics with the very first story where all the mathematical concepts 'came alive' through the story's events and Reema's model. She said the following:

'… *at lessons they were really engaged and enjoyed the lesson …. The most important thing was that the children were now aware of the importance of mathematics in their life ...all this started after the first story where all the mathematics concepts came alive through the story's events and through Reema's figure and her attractive pockets…'*

Teacher 6 also explained how the model of Reema helped to increase children's awareness of the importance of mathematics:

> *'…. Children were now aware about mathematical language and concepts better than before …I think Reema's figure helped in this because now they can see mathematical concepts visually which leads them to make connections between mathematical concepts and mathematics around them …. They know now that mathematics is very important to our daily life ….'*

The increase in the children's awareness of the importance of mathematics could be as a result of one or more of the following:

- using a purposeful and engaging teaching approach with a problem-solving element integrated into all the stories helping children to discover how mathematical concepts can solve their everyday problems;
- using attractive visual material (the stories and the model of Reema). The life-size model of Reema acted as a 'transitional object-to-think-with' (Papert 1972, 1976) helping the children to make connections between their past and present experiences of particular concepts as well as connecting the practical with the abstract;
- increasing teachers' awareness of the importance of mathematics via the stories which in turn impacts positively on the children's awareness of the importance of mathematics.

6.2.2.2.2.3 Children's Active Participation as Learners

As has already been noted, many of the teachers in schools A-C lacked the training, knowledge and appropriate materials to teach pre-school mathematics with confidence. Without the necessary training it is easy for teachers to simply teach by rote as opposed to developing purposeful learning experiences. Rote learning may encourage passive pupils memorising facts and ideas If teachers can use meaningful content to teach and present new ideas to children and adopt a more problem solving approach to their teaching then they can help their pupils to be active learners, to develop thinking and reasoning skills and to build new knowledge based on existing knowledge. (Aubrey. 1993; Aubrey. 1994a; National Council of Teachers of Mathematics [NCTM], 1989; Wilkins, 2008; Williams, 2008)

At the pre-intervention interviews, the teachers talked about mathematics as ‘dull’ and lacking in any life and how it is a very difficult subject for them to teach in an attractive and relevant way. The intervention stories aimed to bring mathematics to life for the teachers and the children, as these stories presented mathematics in a meaningful and attractive way, as well as, linking to children’s everyday lives and with a problem solving content aimed to help children to develop different thinking skills, such as, comparing, reasoning, and problem solving.

However, in the post-intervention interviews, eight teachers said that their role evolved from telling children the information directly to guiding them to discover information by themselves in keeping with their developmental stage.

> *‘….I did not give the children any information… they discovered the information by themselves through my questions and through the events of the stories… they got very excited when they discovered the problem or found the solution ……. children love stories a lot …. the best thing about this approach was that the children reached the information by themselves and based on their abilities and understanding ….which means they learnt by understanding not by rote’* (Teacher 8)

This same point was also made by teachers 2, 4, and 7, whilst Teacher 1 highlighted how the children constructed new knowledge by reasoning and making conceptual leaps or connections beyond the original focus of the lesson:

> *‘….they even discovered by themselves some of the concepts that we did not present to them based on the information that we had already presented to them…for example they reached the small smaller, and smallest concept after we had presented the big, bigger, and biggest concept…the stories helped them to learn effectively and use their knowledge to discover new thing based on what they already had…’*

Teacher 5 commented that the stories helped to engage even the children who normally did not participate in class discussions:

> *‘….before using the new approach there were children never participating in class discussions, but after using the stories every child in my class was so keen to be part of the discussion every one want to help Reema and Maha …it really helped them to learn by themselves…their role changed from sitting and listening to talking, discussing and reaching new knowledge by themselves…they became more interactive learners …’*

Teacher 9 also explained how the stories and the model of Reema helped children to build new knowledge based on their abilities and what they already knew. She also highlighted how this approach met the learning requirements for this age:

> *'…while I am telling them the story you can see their eyes moving between the picture and Reema's figure to find out where the new concept will fit into Reema's pockets …it really helped them to change their role from receiving the information to discovering it by themselves ……. The requirements for this stage are to help children to think and reach the knowledge by themselves …and within this approach the requirements are achieved in a very enjoyable way….for example in 'Our New House' story, because the children were getting used to the approach and the procedure to be followed…. They discovered by themselves that the problem in this story was Reema's dislike for the new room because of the triangle shape …'*

The teachers' post-intervention perceptions identified a significant change in the children's role as learner which moved from sitting and listening passively to the teacher to actively participating, talking, discussing, and constructing new knowledge for themselves.

6.2.2.2.2.4 Children Using Thinking and Reasoning Skills

Problem-based learning is one of the pupil-centred approaches which facilitates the development of children's thinking and reasoning skills and helps children to construct new knowledge based on their existing knowledge. To be successful with this type of learning, children need to develop a range of thinking skills such as creative thinking, problem solving, and reasoning. Teachers have an important role in fostering children's thinking through questioning and encouraging them to explain, reason, and find possible solutions.

In the pre-intervention interviews, the teachers revealed that despite realising its lack of effectiveness, they adopted a didactic teaching and rote learning approach because they lacked the necessary training, subject knowledge and confidence to teach mathematics in a more interactive and open way. The lack of attractive teaching materials alongside very little discussion or interaction with the children inevitably impacted negatively on the quality of their teaching and did very little to encourage the development of the children's thinking skills or positive learning outcomes.

Post-intervention there was an increase in the teachers' confidence, enjoyment and awareness of the importance of mathematics and they engaged more positively with teaching providing more opportunities for discussion in their mathematics sessions. Hence, in the post-intervention interviews, the teachers highlighted a difference in the children's thinking. Teacher 4's comment was echoed by Teachers 5 and 7, as teacher 7 said:

> *'……this approach also helped children to used different thinking abilities for example reasoning, comparing, problem solving, classifying and others…..'*

Teacher 1 reiterated the same point about the children's use of different thinking skills but she also highlighted how the children were making connections for themselves and constructing new knowledge without being prompted to do so by herself:

> *'….The new approach helped the children to build different thinking skills like deductive, comparative, and reasoning thinking…. while I am telling them the story, they discussed new ideas that I hadn't even asked them about ...they looked at the pictures and talked about shapes, numbers, and colours of things in the pictures, which means they are using deductive, comparative, and reasoning thinking …'*

Teacher 8 commented on how the use of stories helped the children to use and apply a number of mathematical skills in a natural way and how they enjoyed what they were doing.

> *'…the other thing that approach did for the children was to help them to use their thinking skills in a very natural way…I mean during one session you could see the child using many mathematical skills at the same time, for example, comparing by size, comparing by length, problem solving, counting and many others ….and they really enjoyed doing that ….'*

After presenting the 'Sharing is Useful' story, Teacher 8 was very surprised about the children's interaction with the story and the way they compared Reema, Maha, their parents and their friends as she said the following:

‘…*Today children really surprised me… it was really amazing to see them using different ways to compare between Reema, Maha, their parent, and their friends…. Some compared them by size, some compared them by length, some compared them by heir colour as well as cloth….it was really amazing …’*

6.2.2.2.2.5 Children Using Mathematical Language more Accurately

Children’s confident and accurate use of mathematical language is a sign of good understanding of mathematical concepts whereas poor use of mathematical language could indicate a lack of understanding. In the post-implementation interviews, five out of ten teachers talked about an improvement in the children’s ability to use mathematical language and how the children started to describe themselves, their work, their friends and their teachers by using the correct mathematical language and description.

Teacher 3 provides a pre- and post-intervention comparison of the children’s use of mathematical vocabulary:

‘…before using [the intervention]stories my children used to say that I am the smallest teacher to describe my height compared to other teachers but after using the stories I heard them saying that I am the shortest one of the teachers…the stories helped them to used mathematical language correctly…’

One possible reason for the improvement in the children’s accurate use of mathematical language is the increase in discussion with the teacher and their peers prompted by the events of the stories. Another explanation could be that the new procedures that the teacher adopted to carry out discussions in the class improved the children’s thinking skills which then translated positively into their accurate use of mathematical language whilst communicating with one another. Teacher 7 commented:

‘…now most children, if not all, can use problem solving thinking very effectively, also it is very easy for them now to use mathematical language and vocabulary when they describe something or talk about any situation…. For example, at the corner time you can hear them using a lot of mathematic vocabulary …, and at the art corner while they are drawing you can hear them tell each other about the different shapes and lines that they used in their drawing….’

Another reason for the improvement in the children's mathematical language might be that the model of Reema acted as a visual or transitional object for the children to connect the mathematical concepts with their daily activities. The children would then verbalise and rehearse their connections in their conversations with one another.

> *'…with Reema's figure in the class, I started to hear many children use a lot of mathematical language in the mathematics lesson and at other periods of the day, like corner time …for example, you can hear them describe and compare things by colour, size, and quantity …. Today at circle time, some children were counting how many windows, tables and chairs in the room…'* (Teacher 1)

Teacher 10 also described how the children started to use mathematical language effectively,

> *'…Now I see children use mathematical language and vocabulary very often and in an effective way ... For example , at corner time they were connecting and comparing numbers, colours, and shapes …. When they talked about something they talked about it or described it by using mathematical vocabulary ...one day we were waiting in the corridor and one of them started to compare his height with his friend, then everyone got involved in that comparison , it was very nice when I saw them doing that, which means they start using mathematics effectively ….'*

The improvement in the children's thinking skills, the increase in their awareness of the importance of mathematics, changing their role from passive to active learners, the enjoyable and meaningful content of the stories, and having the model of Reema as a visual transitional object could all have contributed to the improvement in the children's accurate and effective use of mathematical language.

6.2.2.2.2.6 Using and Applying Mathematics

One of the aims of learning is to help students construct new knowledge and to use it effectively. Children using and applying their mathematical knowledge and understanding in other daily periods in the classroom could be another sign of their understanding of the mathematical concepts.

Data from the post-intervention interviews indicated that four teachers reported that the children started to apply different mathematical ideas outside of the mathematics sessions, for example, during circle time, meal time and corner time. Teacher 4 commented that using stories helped children to connect their daily life situation with the stories' events:

> *'.....this method helped children to make a connection between the different mathematical concepts and their daily life activity and other daily periods like circle time and corner time..... Children were really enjoying stories and trying to make connections between the stories' events and their real life; for example, at meal times the children started counting other children's meals and comparing the shapes of their sandwiches.... Two days ago, one of the children brought toast cut in a triangle shape and she told her friend that she asked the maid to cut it the same way that Reema's father did...'*

> *'... Through this teaching approach, it is very easy to build new knowledge based on the previous one ...we can now connect mathematics concepts not only to children's daily life but also to other daily periods, like circle time, meal time and corner time ... For example, at meal time they are talking about different shapes and size of their sandwiches ...'* (Teacher 9).

Teacher 2 explained how the children made a connection between the events in the stories and solving their own problems in the classrooms.

> *'.....At the blocks corner I noticed that while some children were building they put two triangles together to make a square when they ran out of the square shapes ... this made me so happy because they used what they had learned and started to apply their knowledge effectively to solve their problem...'*

It is evident that the children not only enjoyed the stories but that they also used the same problem-solving techniques used by the characters in the stories to solve their own problems in their play and other classroom activity. The children used their thinking and reasoning skills to find solutions. Hence, the increase in the use and application of different mathematical ideas and skills resulted from the *clear modelling* of everyday problem solving approaches embedded in the content of the stories.

There is evidence from the post-intervention interviews with the teachers in Schools A-C that using the Reema and Maha stories, along with the use of the Reema model, had a positive impact on the children's engagement and enjoyment of mathematics lessons.

The following section will provide an analysis of the data from the pre- and post-intervention interviews with the teachers in relation to the impact on teaching and learning.

6.2.2.3 The Impact of the Intervention on Teaching and Learning

The pre-intervention interviews with the teachers in Schools A-C revealed a number of factors that impacted negatively on their teaching. A lack of adequate training for the early years alongside the lack of a standardised curriculum across schools featured strongly in the data. At the same time, a paucity of appropriate and attractive teaching materials was also highlighted by the teachers. The post-intervention interviews with the teachers highlighted a change in the teachers' practices and provided evidence to suggest that using stories as part of their mathematics teaching had had a positive impact on classroom practice in relation to:

- interactive teaching and learning;
- the teaching process and learning outcomes;
- planning and teaching.

In the following sections each of the elements will be illustrated by data from the interviews with the teachers.

6.2.2.3.1 Interactive Teaching and Learning

According to (Aubrey, 1993; Ginsburg et al., 1998; National Council of Teachers of Mathematics, 2000; Sarama and Clements, 2004; Williams, 2008) children must actively engage in the learning process in order to construct new knowledge and understanding within the boundaries of their individual capabilities and based on their previous knowledge. Interactive teaching is an appropriate way to actively engage children in the learning process and can excite and motivate pupils compared to passive learning which is less effective as it involves children sitting and listening without any kind of participation in the learning process.

During the pre-intervention interviews, the teachers said that, despite their best intentions to teach interactively, they invariably found themselves adopting a didactic teaching and rote learning approach. However, in the post-intervention interviews, five teachers highlighted how the children became more engaged in the learning process and how the mathematics lessons tended to be full of discussion. Teacher 4 commented:

> *'…the whole learning process now builds on interactive learning …children are more involved in the learning as they explore, discuss, and solve problems…'*

Teacher 8 not only talked about how the mathematics lessons became more interactive between herself and the children but she also compared mathematics lessons before and after the intervention, stating:

> *'…before using stories the maths lessons were completely lacking in life … we used to teach by rote but after using the stories there was more interaction between me and the children….the most impressive thing about this method is how the children interact and engage with the story during the lesson….. They are really involved in the learning process from the beginning of the lesson until the end with the same level of engagement… you can tell from their attitudes that they do not want the lesson to come to an end …'*

Teacher 6 described how the children engaged fully with the stories and began to anticipate the problems and look for solutions:

> *'…Children now fully engage in the discussion … from their responses you can tell that all their senses are working and engaging to find out what is the problem and how it can be solved …The beautiful thing that I really noticed was that all the children were concentrated on the story and no one was playing or not paying attention ... Everyone was concentrated on the picture, trying to figure out what the answer was for my question and some of them reached the new information even before I asked any question …and that was exactly what happened with one of my children …she counted the stairs and gave the answer even before I had asked the question…and that means they are really fully engage in the*

> *lesson and starting to use their thinking skills and see maths as a relevant and meaningful…'*

Teacher 9 also highlighted how the stories helped to prompt more discussion and problem solving:

'…Using stories to present mathematics helped to make the mathematics lesson become more discussion and discovery based… it is full of interactive learning …I tell the story and the children listen and try to find the problem…'

6.2.2.3.2 Teaching Process and Learning Outcomes

The quality of the teaching process can reflect positively or negatively on the learning outcomes hence enhancing the teaching quality should result in an increase in the quality of learning outcomes. Evidence from the pre-intervention interviews with the teachers suggested that most of them were not satisfied with the way that they taught mathematics to pre-school children. However, the evidence from the post-implementation interviews revealed that eight teachers thought that there had been a significant improvement in the quality of the teaching process and the learning outcomes. Teacher 8 commented:

> '*…I am more confident in my teaching abilities than before …the right way to teach and present mathematical concepts to children are very obvious and clear to me now which reflects positively on the teaching process itself and the learning outcome …'*

Using the stories had increased Teacher 8's confidence which helped her to engage at a higher level with her teaching which, in turn, had a positive impact on the children's engagement in the learning process echoing comments from Teacher 4:

> *'…now children really engage in the learning process and in the activities that we give to them after each story…. This method helps us to present addition to children in very relevant and natural way …. It is really fantastic …it has improved the teaching process and the learning outcome…'*

Teacher 5 also compared the quality of teaching mathematics before and after using the stories, moreover she talked about how her teaching priorities changed post-intervention:

> *'.....Teaching mathematics became more relevant and meaningful not like before where teaching maths used to be irrelevant and very lifeless… my priorities changed completely… What I want now is to help children to understand and enjoy lessons and writing anything down comes later ….'*

Teacher 9's comments reflected the thinking of Teacher 5 and she also gave an example of how the children's engagement with learning had improved and become more effective:

> *'….if we judge the quality of the learning process and learning outcome before and after using the new method there is a big improvement…That day I asked my children about different shapes and their answers amazed me …They not only gave me the shapes' names but they described them for me with some examples from the surrounding environment …'*

Teacher 2 identified how learning mathematics using stories helped to make the teaching process relevant to everyday life experience which reflected positively in the learning outcomes and made it more memorable:

> *'…the learning mathematics process became very enjoyable, smooth and easy …I feel now that children can see and feel maths everywhere … then something happened to me …. Stories helped to connect the learning process with daily life experiences and activities which improved the teaching process and learning outcome positively ....in the 'Sharing is useful' story…the child knows the shape of the piece of pizza…practically all of the children love pizza which helped me to present triangle shapes in a very easy, interesting, enjoyable, and unforgettable way…I expect in this way a child will not forget this piece of information because he gains it based on previous knowledge……'*

Teacher 10 highlighted how the stories helped the children to be more effectively involved in the learning process:

> *'…this method is suitable for children at this stage ...it offers everything they need; for example, audiovisual, thinking skills, and concrete materials, and all this presented to children in story form….. It helped everyone to be involved in the learning process in a more effective and enjoyable way, even the children that used to be very quiet now became very active and enjoyed the lesson …Maha and Reema became an important part for children in the mathematics session…'*

The evidence from the teachers' post- intervention interviews highlights that using the stories in their teaching impacted positively on their level of confidence in teaching mathematics and they began to enjoy teaching mathematics with a new appreciation of its importance and relevance. Inevitably, the changes in the teachers' practices impacted on the children's learning and an increase in the children's level of involvement in the mathematics sessions had a positive impact on the learning outcomes.

6.2.2.3.3 Planning and Teaching

6.2.2.3.3.1 Objectives

In the teaching and learning process, clear objectives are necessary for high quality teaching and learning (Koshy & Murray, 2011). Teachers need to underpin their planning with clear objectives to ensure that the activities are appropriate and that the children are then able to successfully achieve the learning goal(s).

In the post-implementation interviews, three teachers specifically highlighted how the learning objectives became clearer for them. For example, Teacher 3:

> *'…this approach provides us with clear objectives and interesting materials …which really helped us to focus on the teaching quality….'*

Teacher 5 agreed with Teacher 3 and provided a comparison of her teaching before and after the intervention:

> *'…After using the stories I have clear objectives… not like before where I presented a number and the children wrote it down …, but now I have clear objectives and my confidence about my teaching abilities to present something useful and at the same time interesting is very high because I am pretty sure that I am helping my children to achieve the learning targets successfully…'*

Teacher 4 talked about how everything in her mind changed as she became clearer from the objectives as to how to make the new concept relevant to other concepts and to the children's daily activities.

'…The best thing about this approach is that it is very enjoyable when we present it. Additionally, the ideas are very neat and the objectives very clear…. Before, nothing was clear in my mind but now everything is very clear about the objective, method, questions, materials and the most important thing about how to make the new concept relevant to other concepts and for the children's daily activities…'

The evidence from the teachers' post-intervention interview responses suggests that the teachers were more knowledgeable about the learning objectives and the expectations for the learning outcome, which, in turn, helped them to use the teaching approach effectively. Each story had an attachment which contained a clear lesson plan that described the facts, concepts, skills and attitudes that the teachers could present by using the stories in their teaching. The lesson plan clearly helped the teachers to understand the mathematics objectives which also gave them more confidence in their teaching. Finding connections between different mathematical concepts becomes easier and more enjoyable if teachers have a good knowledge about the subject itself and can develop a range of ways to present the concepts to the children.

In the pre-implementation interviews, the majority of the teachers said that mathematics was 'boring' and 'irrelevant'. On the other hand, at the post-implementation interviews, four teachers talked about how it had now become much easier for them to link mathematical concepts to the children's everyday life situations. Moreover, they were more able to present more than one concept during the same lesson.

'….It is very easy now for children to make a connection between the different mathematical concepts…for example, numbers, shapes, length, similarities and differences …it really helped me to present more than one concept during the same lesson …not like before where we used to present one concept during the lesson using a very boring teaching method ….'. (Teacher 4)

Teacher 6 described more about the steps that she used to present new concepts pre- and post-intervention:

> *'…before using this approach we used to present the new concept separately from other concepts, then at the end of the lesson we finished by letting the children write the new number to confirm it… but now after using the stories, I review the previous concept, present the new concept in relation to other mathematical concepts; for example, numbers, shapes,, size, length…..it is big step in teaching maths…'*

Teacher 7 also highlighted being able to present more than one concept at a time and more specifically, how she managed to present different mathematical concepts in a coherent and natural way:

> *'….The stories helped me to teach mathematics relevant to everyday situations…also they helped me to present more than one concept coherently ...I mean from one picture I can help children to see different shapes, colours , size and length within a very smooth ,natural and relevant way…'*

Teacher 5 noted how using the stories helped her to present new knowledge based on previous knowledge and experience and also to present different mathematical concepts connected to the children's daily life.

> *'…this new approach helped me to present more than one concept at the same time, which means it has not only helped me to build the new knowledge based on previous knowledge but helped me to connect different mathematical concepts together, at the same time as connecting them to the children's daily life….'*

Although only four out of ten teachers specifically highlighted their new found mathematics planning skills, their comments demonstrate that there is potential to explore the scope of stories further in relation to supporting teachers in designing mathematics activities that:

- present new knowledge based on previous knowledge and experience;
- connect mathematical concepts to children's daily lives and,
- present more than one mathematical concept at a time.

6.2.2.3.3.2 Creativity

Creativity is an important element in planning, teaching and learning. To teach creatively is to help children to look at familiar things from different angles with a fresh eye and to try to discover and explore new possibilities. According to an inspection report in the UK (Ofsted, 2010) creative approaches to learning improves pupils' learning by:

- stimulating pupils with memorable experiences and practical activity;
- allowing pupils to question, explore and challenge ideas;
- encouraging pupils to think creatively;
- supporting pupils to reflect on and evaluate their learning.

Four teachers described how their teaching had improved and that they had become more creative as a result of the intervention and using stories. Teacher 8 talked about how the stories helped her to present mathematics creatively:

> *'…stories helped us to present mathematics in a very creative way …that approach was not part of our normal practice… it is full of creativity …the teacher's role was showing all these amazing things and helping the children to be creative learners by increasing their understanding and using different thinking skills …which meant they learned by understanding not by rote…'*

Teacher 6 provided more explanation of the creative elements:

> *'…I am pretty sure this way is full of creativity...this creativity comes from different sources …the story itself is full of creativity… the questions that we ask through the story are another form of creativity… Reema's figure shows special kinds of creativities …it is very unique and very attractive at the same time …children really love it …'*

Teacher 9 also referred to creativity in her responses during the post-intervention interview. Pre-intervention, she taught in a very 'traditional' way although she tried to make her teaching engaging:

> *'…Before using this approach I tried many things to make mathematics interesting, attractive, and meaningful but mostly I failed and I found myself teaching maths in a very traditional way …but after you [researcher]presented the workshop and explained about using stories I felt that this different approach would affect teaching mathematics positively and help me to teach creatively …and I was pretty sure after observing you [researcher]and observing the children's reaction …it was amazing… it involved joy, being creative, and it was meaningful and that's exactly what we need to help children to learn effectively…'*

Presenting the mathematical concepts in a creative way by using the stories also helped the teachers to encourage the children to think creatively and to be more effective learners. In particular, the children were more motivated to engage with new ideas; reason and solve problems, and to make connections across different contexts and mathematical ideas.

6.2.2.3.3.3 Bringing Maths to Life

Teachers need to help children to perceive learning mathematics as a human endeavour (Haylock & Thangata, 2007; Robitaille and Taylor, 1997; Seo and Ginsburg, 2004) which will help to increase their awareness of its importance and value to their daily life leading them to see mathematics as relevant and as a 'living subject' not only in the classroom but also everywhere around them.

The lack of life in mathematics teaching and mathematics itself being 'dull' was mentioned by teachers during the pre-intervention interviews which made some feel that mathematics was an irrelevant subject. This adverse attitude of teachers towards mathematics has been explored previously in this chapter however, some changes in the teachers' attitudes and beliefs about the importance of mathematics were evident in the post-intervention interviews. Seven teachers commented how using the stories in their mathematics teaching brought maths to life and helped to them to see it as a living subject.

> *'…it broke the lifelessness that I faced when presenting and teaching mathematics and made it a living subject … this approach truly delivered to children more than one concept at the same time and this made the learning process easy and made mathematics a living subject instead of being a very dull and irrelevant subject…'* Teacher 2

Teacher 7 agreed with Teacher 2 and added:

> *' …using stories is not only an enjoyable method but it helps all of us to see mathematics as a living subject and believe in its importance as a subject and as skills we need in our daily life… the dullness of mathematics disappeared forever and mathematics became a living subject full of creativity …'*

Teacher 4 reflected on how the concrete materials used alongside the stories helped the children to connect between each story's events and their everyday life:

'...they [the children]are enjoying playing with the concrete materials, especially if related to the stories' events ... that helped them a lot to build a strong connection between the stories' events and their daily life activities, which made maths become a living subject .... They can see it around them everywhere ...'

Teacher 9 described how the weekly story helped her to present mathematics within purposeful framework which helped to increase the children's awareness of the importance of mathematics. Moreover, she mentioned how Reema's figure helped to bring the mathematical concepts alive.

'...the maths stories became a series which the children waited for weekly and they couldn't wait to know Maha and Reema's new adventure... It really helped to teach mathematics within a meaningful framework and made mathematics come alive...they [the children]are really aware of the importance of mathematics in their daily lives ... Reema's model helped on that too....it helped to bring mathematics concepts alive ...'

The stories seem to have contributed to an increase in positive beliefs and attitudes towards mathematics amongst the teachers in Schools A-C which in turn reflected positively on the teaching practices and presentation of mathematical concepts to pre-school children. Moreover, this positive attitude and belief about the importance of mathematics also translated into seeing mathematics as a living subject.

The next section will focus on an analysis of the data emerging from the interviews with three of the children's mothers.

6.2.2.4 Interviews with Mothers

The role of mothers in their children's education has long been recognised as a significant factor in educational success and school improvement. Parents and teachers are two of the main sources that children learn from; parents are the main sources of informal learning and teachers are the main sources of formal learning.

Mothers' attitudes and beliefs about any subject influence their children's attitudes and beliefs toward that subject. In addition, in the context of this study, the mothers could influence the policies in the private schools where the parents' satisfaction is a prime consideration. The interviews aimed to find out about the mothers' attitudes and beliefs about:

- mathematics;
- teaching maths in pre-school;
- teaching maths through stories.

In the context of pre-school education in Saudi Arabia, it needs to be noted that mothers take responsibility for their children's schooling. The researcher acknowledges the wide-ranging research into *parental* (both parents) involvement in children's learning but in the context of this particular study the focus will be on mothers and not fathers or other significant others.

Three mothers were interviewed from schools A and C, none from school B. Two of the interviewees held bachelor degrees and the third interviewee held a high school certificate. Only one of the mothers worked outside of the home. Such a small sample size inevitably restricts the possibility of generalising from the interview data nevertheless, the mothers' interviews add another, albeit limited, dimension to the discussion and provides a flavour of some parental (mothers') perspectives. Further research into this dimension would be an ideal focus for future study.

The three areas to be explored during the mothers' interview are summarised in figure 6-5

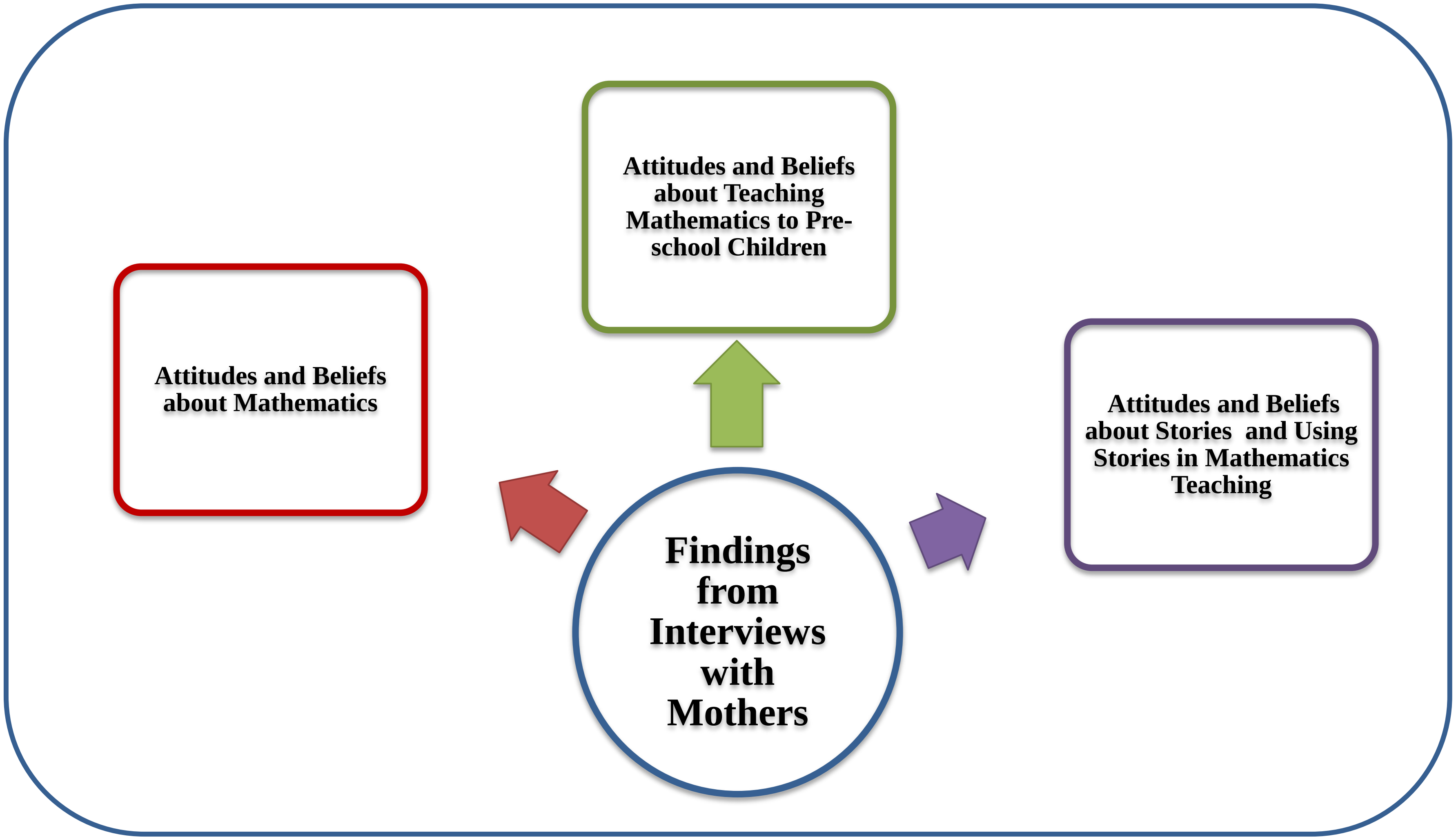


Figure 6-5: Main Findings from Mothers' Interviews

6.2.2.4.1 Mothers' Attitude and Beliefs about Mathematics

Mothers (Parents) have an important role to play in fostering their children's school achievements (Desforges and Abouchaar, 2003). Mothers' attitudes, expectations, and beliefs about schooling and learning guide their behaviour with their children and have a causal influence on the children's development of achievement, attitudes and behaviours.

Hence a mother's attitude toward mathematics is an important element to children's success in mathematics. The interview data with the three mothers revealed that none of them showed a positive attitude toward mathematics.

Mother M had two children, held a bachelor degree and commented:

> *'...mathematics is a very dull and meaningless subject…I suffered a lot because of that subject ...when I had the chance to choose when I started my high school, I decided to continue in the literary section instead of the scientific section, to be far away from mathematics…'*

Mother N had five children and held a high school certificate. She agreed with Mother M about the dull and meaningless nature of mathematics adding that she had to repeat Year 10 because she had failed mathematics which resulted in her not continuing her learning journey:

> *'...I hated maths because it was one of reasons that got in the way of continuing my learning journey…I hated school because I repeated year ten after I failed in maths…it is a very dull, irrelevant, and meaningless subject…'*

Mother R had two children, held a bachelors degree and worked outside the home as an accountant. She commented:

> *'...although I am working as an accountant, I still don't find maths an easy subject, I do not know why I usually have fear of mathematics…it is all about numbers which makes it very dull and irrelevant…'*

Although Mother R is working as an accountant, surprisingly, she still fears mathematics and sees it as a dull and irrelevant subject. When her perspective was probed further she said:

'…it is true that I am working as an accountant but to be honest with you I did not have another choice because that was the only job available and I took it because I wanted to keep myself busy….'

All three mothers demonstrated negative attitudes toward mathematics which resulted from their past experiences of mathematics. All three talked about their schooling: Mother M commented how she chose literature lessons to avoid learning maths. Mother N not only changed her curriculum choices to avoid maths but she decided to end her learning journey altogether. Mother R, even though she was dealing with mathematical operations on a daily basis, still had a fear of mathematics and saw it as an irrelevant subject.

It is possible that the negative attitude towards mathematics as evidenced in the interviews with the mothers could potentially have had an adverse impact on their children's attitudes toward mathematics. Similarly, there could potentially be a negative impact on new developments to the school's mathematics policy as the school's management would want to ensure parental satisfaction thereby ensuring that the children remained at the school hence the management would not want to risk introducing new practices that parents did not value.

6.2.2.4.2 Mothers' Attitudes and Beliefs about Teaching Mathematics to Pre-school Children

All three of the research schools A-C are privately run which means the mothers' requirements are given high priority by the school's management leading to a greater level of mothers' satisfaction. Since parents have this indirect power over the learning process the interviews with the three mothers also aimed to find out about the mothers' perspectives on teaching mathematics to pre-school children, and to what extent they supported their children's mathematics learning.

When the mothers were asked for their perspectives on teaching mathematics to pre-school children, all three mothers agreed that children at this age needed to concentrate on learning literacy (reading and writing) while maths can be learned later in year one. Mother M said the following:

> *'…it is ok [learning maths in pre-school] but I think children could easily learn it later ...I mean reading and writing need more effort…the school must concentrate on them to help children, and make sure they will not face any problems when they move to year one…'*

When asked if she meant that children do not need to learn mathematics at pre-school she commented:

> *'…he does not need it now and he will not get any advantage from it that much…I mean in year one he will learn maths…but reading and writing are more important for them now…any way he can count without help …even for homework, what he needs to do is only write the numbers, and it's only once a week…for maths homework he only counts out the pictures then writes the number, not like reading and writing homework where there is a lot to learn and do for example, recognize letters, writing the letters, and spelling...'*

Mother N echoed the comments of Mother M

> *'…the main reason behind sending my son to pre-school is to learn reading and writing…I chose this school because it is one of the best schools in the city at teaching literacy ...when children finished pre-school they know how to read, write, and spell correctly…for mathematics, it is only about number and they can catch it later…'*

Mother R also showed that she cared more about literacy and English than mathematics, and she believes that children at this stage do not need mathematics because they can count fluently:

> *'… I do not know why they teach mathematics to pre-school children… I think they have to concentrate on literacy and English because that's really what children need ...and for mathematics they can teach it at year one, especially as all children know how to count…'*

All three mothers believed that learning mathematics in pre-school was less important than literacy (reading and writing). Their arguments included:

- children can learn mathematics in year one very easily;
- schools need to concentrate on literacy (reading and writing) at this stage because that will help them a lot when the move to year one; and

- maths is all about numbers and children already know how to count which means they do not need mathematics at this stage as much as they need literacy (reading and writing).

The mothers' perspectives could be the result of their misunderstanding both the importance of mathematics as a subject as well as the content of mathematics (the mothers only saw mathematics as about numbers.) Alternatively, the mothers' perspectives could have resulted from their own experiences of learning maths where the schools adopted a didactic approach to teaching mathematics.

6.2.2.4.3 Mothers' Attitudes and Beliefs about Stories and Using Stories in Mathematics

Using stories in teaching literature is one of the methods that has been widely adopted in pre-school and other stages of education (Anderson et al. 2005) as well as to support the social and emotional development of young children (Hong, 1996). Additionally, parents use stories a lot at home especially if they want to send indirect messages to their children. Most children love stories and enjoy the events and the pictures. Given that the research intervention involved using stories to present mathematical concepts, it was important to find out about the mothers' attitudes toward stories and the use of stories in teaching mathematics.

The interview data revealed that the three mothers had positive attitudes toward stories. They used stories as a technique to correct their children's bad manners indirectly, as Mother M said:

> *'…my son loves stories a lot…he's very keen to know the end of the stories… additionally, I use stories a lot when he does something wrong to correct his bad behaviour indirectly…because he imagines himself the main character in the stories...sometimes while I am telling him the story he said 'but I did not do that' or 'I did it but I am not going to do it again'…I believe that using stories is the successful way to deal with children at this age …'*

As we can see Mother M uses stories as an indirect method to teach her son good manners, and she described her son being interactive with the stories as he not only listens to the stories carefully but he uses his imagination to see himself as the main character.

Mother N, also said that her children love stories and that they have many storybooks at home but she prefers to tell them traditional stories where they can know more about their culture. She prefers to tell the stories that are mentioned in the the Holy Quran, as follows:

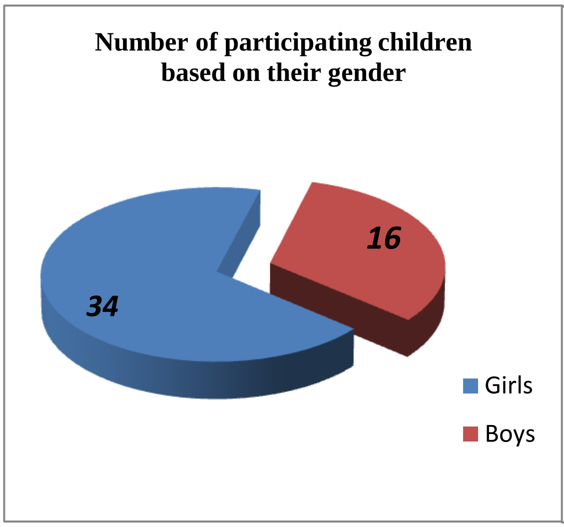
> *'… when I was young, my mum used to sit with us every night and tell us about our culture, all the bountiful stories that are mentioned in the Holy Quran, and the stories that involve the prophet Mohammad's (peace be upon him) era.. . It was so beautiful and we learned a lot from them …. My children love stories and they have a lot of storybooks…. Every night, I sit with them in the same way my mum did and tell the stories about their prophet, culture and all the beautiful stories mentioned in the Quran…for me, it is something very important to build their identity…'*

Mother N uses stories to help her children to build their identities by telling them cultural stories and stories recorded in the Quran.

6.2.2.5 Interviews with Pre-school Children

In the KSA, one of the main purposes of the teaching and learning process is to help pupils to gain the knowledge and skills needed to be effective citizens in their society. However, this cannot be achieved unless pupils enjoy the learning process and find it relevant and meaningful.

It was important to conduct the interviews with the children to find out how the teaching approach that the teachers adopted affected the children. In particular, how the teachers helped the children to develop mathematical skills and knowledge, and an awareness of how mathematics relates to their everyday lives. The interviews were conducted with a group of fifty children (34 girls and 16 boys) attending the three schools A-C. Figure 6-6 illustrates the numbers of children who participated in this study based on their gender and figure 6-7 illustrates the numbers of children at each school.



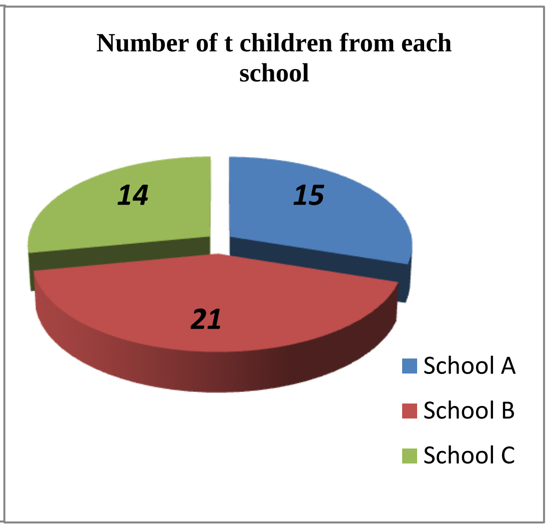


Figure 6-6: Number of Children Based on their Gender **Figure 6-7: Number of Children from each School**

Fifteen children were interviewed from School A, twenty-one children from School B and fourteen children from School C. The children were interviewed twice (pre and post-intervention) in order to make comparisons between the effectiveness of the teaching approaches before and after the intervention, in particular, to explore the impact of using stories on the children's mathematics learning.

An analysis of the pre- and post-implementation children's interview data was organised into two discrete categories in relation to mathematics and one category in relation to children's thinking about stories in general.

- the children's attitudes towards the mathematics lessons:
  - ➢ comparison with other curriculum subjects
  - ➢ feelings about the mathematics lessons
- the children's understanding of the 'bigger picture' of mathematics:
  - ➢ the children's perceptions of mathematical activity
  - ➢ the children's awareness of the use of mathematics in everyday life
- The children's view about the use of stories.

Each category will be illustrated and considered in the following sections.

6.2.2.5.1 The Children's Attitudes towards the Mathematics lesson: Compare with other Curriculum Subjects

All three research schools A-C taught the children the following subjects:

- Quran;
- Arabic (literacy);
- Mathematics;
- English; and
- French (only at School B)

The duration and number of lessons for each subject differed between the schools depending on each school's priorities, interests and orientations. For example, the English lessons at School A were daily for three hours, at School B one hour daily, and at School C one and half hours daily. Mathematics lessons are only once a week at School A and C, whereas mathematics lessons are twice a week at School B.

At the pre and post-intervention interviews with the children at the three schools, I asked them about their favourite subjects. The children's responses are summarised in figure 6-8

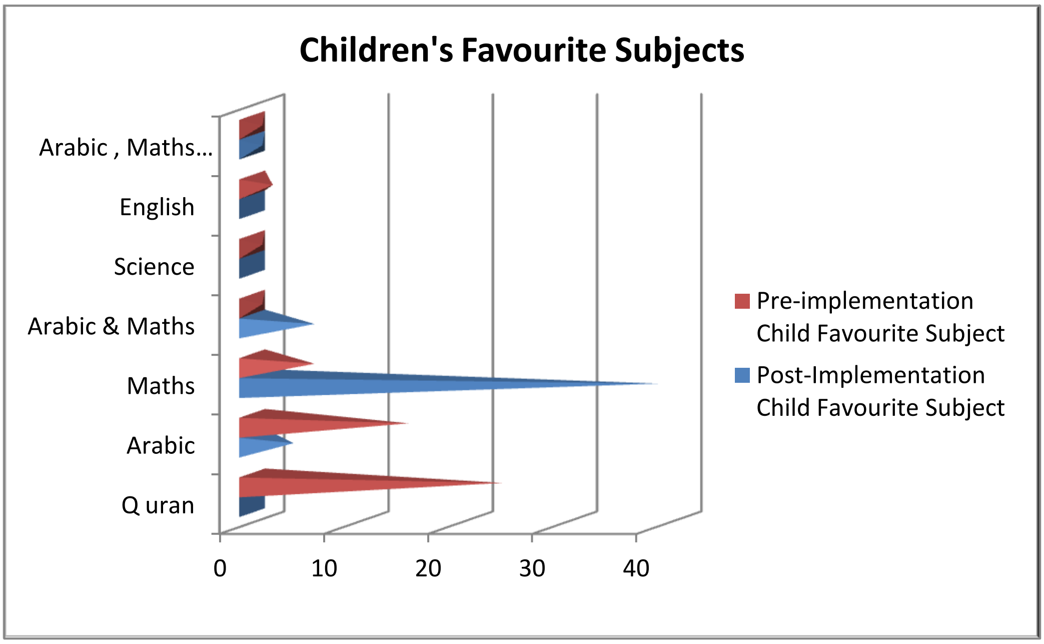


Figure 6-8: Children's Favourite Subjects

As we can see from figure 6-8, the children's pre- implementation interview responses rated their favourite subjects as follows:

Quran; Arabic (literacy); mathematics; English; Arabic and mathematics, science and Arabic, mathematics and English.

On other hand, at the post- intervention interviews the order had changed as follows:

Mathematics; Arabic and Mathematics; Arabic.

None of the children mentioned Quran, English, and Science during the post-intervention interviews.

Table 6-2 provides a percentage comparison for each subject from the pre and post- intervention interview data.

Table 6-2 : Children's Favourite Subjects

Children's Favourite Subjects	Pre-implementation		Post-implementation	
	Numbers of Children	Percentage	Numbers of Children	Percentage
Quran	24	48%	0	0%
Arabic	15	30%	4	8%
Maths	6	12%	39	78%
Arabic& Maths	1	2%	6	12%
Arabic, Maths & English	1	2%	1	2%
English	2	4%	0	0%
Science	1	2%	0	0%
Total	50	100%	50	100%

Table 6-2 illustrates that pre-intervention, the Quran lessons were the most popular with the highest percentage of 48% (24 children) favouring the Quran and representing almost half of the interview group of children. The children's pre-intervention interview responses give some insight into why the Quran was rated so highly by the children. School A: Child 1 said:

Ch 1: I love Quran the most…
R: Why?
Ch 1: Because it is Allah's words… if you read Quran every day Allah will make you go to heaven….

Child 1 loves the Quran lessons because it is Allah's word and he reads it because he wants to go to heaven. As Saudi Arabia is a religious country where everything is built on Islamic law and people encourage themselves and their families to follow this law and motivate themselves to do good deeds, the reward of going to heaven could be the reason for that child's answer. It looks like his mum encourages him to read Quran by telling him about the big rewards that Allah will give him for his good deeds. The interview responses from Child 11 (School A) and Child 14 (School A) also emphasise the importance of Quran for Saudi children and their families:

Ch 11: I love Quran session…
R: Why
Ch 11: Because it is Allah's words….and I love Allah and I want him to love me…

Ch 14: I love Quran …
R: why
Ch 14: Because it protects us from bad things….my mum said even when I get scared if I read Quran I will not be scared any more…

As can be seen from the above responses, the children usually connect reading the Quran with their love of Allah and they use it as a way to show that love, and at the same time they feel more protected if they continue reading it.

The children's post-intervention interview responses about their favourite subjects revealed a significant change in their preferences with the percentage of children favouring the Quran lessons falling from 48% to 0%. At the same time, the percentage of children favouring the mathematics lessons rose from 12% (pre-intervention) to 78% post-intervention.

At the post-implementation interview with Child 1, her answer to the question about which is her favourite subject. Differed as follows:

Ch 1: I love maths
R: Why?
Ch 1: Because it is very useful…
R: Why is maths very useful?
Ch 1: Because we learned many useful things …now I can draw different things with triangle…even my teacher said I am good at that….

Post-intervention, Child 1's favourite subject had clearly changed from the Quran to mathematics. This change could be the result of using more purposeful and attractive materials to teach mathematics, (i.e. the stories) or it could be the change in the child's role from a passive learner to an active learner who can talk, think, and find a solution (or a combination of both possibilities).

Child 11, post-intervention, said that he loved mathematics because he learnt nice things (numbers, colours, money, and size). He said the following:

Ch 11: I love maths…
R: Why do you love it?
Ch 11: It is nice….
R: Why it is nice?
Ch 11: We learn in maths many nice things ….we learn about numbers …shapes…colours…money…and …ahhh….yah I remembered we learned about size….

Whereas at the post-implementation interview, Child 14 identified her favourite subject as mathematics mentioning Maha and Reema's stories as a reason for her love of mathematics:

Ch 14: I love maths…
R: Why do you love it?
Ch 14: Because I love the Maha and Reema stories… I remember Reema's story when she refused to go to school….after that we helped her to put all the things in her pockets… numbers, shapes, colours …money and size

It is possible that such a dramatic increase in the attitude of children towards mathematics was because of the use of stories in the mathematics sessions.

6.2.2.5.2 The Children's Attitudes toward the Mathematics Lessons: Feelings about Mathematics

The second section of the children's interviews explored the children's attitudes towards mathematics lessons and their feelings in particular. This set of questions aimed to monitor the impact of the intervention (prompting changes to the teacher's approach to teaching mathematics) on children's attitudes towards mathematics lessons by comparing their responses pre-and post-intervention.

Figure 6-9 illustrates the findings from the pre- and post-intervention children's interviews and shows their feeling about mathematics lessons.

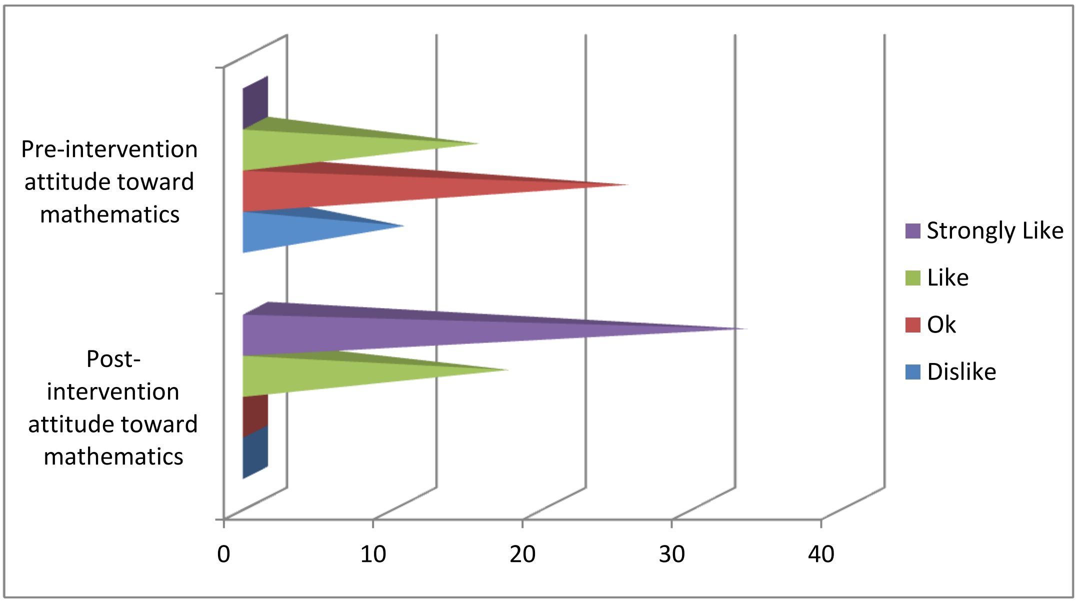


Figure 6-9: Pre- and Post- intervention Children's Attitude toward Mathematics

We can see from figure 6-9 that the children's responses confirmed the four answers; strongly *like, like, ok,* and *dislike*. At the pre-intervention interviews, the order of the children's responses (from most to least) was *ok*, *like*, *dislike*, with none of the children mentioning *strongly like*. However, at the post-intervention interviews, the order of the children's responses were completely different, as *strongly like* came first, *like* came second, and none of the children mentioned *ok* or *dislike*.

Table 6-3 provides a percentage comparison of the children's responses in each category during the pre- and post-intervention interviews.

Table 6-3: Pre and Post- intervention Children's Attitude toward Mathematics

Children's Attitude Toward Mathematics Lessons	Pre-intervention		Post-intervention	
	Numbers of Children	Percentage	Numbers of Children	Percentage
Dislike	10	20%	0	0%
OK	25	50%	0	0%
Like	15	30%	17	34%
Strongly Like	0	0%	33	66%
Total	50	100%	50	100%

At the pre-intervention interviews the highest percentage of children (50%) chose *ok* in relation to their feelings about the mathematics lessons. and the lowest percentage was *strongly like* with 0%. However, there was a distinctive change in the children's responses at the post-intervention interviews signalling an increase in positive attitudes towards the mathematics lessons with the highest percentage (66%) in the *strongly like* category and the lowest categories were now *ok* and *dislike* with 0% for each category.

The pre-intervention interview with Child 31 provides some insight into her feelings about the mathematics lessons.

R: What about the maths session, how do you find it?
Ch 31: I do not like it …
R: Why do you not like it?
Ch 31: Because we only write numbers…
R: How?
Ch 31: We only write numbers….we do not do anything else…
R: You do not do anything else?
Ch 31: aah …the teacher said the number then we count and after that we have to write in the book…

Child 31 dislikes mathematics because it is only about writing numbers which reflects the teacher's approach to teaching mathematics. It is very obvious from the child's comments that her teacher adopts the teaching by rote approach where the children have no role except to follow what the teacher says.

Child 39 had the same attitude as Child 31 and was able to explain more about her feelings and the reasons that make her love the Arabic lessons more than the mathematics lessons:

R: What about maths session how do you find it?
Ch 39: No…
R: No?
Ch 39: I do not like it…
R: Why?
Ch 39: I get bored…we only count then write …I do not like it …not like Arabic lesson…in Arabic we have many nice things…first our teacher tells us stories than we tell her what the new letter is…but the most beautiful thing when we work on the active board is to find out the right order to the stories…and sometimes she ask us about words that start with the letters….

Child 39 had the same negative attitude as Child 31 but also gave very strong reasons for that negative attitude being due to the teacher adopting a teaching by rote approach in mathematics where children sit passively and do not participate in the learning process. At the same time, Child 39 talked about her feelings towards the Arabic lessons where the teacher adopted a more interactive approach where the role of the children change from passive learners to active learners, motivating them and helping them to build a positive attitude towards Arabic.

At the post-intervention interviews with the same two children (Child 31 and Child 39), their answers were completely different. For example, Child 31 responded as follows:

Ch 31: I love maths…
R: Do you love mathematics?
Ch 31: A loooot……
R: Why?
Ch 31: It's very nice….it helps me to do many nice things…and I love Maha and Reema's stories…if you do not know mathematics you will be like Reema….
R: I will be like Reema?
Ch 31: Yaa…you will not know how to count things correctly ….not only that even you will not know how to draw…when Reema's mum told her about triangles….Reema drew very nice picture at the end…she only used triangle….

A similar change of attitude was demonstrated at the post-intervention interview by Child 39:

Ch 39: I love mathematics and Arabic …but I love mathematics the most…
R: You love mathematics the most?
Ch 39: I love mathematics' stories and I am really good at finding about Reema and Maha's problem…I love Reema's figure and love her dress with all that nice pockets…..I drew Reema with all her pockets and hung it in the living room…
R: Why?
Ch 39: To help my mum and my brother to know about the different things that mathematics helps us to learn….

The responses from Child 31 and Child 39 revealed a complete reversal in their feelings towards mathematics post-intervention. Both children were now very positive about mathematics and really enjoyed the mathematics lessons. Moreover, they fully understood and were aware of the importance of mathematics.

This dramatic shift in the children's attitudes towards mathematics from the percentage of *strongly like* at 0% at the pre-implementation interviews to 66% at the post- implementation interviews seems to have been brought about by the changes in the teaching approach prompted by the intervention. The teachers were now teaching in a more interactive way using highly motivating materials (the Reema and Maha stories) and encouraging the children to be active learners participating in (and enjoying) the learning process.

Children seemed to favour the characters in the story which may have provided extra motivation.

6.2.2.5.3 The Children's Understanding of the 'Bigger Picture' of Mathematics

In this section, the results of the pre- and post-intervention interview data will be presented in relation to two aspects of the children's perceptions of the 'bigger picture' of mathematics: the children's perceptions of mathematical activity and their awareness of the usefulness of mathematics in everyday life.

The interviews with the teachers explored their perceptions of mathematics pre- and post- intervention and the data demonstrated that, post-intervention, the teachers had developed a 'bigger picture' of what counts as mathematical activity in the early years and also had a better awareness of the usefulness of maths in everyday life. The interviews with the children continued to explore their perceptions of mathematics in order to monitor the impact of the intervention on the children's perceptions and to what extent the changes to the teachers' practices and the use of new materials (the stories) had had a positive impact on the children's awareness and perceptions about mathematics.

6.2.2.5.3.1 The Children's Perceptions of Mathematical Activity

Figure 6-10 summarises the pre- and post-intervention findings regarding the children's perceptions of mathematical activity.

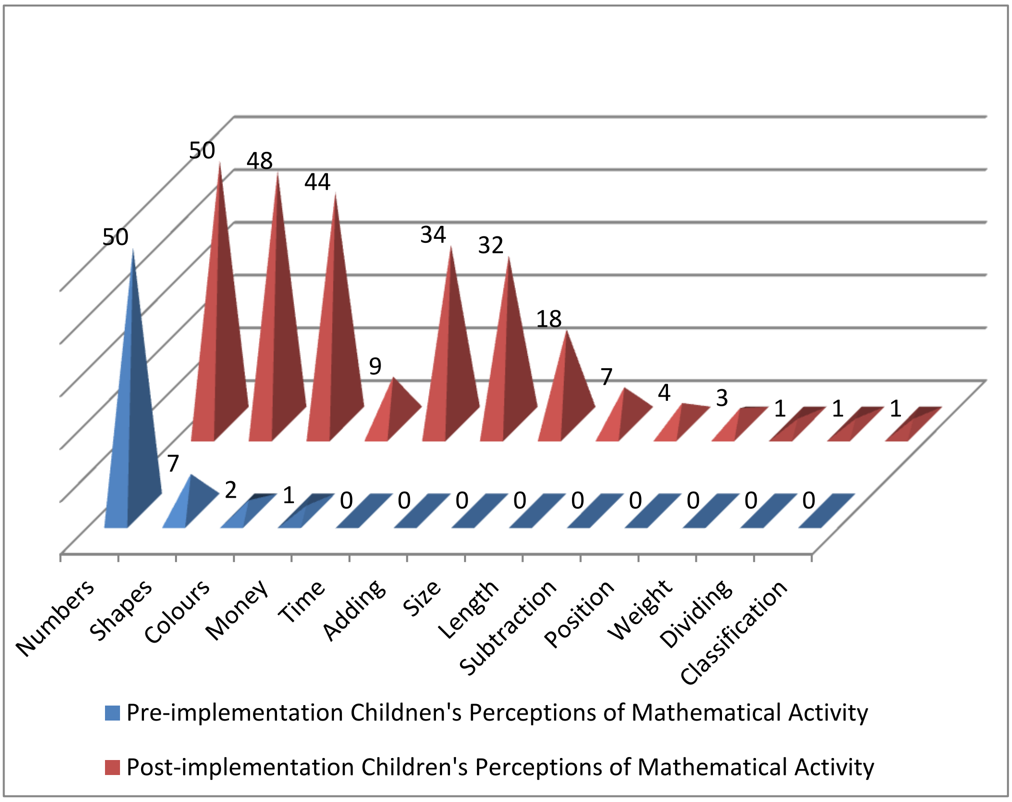


Figure 6-10: Children's Perceptions of Mathematical Activity

The evidence from the pre-intervention interviews highlights that the children's perceptions of mathematical activity is confined only to 'numbers' with a few children mentioning 'shapes'. However, the post-intervention interview data revealed that the situation entirely changed with the children's answers not just confined to numbers and shapes but included money, time, adding, size, length, subtraction, position, dividing and classification.

Table 6-4 summarises the children's perceptions of mathematical activity in percentage form.

Table 6-4: Children's Perceptions of Mathematical Activity

Children's Perceptions of Mathematical Activity	Pre-intervention		Post-intervention	
	Numbers of Children	Percentage	Numbers of Children	Percentage
Numbers	50	100%	50	100%
Shapes	7	14%	48	96%
Colours	2	4%	44	88%
Money	1	2%	9	18%
Time	0	0%	34	68%
Adding	0	0%	32	64%
Size	0	0%	18	36%
Length	0	0%	7	14%
Subtraction	0	0%	4	8%
Position	0	0%	3	6%
Weight	0	0%	1	2%
Dividing	0	0%	1	2%
Classification	0	0%	1	2%

As we can see from table 6-4, ‘numbers’ was identified by the highest percentage of children at the pre-intervention interviews (100%) with ‘shapes’ at 14%, followed by colours with 4% (in the Saudi curriculum colour is one of the concepts to be taught to the children in mathematics but the researcher recognises that colour is not a mathematical concept), and the last one was 2% of the children perceiving money as valid mathematical activity. None of the children mentioned any of the following as mathematical activity: time, adding, size, length, subtraction, position, dividing or classification. Conversely, during the post-intervention interviews, the children’s responses were far more wide-ranging. ‘Numbers’ remained first with 100%; shapes 96%,; colours 88%; time 68%; adding 64%; size 36%; money 18%; length 14%; subtraction 8%; and position 6%. Weight, dividing and classification were each identified by 2% of the children. The post intervention interview data demonstrates a definite broadening of the children’s perceptions of what counts as mathematical activity which will be further illustrated by the following pre- and post interview conversations.

Child 15 from School A

R: What about the maths session how do you find it?
Ch 15: I like it …
R: You like it…
Ch 15: Yahh….
R: Why…
Ch 15: Because I have to study and learn if I want to be grown up……
R: You have to study and learn to be grown up?
Ch 15: Yahh…now I can write one, two, three perfectly…even my teacher today she put nice sticker in my book when I wrote number four…
R: Good for you …ok…what do you learn in mathematics?
Ch 15: We learn about numbers…first our teacher counts and we count after *her then…after that she says to go to the table then I sit quickly and write neatly…I do not like it when the teacher rubs it out and asks me to write it again…*
R: What else do you learn in mathematic other than numbers?
Ch 15: Only numbers…number one …number two…but I like to write number four…
R: You mean in mathematics you only learn about numbers?
Ch 15: Yahhh…

Child 15’s experience and perception of mathematics is that it only involves learning counting and how to write numbers. The teaching approach adopted by the teacher is a teacher-centred, expert-novice approach “… *first our teacher* *counts and we count after her then…after that she says to go to table then I sit quickly and write neatly…".* There is an absence of explanation from the teacher about the possibility of applying and using the new knowledge and also an absence of any follow-up teacher-pupil or pupil-pupil opportunities for discussion.

Child 38 (School B) did not show a positive attitude toward mathematics in her pre-intervention interview and had a similar perception of mathematical activity as Child 15.

R: What about the maths session how do you find it?
Ch 38: Ahhh…I do not like it that much…I like Arabic more….
R: You like Arabic more?
Ch 38: Yahhh…it is more fun…not like mathematics; we only learn about numbers…
R: You only learn about numbers in mathematics?
Ch: Yahhh…every time, all we did was count the numbers many times and after that we write it in the book…and when I go home I have to write it again in the work book…

Child 15 and Child 38 had the same perception and experience of the mathematics lessons even though they attended two different schools and had been taught by two different teachers. However, that could be a sign of major disruption in teaching mathematics in pre-schools in Saudi Arabia as a result of teachers' lack of subject knowledge, training programmes, and misconceptions about learning mathematics.

However, the children's responses at their post-intervention interviews showed that their perceptions of mathematics had changed and they were more able to understand that mathematical activity covers a range of ideas and concepts and not just numbers. For example, post-intervention Child 15 mentioned not only numbers but shapes, colours, time, and money:

R: What about maths session how do you find it?
Ch 15: I love it ….and I love all the stories …
R: Why do you love mathematics?
Ch 15: Because it helps me to learn many good things….
R: Good thinks like what?
Ch 15: Nice things like numbers…shapes…colours…look here (child points at my blouse) that's black…and that red…and this one green…you see I can name all different colours…

R: Wow, you are so good…you said mathematics helps you to learn numbers…shapes…colours…..
Ch 15: There is more ….ammm….yahh time and money…now I am good at using money, not like Reema who gave the seller five instead of fifteen

Similarly, Child 38 highlighted more aspects of mathematics in her post-intervention interview:

R: What about maths session how do you find it?
Ch 38: Yaaa ….I love mathematics the most…I love Arabic but I love mathematics more…
R: Why do you love mathematics more?
Ch 38: It helps me to learn and think….
R: How?
Ch 38: In mathematics we learn about numbers…colours…shapes…and how to add….ammm… also about the time…money …and ahhh…wahhh… I remember one…sizes…do you know how I remembered…
R: How?
Ch 38: I remembered from Reema's figure and her pockets…one for numbers...shapes…colours...time…money…size…ahhh…length…there is more but I got tired (child smiled when she said that)…..

Both Child 15 and Child 38 have started to understand that mathematical activity includes a variety of concepts and not just numbers. This broadening out of the children's perceptions of mathematical activity mirrors the post-intervention developments in the teachers' understanding of mathematics as evidenced in their enhanced teaching practices and reflected in their post-intervention interview responses. The intervention supported the teachers in extending their teaching skills and approaches using the Reema and Maha stories as a focus for less teacher-centred and more interactive teaching. More time for discussion and problem solving enhanced the opportunities for learning which reflected positively on the learning outcomes which in turn enhanced the children's perceptions of mathematics.

Another reason for the change in the children's perceptions could be the model of Reema with her pockets displaying most of the different mathematical concepts. This visual image makes recalling the information much easier for the children whilst at the same time acting as a transitional object to think with and to support the children in constructing and building new knowledge based on their previous learning.

6.2.2.5.3.2 The Children's Awareness of the Use of Mathematics in Everyday Life.

After exploring the children's perceptions of what counts as mathematical activity, the data analysis focused on the extent of the children's awareness of the use of mathematical concepts in everyday life. Mathematics teaching is partly about providing learners with groups of concepts that they can use separately or together to make their lives much easier. Were the children beginning to understand that it is possible to use and apply mathematics in the 'real world'? Did the intervention provide the teachers with materials and teaching strategies that would encourage the children to use and apply mathematical ideas?

The primary findings of the pre-intervention interviews with the children showed that the children's use of mathematical concepts in their daily lives only included writing numbers with teachers and at home with their mum to do the homework. However, the results of the post- intervention interviews were very encouraging as the children talked about and gave examples of their use of mathematical concepts in their everyday life.

Figure 6-11 summarises the results of the pre- and post-intervention interviews in relation to children’s use of mathematical concepts in their daily life.

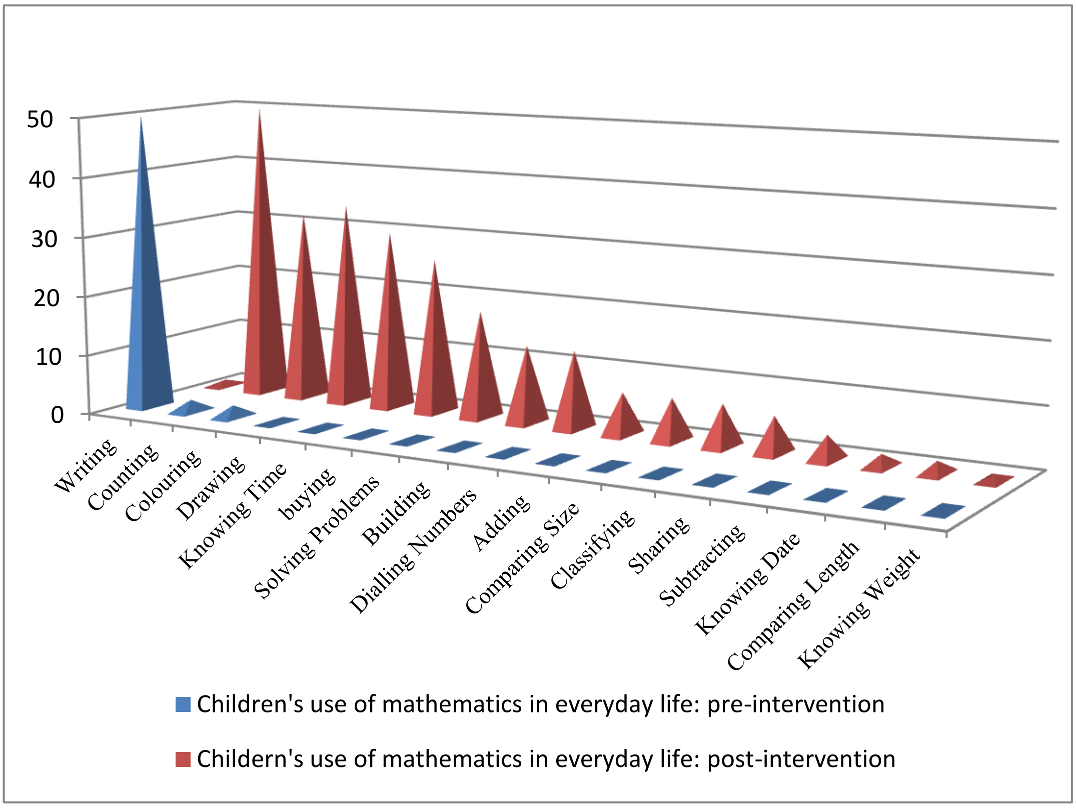


Figure 6-11: Children's Use of Mathematics in Everyday Life

All of the children, pre-intervention, mentioned writing numbers and a few mentioned counting and colouring as ways to use mathematical concepts in their daily lives. However, the post intervention interview revealed a change in the children’s responses and showed a clear improvement in their understanding of the range of uses of mathematical concepts. Not only did the children mention writing, counting and colouring but they added drawing, knowing the time, buying, solving problems, building, dialling numbers, adding, comparing size, classifying, sharing, subtracting, knowing the date, comparing length and knowing the weight of something. This indicates that the children’s knowledge of the possible uses of mathematical concepts in their daily lives had increased from three applications to seventeen applications.

Table 6-5 summarises the percentage of children's interview responses in each category of the use of mathematics in everyday life both pre and post-intervention.

Table 6-5: Children's Use of Mathematics in Everyday Life

Uses of Mathematical Concepts in Daily Life	Pre-intervention		Post-intervention	
	Numbers of Children	Percentage	Numbers of Children	Percentage
Writing	50	100%	1	2%
Counting	2	4%	50	100%
Colouring	2	4%	32	64%
Drawing	0	0%	34	68%
Knowing Time	0	0%	30	60%
Buying	0	0%	26	52%
Solving Problems	0	0%	18	36%
Building	0	0%	13	26%
Dialling Numbers	0	0%	13	26%
Adding	0	0%	7	14%
Comparing Size	0	0%	7	14%
Classifying	0	0%	7	14%
Sharing	0	0%	6	12%
Subtracting	0	0%	4	8%
Knowing Date	0	0%	2	4%
Comparing Length	0	0%	2	4%
Knowing Weight	0	0%	1	2%

Table 6-5 shows that during the pre-intervention interviews, of the three applications identified by the children, writing numbers was mentioned by 100% of the children; counting 4%; and colouring 4%. This indicates that the teaching approach and the materials adopted by the teachers did not help the children to develop an understanding of the applications of mathematics in the real world. However, the post-intervention interview data reveals a very different picture and the percentage of children's responses in each category confirms their enhanced understanding about using and applying mathematics. 100% of the children identified counting as a real-world use of mathematics followed by drawing 68%; colouring 64%; knowing time 60%; buying 52%; solving problems 36%; building 26%; dialling numbers 26%; adding 14%; comparing size 14%; classifying 14%; sharing 12%; sharing 12%; subtracting 8%; knowing date 4%; comparing length 4%; knowing weight 2%; and writing 2%.

This post-intervention change in the range of the children's responses regarding the use and application of mathematics is evidence that the changes to the teaching and learning practices prompted by the intervention impacted positively on the children's awareness. The content of the Reema and Maha stories were centred on problem solving, encouraging children to use their thinking skills and to connect the events of the stories to their own lives to find the possible solutions.

Examples from the pre- and post-intervention interviews with the children will further illustrate the changes in their thinking about the use of mathematical concepts in daily life. Pre-intervention, Child 7 who attended School A commented:

R: Do you think mathematics is useful?
Ch 7: Yahhh…
R: Why?
Ch 7: Ahhh….I do not know…
R: What do you learn in maths?
Ch 7: Amm…today we learned about number four wrote it in the book….we counted how many things there then we wrote the number on the blank page….
R: Where do we need to use numbers…for example, at school or outside the school?
Ch 7: In school ….when we write with teachers…
R: To write with teacher…

Ch 7: Yaaah …and at home…in the afternoon when mum asks me to bring my homework….
R: Your homework…
Ch 7: I have to know how to write properly to make my mum happy…
R: Where else do you need to use numbers other than writing…
C 7: ….Other than writing…ammm… I do not know….

Child 7's limited school and home-based experiences of mathematics has not helped her towards a broad understanding of how to use mathematical concepts effectively in her daily life. However, Child 7's response during the post-intervention interview was completely different:

R: Do you think mathematics is useful?
Ch 7: Yaaaah…and I love it….
R: Why?
Ch 7: In maths we learned about numbers, shapes, colours …ahhh…let me think….I know…money and size…I remembered this when I thought about Reema's story when she refused to go to school…. After that we helped her to put all the things in her pockets…it was fun …I liked it…
R: Good for you….
R: All these things that you said you learnt in maths shapes, numbers, colours, and time. Where do you need to use it?
Ch 7: Everywhere…
R: Everywhere….
Ch 7: To counts things …to call my mum…to know the time ….I use it also when I play with my friend.
R: When you play with your friend … how?
Ch 7: When we play hide and seek…I am good at hiding…when my friend counts I hide fast sometime under the table and sometime behind the door….

Child 7's responses show a good improvement in her awareness of the use of mathematical concepts in her daily life as she mentioned counting, dialling telephone numbers, knowing the time, and playing. One of the reasons behind that change might be seen in the response, *"I know….but…",* as through the discussion the teachers asked many questions to help children find other situations that they need to use numbers, where they mentioned many example, such as, dialling telephone numbers, playing hide and seek, and counting money. At the same time, the model of Reema's figure and the story content also seems to have been a factor in raising and enhancing Child 7's awareness. "*….I remembered this when I thought about Reema's story when she refused to go to school….after that we helped her to put all the things in her buckets…it was fun …I liked it…"*. Child

7 highlighted how thinking about the Reema story makes her remember the different uses of mathematical concepts. The strong visual image of Reema could have linked to Child 7's visual memory and helped her to recall the information effectively.

Child 10 also illustrates a change to his awareness of using and applying mathematics pre- and post-intervention. In his pre- intervention interview he said

R: Do you think mathematics is useful?
Ch 10: Yahhh…
R: Why?
Ch 10: Because it helps us to know how to write numbers….
R: It helps you to know how to write numbers….
Ch 10: Yahh….if we do not know how to write numbers everyone will think that we are babies….
R: Why do you need to learn about number?
Ch 10: Because I need to use it….
R: You need to use it …
Ch 10: Yahh…in maths lessons, the teacher asks us to write in the book…
R: You only use numbers to write with the teacher….
Ch 10: Yahhh…and when I go home I write the number in my homework book …that day my aunty saw my homework book and said, I am so good…
R: You are so good….

In this extract, Child 10's response reflected Child 7's earlier thinking as both stated that using mathematics was solely to do with writing numbers with their teacher and at home with their mum or aunty for homework. At the post-intervention interview with Child 10, his response showed a positive change where he mentioned a greater variety of ways of using of mathematical concepts in his daily life.

R: Do you think mathematics is useful?
Ch 10: Yes….it is very useful...
R: Why?
Ch 10: Because it helps us to do many nice things …
R: Nice things like what?
Ch 10: Like colouring… counting our friends before entering any corner…we cannot count money or know our mum's phone number if we do not know numbers….
R: That means you need to learn numbers to count money and call your mum…
C 10: Yahh…..even if we do not learn about shapes we cannot build houses in the blocks corner…even now I can put two triangles to make square if my friend used all the squares…

In his post-intervention interview, Child 10 described far more ways to use mathematical concepts effectively in his life. He mentioned colouring, counting, money, dialling telephone numbers and building. In the latter context he talked about the technique that he adopted when he found himself at the blocks corner without a square shape. He used two triangles to make a square, showing how he used his knowledge and applied it in a real situation in an effective and productive way. Again, the change to the teaching practices and materials prompted by the intervention seems to have impacted positively on Child 10's awareness of the uses of mathematics in the real world. Additionally, Child 10 is able to give an example of how he used the problem solving technique modelled in the Reema story (Sharing is Useful) to solve his own problem whilst playing with the blocks.

6.2.2.5.4 The Children's Attitude towards Stories

Finding out about the children's attitude towards mathematics was an essential aspect for carrying out this project where the main aim was to explore the impact of using stories to present and teach mathematical concepts to pre-school children. At the beginning of the research, all three schools (A-C) were using stories for different periods of the day; for example, circle time, last meeting time, and for teaching literacy (Arabic) but stories were not part of the mathematics teaching. The data analysis that follows, looks at the children's attitudes towards stories pre- and post intervention but the researcher is aware of the limitations of comparing the data pre- and post-intervention because stories were only introduced into the schools' mathematics teaching *during* and *after* the intervention itself. Hence, any comparison of the children's pre- and post-intervention attitudes in relation to stories will not be a strictly like for like rigorous comparison as the pre-intervention interview focused the children's attention on stories *in general* and the post-intervention interviews asked for their responses to the Reema and Maha *mathematics* stories. Nevertheless, the interview data with the children is worth pursuing in order to gain some sense of the impact of stories on the children's learning experiences – and particularly the impact of the researcher's own stories.

Figure 6-12 shows the responses of children toward stories at the pre- and post-implementation interviews.

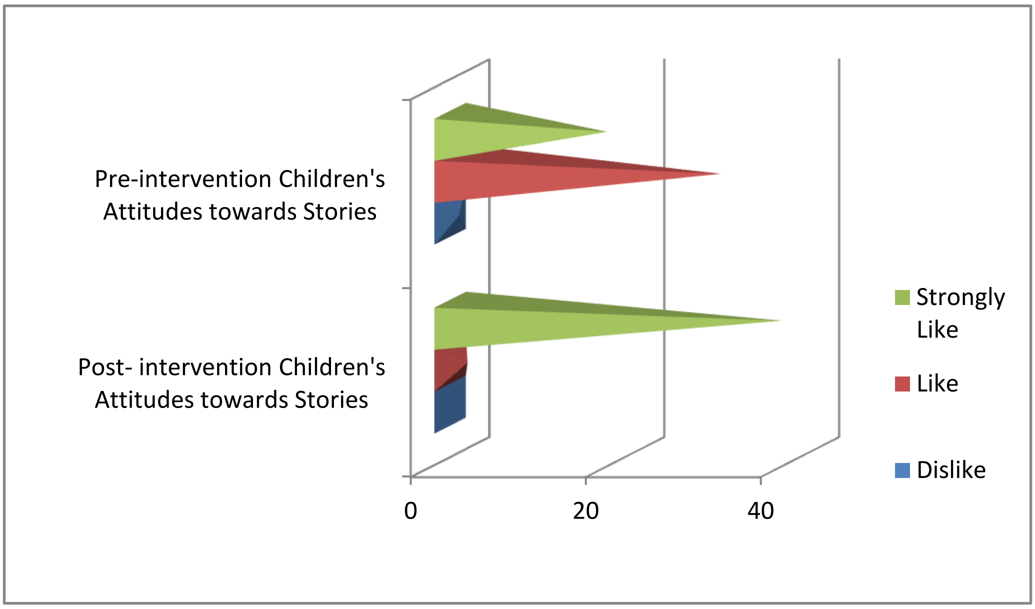


Figure 6-12: Children's Attitude toward Stories

An analysis of the data from the pre-intervention interviews showed that the children had positive attitudes towards stories with most of indicating that *they liked* stories, some of them saying they *strongly liked* stories, and very few responding that they *disliked* stories. However, the data from the post-intervention interviews, indicated an increase in highly positive attitudes towards the Reema and Maha mathematics stories as most of the children said they *strongly liked* the stories, a few said they *liked* stories, and none of them said they *disliked* stories. Table 6-6 provides a detailed summary of the pre- and post-intervention interview data in relation to the c children’s attitudes toward stories.

Table 6-6: Children's Attitude toward Mathematics Stories

Children' Attitudes Towards Stories	Pre-intervention		Post-intervention	
	Numbers of Children	Percentage	Numbers of Children	Percentage
Dislike	1	2%	0	0%
Like	31	62%	2	4%
Strongly Like	18	36%	48	96%
Total	50	100%	50	100%

This table clearly shows that children's attitudes toward stories (in general) at the pre-intervention stage was positive: 62% of the children said they liked stories, followed by 36% who strongly liked stories and 2% who disliked stories. However, after the intervention and the teachers' use of the Reema and Maha stories with mathematical content, the children's attitude toward mathematics changed positively and the numbers of children who strongly liked increased to 96%, with liking stories at 4%, and none of the children disliking stories (0%).

The following interview transcripts are representative of the children's thinking pre- and post intervention. At the pre-intervention interview, Child 43 commented:

R: What about story…how do you find it?
Ch 43: Ok….
R: What do you mean by ok?
Ch 43: I mean some stories I like it and I feel happy when I heard …but some not…
R: Why some not?
Ch 43: because it is boring….
R: Why is it boring?
Ch 43: Ammm…I do not now…but I do not feel happy when I hear it …

This demonstrates that this child liked some stories but not all and his reason was that he did not feel happy because to him some stories were boring which indicates that the content might not have been relevant or attractive enough to catch his attention thus decreasing his enjoyment and happiness. However, the child's responses during the post-intervention interview showed that he had a highly positive attitude towards the Reema and Maha mathematical stories.

R: What about story…how do you find it?
Ch 43: I love it more than anything….it is the best….
R: You love it more than anything…
Ch 43: Reema and Maha stories are my favourite…
R: Why…..
Ch 43: It is very nice and makes me so happy …. Many funny things happen with them …but some of them not…
R: how….
Ch 43: When Reema counted wrong it was very funny. She said one, two, three, five, seven, ten…. it made me laugh…, but when they got to their mum's room without permission and Reema ruined the clothes it was bad… I do not go to my mum's room without asking …

It is clear that the mathematical stories captured Child 43's attention and imagination. He appreciated the humorous elements of the stories and also the challenges to the rules of behaviour by Reema and Maha.

During her pre-intervention interview, Child 47 demonstrated a highly positive attitude towards stories:

R: What about story…How do you find it?
Ch 47: I love it a lot …our teachers told us many nice stories …. I love all the stories ...ahh do you know even when it is corner time I go quickly to the reading corner and look at all stories…
R: Do you mean you read them?
Ch 47: No…only look at the pictures…
R: You only look at the pictures?
Ch 47: Yaaah…do you know …my mum sometimes reads me a story before bedtime…. I wish she would read to me every night….sometimes when I ask her she says she is busy….

Child 47 continued to have a positive attitude toward stories following the introduction of the Reema and Maha stories. At her post- intervention interview she was highly perceptive in relation to Reema's character:

R: What about story…how do you find it?
Ch 47: I love stories more than anything…
R: Why?
Ch 47: Reema and Maha stories so ..so…so nice…it was nice when the teacher told us that we had to think if we want to help Reema and Maha to find out the problems and solve it….
R: Did you think to help them?
Ch 47: Yaaah …I think a lot …do you know that Reema is the one who creates the problems… (Child smiled when she said that)…

R: Why do you say that?
Ch 47: Because she is the one who refused to go to school…. Also she is the one who ruined the clothes….amm… and she is the one who did not like her room… the nice thing about her is that she became nice at the end (Child smiled)…

Once again, the Reema and Maha characters have captured the imagination and Child 47 was also motivated by the need to help Reema and Maha identify and solve their real-world problems. Finding Reema and Maha's problem provided a focus for the children's attention and encouraged them to listen and actively participate in the story and problem solving process.
In summary, the evidence from the pre- and post intervention interviews with the children from Schools A-C indicated that using stories to present and teach mathematical concepts to pre-school children impacted positively on the children's:

- attitudes towards mathematics;
- understanding of the 'bigger picture' of mathematics;
- awareness of the uses of mathematical concepts in everyday life;
- engagement with mathematical thinking, discussion and problem solving.

The following sections will provide an analysis of the observations of ten teachers carried out during the mathematics lessons and free play time in Schools A-C.

6.2.3 Data Analysis Part 3: Classroom Observation

Observation was adopted as the third data collection method to facilitate the collection of in-depth, rich data. Observation helped to record things in the natural setting rather than relying on the perceptions of the participants. In this way, insights were gained into

- how mathematics was being taught;
- the interactions between the teacher and the children;
- the attitudes of the teachers;
- the relevance of the mathematical content;

- the objects and materials used as resources; and
- the behaviour of the children.

As outlined in chapter four, the observations were carried out during two distinct classroom activity periods: the mathematics lessons and free play time. In the following section, the issues arising from the mathematics lesson observations will be presented first followed by the free play time observation.

6.2.3.1 Mathematics Lessons Observations

The observations of the mathematics lessons were carried out in two parts: pre-intervention whereby the teachers presented the mathematical concepts by using their own way of teaching and post- intervention whereby the teachers used and applied the new method of integrating stories into their mathematics teaching.
Mathematics lessons were provided once a week at schools A and C, and twice a week at school B (see table 5-2 in Chapter 5). I observed four lessons for each teacher, but for four teachers (teachers 7, 8, 9, &10) I observed two lessons for each of them (two teachers were sharing teaching the same class). The technique that I followed to carry out this observation involved completing a two page checklist (see appendix B). The first page recorded the background information for each observation: date, school, teachers, time, the teacher's role, the children's role, the new mathematical concept, materials, and teaching approach. The second page was divided into two columns: one about the teacher and the other for the children to write continuous running records of what was happening during the lessons in descriptive form, thus helping me to conduct a naturalistic, non-participant approach to the observation.
The following section provides details and analysis of each observation in order to illustrate and compare the mathematics lessons before and after the intervention implementation in each of the three schools.

6.2.3.1.1 Observations of Mathematics Lessons: Pre-intervention

The pre-intervention observations of the mathematics lessons showed that the content of the lessons was hierarchical. With the exception of the first lesson which focussed on presenting shapes and colours, each lesson concentrated on a number from the counting sequence from number 1 up to number 3. The teachers at the three schools followed the same *steps* and *procedures* to introduce and teach the mathematical concepts although the resources and materials used to present the counting tasks differed:

- The teachers introduced the lesson using a variety of ways and materials: some used role play whilst others used a box full of objects such as, plastic animals, coloured balls, and different shapes, or a short story repeating the number of the day. During this introduction, the new number was repeated several times by the teacher counting the appropriate number of objects.
- The teacher then repeated the counting and the children counted after or sometimes with the teacher. The teacher then asked the children to name the new number.
- After naming the new number, the teacher chose individual children to count objects until they reached the new number. In some classes, the teacher provided sufficient objects for all the children to count and asked individual children to count out loud while she and other children were watching.
- The teacher then presented the number written on a flash card as well as writing it on the board in order to demonstrate how the number should be written. Teacher 6 also provided the number shaped with a piece of rough material so that each child could feel its shape.
- The last step before the children moved to their writing tables involved the teacher asking the children to write the number on the carpet and in the air.
- The lesson concluded with the children writing in their workbooks. Each page starts with a counting exercise where the children needed to count and circle the right number of objects. The next exercise involved more

counting before circling the correct number and the final exercise involved writing the new number several times.

Table 6-7 provides a summary from one of the lesson observations (School B, Teacher 5) as a representative example of the teaching practices in all three pre-schools prior to the intervention.

Table 6-7: Pre-intervention Mathematics Session Observation

Title of lesson	Lesson Objectives	Teaching approach	Teaching materials and resources	Lesson's format
The concept of 3.	To recognize and write number 3 To count and identify three objects.	Teacher directed	Box with different objects; for example, three pens, books, rulers, pencils. White board Children's workbooks.	1- Teacher started the lesson by saying that she had a box full of nice things; 2-Teacher put her hand inside the box and pulled out a pen, then she told the children " *let us see how many pens do I have inside the box*" , then she started to count the pens; 3-Teacher followed the same technique with the other objects in the box, the children counting after her and sometimes with her; 4-Teacher provided objects for four children and asked them to count three objects; 5-Teacher chose another four children and asked them to bring three objects from the class environment (art corner, blocks corner, drama corner and reading corner); 6-Teacher wrote the number on the board then asked the children to write the number on the carpet then on the air; 7-Teacher asked the children to move to the table to write the new number in the workbook; 8-Finally, the teacher distributed the workbooks and asked the children to write nicely and neatly. She walked around them to help them.

As can be seen from the example in Table 6-7, the teacher presented the mathematical concept (the concept of 3) in a way that was completely unrelated to other mathematical concepts or to the children's everyday life experiences. At the same time, by adopting a teacher-centred approach, the teacher controls every part of the lesson and the children are mostly passive with very little involvement with the learning process except by chanting (counting) after or with the teacher and then writing in their workbooks. This typical teaching approach followed by the teachers at the three pre-schools did not encourage active involvement by the children or help them to construct their own knowledge or build a new knowledge base from the previous one. Furthermore, it did not encourage children to use their cognitive skills or develop different thinking skills. Additionally, it did not help them to make the right connection between mathematical concepts and their daily life activities which only encourages them to see mathematics as a subject that they have to learn and not to see it as discipline for their everyday life situations. In other words, this kind of teaching approach helps the teacher to deliver the information successfully but it does not help the children to develop the skills to use and apply mathematics successfully.

Moreover, adopting this approach to teaching mathematics may not help the teacher or the children to enjoy the process as it does not help them to interact and engage together which in turn affects the quality of the learning (and could subsequently have a negative effect on their attitude toward mathematics).

The analysis of the data from the lesson observations in the three schools indicated that the teachers were not confident in using a range of teaching approaches and strategies possibly owing to gaps in their knowledge relating to teaching mathematics in general and teaching mathematics to pre-school children in particular. Hence, their practice was limited by their lack of subject and pedagogic knowledge coupled with limited knowledge of teaching approaches and resources.

6.2.3.1.2 Observations of Mathematics Lessons: Post-intervention

After the teacher had attended the intervention training workshop and observed the researcher teaching a mathematics lesson with stories as integral to the teaching approach, the subsequent post-intervention observation data revealed a significant shift in the teachers' classroom practice. On four occasions, the teachers were observed using stories in their mathematics teaching and the changes in their practice included: the quality of the organisation of the lessons; the teaching approach that they adopted; the steps that they followed in presenting and teaching the mathematical concepts; the interaction between the teacher and the children; and the questions that the teachers asked the children to encourage them to engage in the learning process, and to relate the mathematical concepts to their everyday life activities.

The teacher's practice and interactions with the children can be summarised as follows:

- The teacher introduces the lessons using one of the Reema and Maha stories. Before the teacher starts the new lesson she asks the children some questions that relate to the previous story's events and about the mathematical concepts involved in that story.
- The teacher displays the story front cover and asks the children if they can figure out about what will happen to Reema and Maha in the story. After a discussion of the children's ideas, the teacher starts to tell the story;
- While telling the story, the teacher interacts with the children and asks a range of questions; for example, reasoning and problem solving questions;
- The teacher reviews the story with the children by asking them about the events in the story and then asks the children about the new number and other mathematical concepts mentioned in the story;
- The teacher shows the children the new numbers using the flash card, and after that provides the number on a piece of rough material, which each child can touch. After that, she writes the number on the board several times to make sure that children recognize its shape;

- Once the new concept has been explored with the children, the teacher asks them to put it in Reema's pockets, and the children look at Reema's model and place the new number (and any other mathematical concepts, such as shape, size, length) in her pockets;
- The children then go to play with the concrete materials that the teacher has already distributed on the tables. The children spend time counting and playing with the materials and the teacher supports them when needed.
- The final step in the lesson is writing the number on the worksheet after an explanation from the teacher about what the children need to do to help Reema and Maha count and write the number. The teacher supports the children in completing the task where necessary.

Table 6-8 provides a summary from one of the lesson observations (School B, Teacher 5) as a representative example of the post-intervention teaching practices in all three of the pre-schools.

Table 6-8: Post-intervention Mathematics Session Observation

Title of the lesson & the lesson objective	Teaching approach	Teaching materials & resources	Lesson's format
Presenting number 10 and triangle shape concepts. **Recognize and write number 10.** **To count and identify ten objects.** **To recognize & draw triangles**	Child-centred approach where the teacher guides and helps the children to construct the new knowledge.	Overhead projector to display the story; Different concrete materials; Reema's figure; Whiteboard; Children's worksheet; and The story	1- Teacher started the lesson by asking the children about the last story and how Reema and Maha and their cousin Lena solved out the problems and which mathematical concept the used; 2-Teacher displayed the cover page for the new story, " *Our New House*" and asked the children about the picture and if they have any suggestions about the new story subject, 3-Teacher started to tell the story and she asked children different kind of questions to help them use different thinking skills ; 4-After the teacher has finished telling the story she asked the children about the story events; 5-Teacher asked the children about the new number and after they named it, she asked them to name and count the objects that have a triangle shape in the story; 6-Teacher used a clock made of cork to present the number 10 to children; 7-Teacher provided the number 10 on a piece of rough material and asked children to move their finger on it; 8-Teacher wrote number 10 on the board ; 9- Teacher asked the children about the new concepts that they learned to put them in Reema's pockets ; 10-Teacher asked the children to move to the tables to have fun and play with the materials and while they were playing she moved around them ; 11- Finally, she explained the worksheet for them and asked them to complete it. While the children were writing, she and her assistant moved around the children to make sure that they understood the lesson.

By comparing table 6-7, which details the organisation of the mathematics lesson and the steps that the teacher adopted and followed *before* the intervention implementation, and table 6-8, which details the organisation of the lessons and steps that the same teacher adopted and followed during mathematics lesson *after* the intervention, it is possible to identify the changes in the teachers' practice as follows:

- The lesson objectives for the pre-intervention lesson observation only focused on number but the post-intervention lesson objectives included both number and shape concepts.
- The teaching approach that the teacher adopted in the pre-intervention sessions was teacher-centred whereby the teacher directed the lesson and the children were mainly passive. However, the teaching moved to a more child-centred approach post-intervention with the teacher adopting the role of guide, making new connection between mathematics.
- The post-intervention observations highlighted that the interactions between the teacher and the children became more dynamic and effective whereby the teacher prompted the children to be more actively involved in the learning process by asking them different type of questions that encouraged the children to use different thinking and reasoning skills and to construct new knowledge based on their previous understanding.
- The teaching materials were less repetitious and more motivating and relevant to young children in the post-intervention lessons. The story itself, the model of Reema, the concrete materials, and the worksheet linked together and were more engaging representations than previously. The stories were designed to illustrate the usefulness of mathematics in everyday life and the lifesize representation of Reema provided an excellent transitional object for the children's thinking.
- Using the stories and Reema's model as a method to present mathematical concepts helped the teachers to present mathematical concepts in a purposeful way which helped the children to see mathematics as a relevant subject for their daily practices.

The post-intervention changes to teaching practices, lesson organisation, resources and the steps that teacher 5 followed are representative of the changes for all ten teachers involved in this study. All of the teachers were more fully engaged with the teaching process and enjoyed mathematics lessons which reflected in their interactions with the children and helped to make the mathematics lesson full of enjoyment, encouragement and enthusiasm.

These changes in practice could have been prompted by one or more of the following:

- **Enhanced subject knowledge** whereby post-intervention the teachers were more aware of the importance of mathematics as a subject and as a discipline for everyday life as well as for other subjects. The teachers became very keen to help the children to build positive attitudes toward mathematics as evidenced in their classroom interactions with the children, including the variety of questions they asked during lessons.

- **Increased awareness of a new teaching approach** for teaching mathematics in general and to pre-school children in particular where the teachers adopted the framework of facts, concepts, skills, attitude and appreciation to present and teach mathematical concepts to children.

- **Enhanced understanding of constructivism** and its importance in helping children to build their conceptual structures and find the right connection to connect the different mathematical concepts together;

- **An appreciation of choosing appropriate and engaging teaching materials and representations.** The Reema stories and materials helped the teachers to present the mathematical concepts in a purposeful and relevant context which in turn reflected positively on the quality of the teaching process and learning outcome.

6.2.3.2 Observations of Free Play Sessions

The purpose of this observation was to identify any maths-related activities that the children practised during free play sessions and to provide insights into whether the children were interested in initiating or practising maths-related ideas beyond the mathematics lessons. During each observation I concentrated on the following four areas of the classroom: the blocks corner, the drama corner, the art corner, and the cognitive corner. Mathematical concepts were evident in each of these corners, for example, the block corner included geometrical and environmental shapes.

The data collection method involved noting down the children's actions in a form of continuous running record (open, blank format) for later qualitative analysis. The observation was conducted using a naturalistic, non-participant approach. I was looking for evidence of the following mathematical concepts, ideas or ways of working: geometrical and shapes in the environment, classification, matching, sequencing and ordering, patterns, and physical and mathematical language. The four areas of the classroom were located next to each other which made my observation much easier as I sat quietly and observed the children playing.

In keeping with the mathematics lesson observations, the free play observations were divided into two parts (pre and post intervention). The duration of the free play lessons at each of the three schools was 45 minutes where every child played in any area or corner based on his/ her interests. However, before any child could enter the corner s/he needed to count the children in the area to make sure that the group was less than the permitted maximum number. By counting the children in the corner, the children were using and applying their counting skills, for example the permitted number of children in the blocks and art areas in Schools A and C was six but only four children were permitted in these areas in school B.

In the following section, I am going to write about each one of the four corners: blocks, drama, art, and cognitive, and show how the children interacted while they were playing pre and post-intervention.

6.2.3.2.1 Observations in the Blocks Area

This area was full of geometrical and environmental shapes for the children to play with and continue to explore the different mathematical concepts that had been introduced to them during the mathematics lessons. Of course, if the teacher did not introduce the mathematical ideas by adopting a teaching style that helped the children to connect the mathematical knowledge with their daily activities the children would not necessarily be able to rehearse or apply the concepts in their free play. Hence, the focus of my pre-intervention observations was to note any activities or mathematical language that the children might use during free play which demonstrated their ability to link the mathematical concepts covered in the lesson and their free play activity. The free play observation data in all three schools demonstrated that the blocks corner was more enjoyable and attractive to the boys but it is beyond the scope of this study to include an exploration of gender issues in children's play although the researcher is aware that some of those issues may also impact on children's mathematical development.

The pre- and post-intervention observations of the maths related activity in the blocks area of the three schools can be summarised as follows:

- counting the children before entering the corner to make sure that there was less than the permitted number;
- making environmental shapes with three-dimensional blocks; for example, imitating the everyday world buildings (houses, farms, zoos and roads);
- at the end of the free play session, using classification, matching and ordering to put the blocks back on the shelf matching each shape to the teacher's guiding labels.

Interestingly, the *variety* of mathematics-related activities in the blocks corner at the three schools did not change post- intervention but the *quality* of the children's play at this corner and the way that they used the events from the Reema stories to solve some problems facing them in the corner was significantly different. The quality of the mathematical language that the children used in their play also improved significantly post-intervention. The following two examples illustrate the changes in the children's play in the blocks area.

❖ Observation example 1: School A Teacher 2's Class

Five boys were playing in the blocks area. Two of them were building a road by using three-dimensional rectangles, triangles, and squares and using different cars and some trees as decoration. The other three boys were building a zoo by using three-dimensional triangles, squares and rectangles. They used the rectangles to build the fence and they used the squares as a home for the animals to stand on. The children were really involved in their play but found themselves running out of the three-dimensional squares:

> *Ch 1: We need more squares …one for the kangaroo and her baby and one for the elephant…..*
> Ch 2 looked on the shelf but he could not find any.
> *Ch 2: There are no square shapes…what about using rectangle instead?*
> *Ch 3: No we cannot…now I will ask A to give us two ….*
> Ch 3 went to the other two children who were building the road and asked them if he could borrow two squares, but unfortunately both of them refused to give him any. He went back to his friend and said:
> *Ch 3: They said no….let us continue without putting the kangaroo and the elephant…*
> *Ch 2: What if we used two triangles together….*
> *Ch 3: How…..*
> *Ch 1: Yahhh...you right we can make square by using two triangles…* (The child was smiling from happiness)
> Child 2 went to the shelf to bring the triangle shapes and child 3 told him to bring only four.

It is evident from the transcript that the children did not give up but used their problem solving and thinking skills when they ran out of the square shapes by asking the other group if they could borrow some shapes from them and when they refused they used their own knowledge effectively by using triangles instead to make the square. Reemas' story *(Sharing is useful*) helped Child 2 to solve his problem by adapting the same technique that Reemas' father used when they found out that the number of sandwiches are four and the total number of the girls eight, where he decided to cut the square sandwich into two triangles. Child 2 put two triangles to make square, which would suggest that he fully understood the concept (dividing one square makes two triangles, and put two triangles together makes a square)

❖ **Observation example 2: School B Teacher 5's Class**

The children were playing without noticing that the free play time had finished until the French teacher knocked on the door. Teacher 5 was surprised and apologized to the French teacher, asking her for five minutes to tidy up the corners. Immediately, teacher 5 asked the children to clear up the areas. The messiest area was the blocks corner where 5 boys were playing and all of the blocks were off the shelves. The five boys were running about and trying to put the blocks on the shelves as quickly as they could but they found it very difficult until Child 1 said *"…I will pick up all the squares and put them at their place…"* Child 2 looked at the flower and said *"… I will pick up all triangles…and you (S) pick rectangles…"* The other two children followed the same technique and each one of them picked one kind of shape and put it back on the shelves.

Reema's story (Our Mum's Surprise) could be the reason behind that improvement in the children's way of thinking and finding an effective solution to solve their problem. In the story Reema mixed the clothes together and when she tried to put it back the way they were, she could not. She tried with the help of Maha and Lena to solve the problem by trying to find out the technique that the mother used as they tried to classify them by colour, and then by design and finally the found out that the mother classified them by size.

In the previous example, the children, in teacher 5's class, were in the same situation as they needed to put back the blocks as fast as they could, and when they worked without following any technique they found it very difficult. But the situation changed after Child 2 decided to group them based on their shapes. He had no other choice because all the blocks were the same colour, but his strategy helped the children to succeed in putting all the blocks back and solved the problem.

Following the intervention, the children interacted more during their play with each other and played more as a team not as individuals in the blocks area.

Additionally, the way that they described the steps and techniques that they followed in their building showed a high level of understanding about geometrical and environmental shapes.

6.2.3.2.2 Observations in the Drama Area

At each of the three schools A-C, the drama corner contained a kitchen full of different toys, including kitchen utensils (plates, cups, pots and pans) and toy food for children to use in their play. There is also a living room section with some clothes to give the children a chance to play different characters; for example, mother, father and friends. In some classes, a bed is included in the corner and in others, a supermarket and cash register or a restaurant. This area gives the children the opportunity to practise every day routine activities through their play. If the corner contains a kitchen only, none of the boys enter it but if it has the possibilities of selling and buying the boys love to play in it. For the majority of time it is girls that use the drama area. As noted previously, it is beyond the remit of this research to explore the gender issues arising from children's play although the impact on children's mathematical development would be a fruitful area for future research. Many mathematical concepts are linked to the home-related drama area, for example, counting, classifying, using money and using mathematical language that relates to length, size and position (for example, big, small, up, down, short, tall, heavy and light).

The following is a summary of the children's mathematics-related activities in the drama area in the three schools both pre- and post-intervention:

- counting the children before they enter the drama corner to make sure that there are less than the permitted maximum number;
- using money for exchanging goods where they are using it as a symbol not as a quantity for most of the time;
- grouping things based on similarity and differences, for example, putting plates together, putting vegetables together and putting fruits together;
- dividing food on the plates equally;

- ordering things based on the size, length and colour;
- using mathematical language relating to length, size, shape, colour, quantity and position.

The data from the pre and post-intervention observations in the drama area highlighted that the type of play and activities that the children were involved in did not change but their way of talking about and describing things using mathematical language did differ. At the post-intervention phase, the children were able to use mathematical language more effectively in *describing* what they were doing and *giving reasons* for why they were doing it. The following example from the post- intervention observation data illustrates the use of mathematical language in the children's play.

- **Observation example 3: School A Teacher 3's Class**

Three girls were playing in the drama area close to the bed. They decided to play and pretend that they were at a clinic but Child 1 told them that she had a better idea asking them to pretend that they were Reema, Maha, their mother and the father from the Our *New House* story:

> *Ch 1: I will be the mother…I am the taller….* (The child compared her height with her other two friends)
> *Ch 2: Then I will be Reema… and you G will be Maha because you are taller than me…*
> *Ch 3: I love Maha she is always listening to what her mum says….who is going to be the father?...I do not want to play with any boy …they annoy me…*
> *Ch 1: What if we ask T to be the father?*

Child T was sitting at the reading corner playing with finger puppets. Child 1 asked her if she would like to play with them and she agreed immediately and they moved to the drama corner. Before the start of their play, Child 1 put a scarf on her head and Child 4 put on the special head cover for the father.

Child 3 asked Child 4 to sit in the living room whilst they were in the bedroom where the following conversation took place:

Ch 3: Mummy…mummy, I love our new room, I love it so much…I like this shape mummy….(Child 3 was carrying three dimensional triangles brought from the blocks corner.)
Ch 1: Yes, sweetie it is very nice…..it is called a triangle
Ch 2: No it is not nice… I do not like it …
Ch 1: Why Reema …..tell me ….
Ch 2: I do not like that shape ….it is not beautiful…
Ch 1: Do you mean triangle…
Ch 2: Yahhh…..
Ch 1: Triangle is very beautiful Reema…come with me, I will show you something…
Ch 3: said *"No …it is time for me and Reema to play while you are preparing the pizza and cake"*

Child 1 smiled and agreed with Child 3, then moved directly to the kitchen. She asked Child 4 who was taking the father's role to help her, while Child 2 and Child 3 were pretending that they were playing in their room.

Child 1 and Child 4 put four plates on the table in the living room; plates full of pizza, and plates full of cake. Child 1 called Child 3 and Child 4 to join them in the living room.

At that moment, Teacher 3 noticed what the four girls were doing and she watched them silently with a smile on her face.

All the four girls sat in the living room continuing their play.

Ch 2: Thanks mummy….I love pizza a lot ….
Ch 3: Me too ……it is yammy …
Ch 1: Reema what does the shape of the pizza looks like?
Ch 2: It looks like the shape of cake….
Ch 3: I know …it looks like the boat's sail, doll's house, and…..and…..I forgot…. (As she said that she started to laugh)
Ch 1: Your dad's head cover….
Ch 4: No…I have to say that…it is on my head….
Ch 1: Yahhh…that's right…ok say it now…
Ch 4: It looks like my head cover….envelope ….safety triangle … tent…and …yahhh sandwich…..
Ch 3: I remember one …the clock ….
Ch 4: Yahhh, you are right…
Ch 1: Ok… who can tell me …all these beautiful things look like which shape?
All the four girls said together "….*triangle…"* then Child 1 added *"because it has three sides…"* and started to laugh… Child 2 said *"…wait we forgot about the drawing ….I am going to draw it at home and bring it tomorrow".*

At that moment the teacher came close to them and told them it was very nice play. Here Child 1 said *"I love to play all the Reema and Maha stories…it is really fun"* then she went to her friend and told them that they had to tidy up now and pretended that they were going to see a doctor at the clinic.

As has been shown above, the children played the story to have fun but at the same time they seemed to have good level of understanding of the mathematical concepts, and how they can use maths in their daily life. The children were rehearsing the key mathematical ideas from the story: naming the shape (triangle); naming a property (three sides), and remembering all the examples of triangles from everyday life. Not only that, but the children showed that they were using their thinking skills effectively, as Child 1 chose to be the mother because she was the taller one of them.

Using the stories helped the children to practise mathematical concepts in a motivating, relevant and enjoyable way. Additionally, using the stories helped them to use mathematical language effectively by describing themselves, others and different objects in their environment. This change to the children's play, along with the increased use of mathematical language could be as a result of the changes to the teaching approach followed by the teachers. At the post-intervention phase the interaction between the teachers and children was more effective as the teachers worked hard throughout each lesson to help the children to be involved in the learning process and to use different thinking skills. The teachers were questioning the children more throughout the lessons in order to help the children connect with the events in the stories which in turn connected mathematical ideas with everyday life.

6.2.3.2.3 Observations in the Art Area

The Art area is one of the children's favourite corners and, as previously noted in the blocks and drama sections, there were gender differences in the children's preferences for play in this area. Most of the girls loved drawing pictures and

colouring whereas the boys mostly loved to play with play dough and make different models, for example, houses, people, animals, balls and playgrounds.
The data from the observations in the art area did not highlight any major differences in the children's play pre- and post-intervention. In both phases the children continued to explore mathematical concepts in their art play as follows:

- counting the children at the corner before they enter to make sure there are less than the permitted maximum number;
- using geometric shapes, such as triangle, square, rectangles and circles, and different types of lines to draw different objects that relate to their environment' such as, using circle to draw sun or moon or using square and triangle to draw a house ;
- doing different art crafts using collage, such as making flowers out of pieces of colour papers or making a doll by using different materials (buttons, netting threads, different shapes made of wood) ;
- using different art materials and collage to copy a model that the teacher made previously, for example, for example, piece of cake, doll, house, and many others;
- using play dough to make different models and objects, such as people, balls, flowers and cars.

However, the post-intervention observations did highlight a change in the children's use of mathematical language both whilst they were drawing or making models and as they described their work to others. The change in their use of mathematical language was particularly noticeable if they were drawing something related to the Reema stories. At all three schools (A-C), some girls chose to draw something related to the mathematics stories whereby some of them not only drew the characters that appeared in the stories but they also drew objects with the same number concepts that the story presented. The following transcript illustrates how the stories prompted an improvement in the use of mathematical language and supported the development of conceptual understanding building on the teacher's introduction of the mathematical concepts by using *Our Mum's Surprise* as a focus for her teaching.

❖ Observation example 4: School C Teacher 6

After the teacher presented *Our Mum's Surprise* story to her class, and discussed with them the concepts of comparing by size and the number nine, the teacher decided to set up free drawing activity in the art corner plus play dough. At the free play time, Child G went to the art corner and picked up some paper and started to draw. At that time, the teacher was moving around the classroom areas to make sure that every child was settled in their play. When she came to the art corner she looked around at the children until her eye stopped at Child G and she looked at her work with an amazed look. Child G was finishing her drawing and was ready to hang it on the art display board:

> *T6: G did you finish your work?*
> *Ch: Yahhh….*
> *T6: Let me see…* (The child gave the drawing to the teacher and the teacher put it on the table.)
> *T6: It is really beautiful…who are these girls?*
> *Ch: The big one is Maha… that one at the middle is Reema…the smallest one here is Lena….*
> *T6: Wow very nice ….what about these things here?* (Teacher was pointing at some oval shapes.)
> *Ch: They are balloons…look I wrote the numbers on it …look there are nine…three for Maha…three for Reema…three for Lena…do you know why they have balloons?*
> *T6: Why?*
> *Ch: Because they are celebrating Eid….and look there, I draw boxes full of presents for the three of them…*
> *T6: Very nice drawing G …would you like to show it to your friend and talk about it at our end of the day meeting?*
> (The child agreed by nodding her head and hung her drawing on the display board)

This transcript extract provides evidence that the child not only enjoyed the story events and the characters in the story but that she had a good level of understanding about the mathematical concepts that were presented in the story. She was able to communicate her understanding through her own free drawing and through the conversation with her teacher. Drawing the characters from the stories happened in several classes which can be taken as a sign that the children engaged with the stories and, as in the case of Child G, where the children also included the mathematical ideas from the stories in their drawings they were able to reflect the level of their developing understanding of the conceptual content of the stories as well. Providing the children with the opportunity for free play (and drawing in particular) in the art area also provided the teachers with the potential for assessing the children's learning via the children's drawings and their explanations during conversations with the teacher.

6.2.3.2.4 Observations in the Cognitive Area

The final free play classroom area was the cognitive corner. In this area, the children have a choice of small play table-top activities including puzzles, sorting materials, beads and laces, and matching games. The children can experience and practise a range of mathematical concepts through their play with the materials in this corner as follows:

- play with puzzles where children compare sizes, shapes, and details of the pictures and lines by sorting;
- classifying objects based on shape, colour, size or type;
- following particular patterns with match-ups, for example, by playing with two-piece puzzles children can learn to recognise and extend different patterns:
- lacing beads for counting, sorting, stacking and sequencing.

It was very difficult to identify any changes to the children's play in the cognitive area post-intervention mainly because children mostly engage in sole or lone play in this area therefore most of the children's thinking remained in their heads and did not easily appear in their representations or verbalizations. However, some changes were evident in Schools B and C where each school's cognitive area contained some highly motivating and very attractive classification materials. Some children at Schools B and C started to play in groups, talking to each other and discussing the steps that they had followed to classify the objects. They sometimes said that they were going to classify based on the colours and sometimes based on the size, and other times based on the shapes. This strategy might be adapted from Reema's story "My Mum's surprise", where Maha, Reema, and Lena tried to solve their problem by following different ways of classification, such as, classifying by colour, by shape, and by size.

The following example illustrates the kinds of conversations that went on in Schools B and C when the children moved from lone play to playing and talking to their peers.

- **Observation example 5: School B Teacher 6's Class**

Initially two children were engaging in lone play in the cognitive area exploring the classification materials. Child 1 started to take some objects from the jar of materials and tried to find a way to classify the objects. This caught Child 2's attention and he came closer and the following conversation took place:

> Ch 2: *Why do not you put the similar colours together?*
> *Ch 1: There are many different colours…there are red… blue…yellow…and green...*
> *Ch 2: What about if we play together….I will work with yellow and blue…and you at the red and green…*
> *Ch 1: Ok …and the one who finished first will be the winner…*
> *Ch 2: I am very fast, even faster than you ….* (He said that in an enjoyable way)
> *Ch 1: No…I am faster than you ….you will see now ….*

The two children started to play in a very enjoyable way, with each one of them trying to finish his part before the other. Both of them finished at the same time, whereupon Child 1 had two groups one red and one green, and Child 2 also had two groups, one yellow and the other blue. The two children enjoyed the game and they mixed the objects together and decided to play again but this time classified by shapes. The previous conversation between the children was a sign of using good thinking skills. They used a useful strategy to sort out a way of classifying the objects.

This short transcript extract illustrates the importance of providing play activities whereby children are prompted to share their play tasks and to discuss their thinking out loud in order to develop their mathematical language and understanding. This particular example also illustrates the limitations of non-participant observation particularly so in a context whereby the children were engaging in solitary play. It might be helpful if similar studies in the future included interviews with children or participant observation in order to gain further insights into children's actions and thinking.

6.3 Summary

In summary, the purpose of this chapter was to provide evidence of the impact of using stories in mathematics teaching with pre-school children from an analysis of three different data sets:

- teacher questionnaires;
- interviews with teachers, mothers and children;
- classroom observations.

A discussion of the limitations of the research along with the key findings from the analysis of data will follow in Chapter 7. The implications and recommendations for future practice in pre-school mathematics teaching and the training of pre-school teachers in Saudi Arabia will be identified in the final concluding remarks, along with some possible topics for further research.

Chapter 7: Concluding Discussions

7.1 Introduction

The overall aim of this research study was to explore the impact of using stories as a method for teaching mathematics to young children (age 5-6 years) in Saudi Arabia. All five stories used in this study were designed and written specifically for early learners to help them to link mathematical ideas with their everyday life experiences, and to enable them to construct their own understanding of mathematical concepts. At the same time, the impact of using stories in promoting interactive mathematics teaching and active learning approaches has been considered. The following two research questions were addressed:

- What is the impact of teaching mathematics through stories on pre-school *teacher practices*: subject knowledge, attitude, confidence and classroom practice?
- What is the impact of teaching mathematics through stories on pre-school children's learning: engagement and enjoyment, understanding, application and thinking skills?

This study was carried out in two stages and sought to answers the two research questions by adopting a qualitative constructivist technical action research approach as a means to explore the impact of using stories as a method for teaching mathematics. Several types of data collection methods were used to gather evidence and to achieve a better insight and understanding of the factors influencing teaching and learning practices. The research tools included a biographical questionnaire for teachers; pre- and post-intervention interviews for teachers and children; pre-intervention interviews with mothers, and pre- and post- intervention classroom observations of maths sessions and free play periods.

The first stage, the pre-intervention phase, gave me an initial insight into how mathematics was presented by the pre-school teachers (children age 5-6 years) in

Saudi Arabia, as well as useful data in relation to the teachers themselves; the curriculum and teaching resources; the children, and a small sample of mothers. The second stage was post- intervention which explored in depth the impact of using stories as a method for teaching mathematics to pre-school children. Using stories in their mathematics teaching had a positive impact on the teachers' confidence, attitude, subject knowledge and classroom practice, as well as a positive impact on the children's enjoyment, understanding, thinking skills and application of mathematical ideas.

All the data gathered and analysed from both stages has contributed to answering the research questions and highlighted considerations that may be of interest to audiences in Saudi Arabia, the UK and other countries with regard to the provision of mathematics education for pre-school children and improving pre-school teachers' classroom practice. An analysis of the research data was presented in Chapter Six. In this chapter, the findings are discussed with reference to the established literature presented in Chapter Three, along with my own commentary which includes the implications for future classroom practice. The discussion is structured under two main themes in order to demonstrate how the two research questions have been answered. Each research question is separated into the sub-themes which emerged from the thematic analysis of the findings presented in Chapter Six.

7.2 Research Question 1

What is the impact of teaching mathematics through stories on pre-school teacher practices: subject knowledge, attitude, confidence and classroom practice?

7.2.1 Subject Knowledge

The pre-intervention stage of the present study identified that the teachers at the three pre-schools were limited in their understanding of mathematics subject knowledge. Most of the teachers did `not have the ability to view mathematics in any way other than groups of numbers and operations (addition and subtraction) that children must learn throughout their schooling. This lack of mathematical knowledge limited the teachers' ability to see the bigger picture of learning and teaching mathematics. The importance of teachers' subject knowledge has been highlighted by several researchers (Aubrey, 1994b; Ball et al., 2008; Shulman, 1986) who exposed the role of subject knowledge in influencing teachers' practices. A lack of subject knowledge (Bennett and Carre, 1993; Brophy, 1992; Lee, 2010) affected the teachers' practice in this study as it made them present mathematics to children by didactic teaching and rote learning approaches even though the teachers said in their questionnaire responses that they adopted active learning approaches. It seems that the participating teachers' low level of pre-service qualifications along with the weaknesses in the teachers' training programme and a lack of in-service mathematics' training programmes impacted negatively on the teachers' mathematics subject knowledge which in turn affected their confidence in their teaching abilities and teaching practices. Limited mathematical *and* pedagogical knowledge made it difficult for the teachers to make appropriate choices of teaching methods, curriculum content and teaching resources which in turn perpetuated the teachers' perception of mathematics as a very dull and irrelevant subject.

On the other hand, at the post-intervention stage (and after the teachers' had participated in the preparatory workshop which illustrated how to use stories to teach mathematics) all ten teachers showed an improvement in their mathematics subject knowledge as evidenced in the post-intervention interviews and the classroom observations. The teachers' enhanced subject knowledge impacted positively on their classroom practice as they chose more suitable ways to present mathematics to pre-school children.

This transformation seemed to be as a direct result of the workshop that the teachers attended as its main focus was to help teachers to develop knowledge and understanding about mathematics teaching and learning including:

- the importance of mathematics in everyday life (using and applying mathematics);

- mathematics as knowledge in the holy Quran;
- the impact of teachers' beliefs on the learning process and,
- the impact of teachers own subject knowledge on the teaching process.

The intervention preparatory workshop helped the teachers to grasp the big ideas of teaching and learning mathematics encouraging them to see mathematics as a purposeful and relevant subject. The theoretical underpinnings of the workshop became more realisable when the teachers adopted the stories in practice as all five stories were built on a problem solving approach grounded in the Saudi Arabian social structure. The improvement in teachers' mathematics subject knowledge had a positive impact on raising the teachers' awareness of the importance of mathematics and in enhancing their level of engagement with teaching mathematics.

7.2.1.1 Awareness of the Importance of Mathematics

At the pre-intervention stage, most of the teachers lacked a clear understanding of the importance of mathematics either as a subject or as a discipline for everyday practices. For example, some teachers described mathematics as a *useless and boring* subject. These negative responses seem to relate to the teachers' lack of mathematics subject knowledge. Additionally, the expectations of managers (head teachers and inspectors) and parents also influenced teachers' lack of awareness of the importance of mathematics.

At the pre-intervention stage, the teachers' interviews highlighted that mathematics did not have the same status in the curriculum as literature. This was echoed in the mothers' interviews whereby the three participating mothers stressed the value of literacy over mathematics. Moreover, they demonstrated misconceptions and negative attitudes towards mathematics.

Mathematical subject knowledge provides teachers with a deep understanding of the importance of mathematics as a subject and as a discipline. Many researchers highlight the importance of mathematics (Boaler, 2009; Duncan et al., 2007; Ginsburg et al. 2008; McGrath, 2010; Pound, 2006; Pound & Lee, 2011), and how humans are born with a wide range of mathematical competence (Devlin, 2000; Pound 2006). These factors, when delivered to teachers through the preparatory workshop, helped them to understand the big ideas of teaching and learning mathematics. Also, when the researcher explained mathematics as knowledge in the holy Quran, this helped the teachers to recognize how much mathematics is integrated into their everyday practices. In the post-intervention interviews, teachers talked about how the workshop and the use of stories helped them to see mathematics differently.

This improvement in teachers' awareness of the importance of mathematics became obvious when they started to use the stories to present mathematics to children. It was very clear that the teachers more fully understood the subject matter that they were teaching, the importance of the questions that they asked, and the relevance of the concepts they presented in relation to the children's daily life experiences. In other words, the increase in the teachers' mathematical knowledge reflected positively on their awareness of the importance of mathematics.

According to Evans (2003), the teachers' abilities to develop meaningful classroom practices are strongly connected to their beliefs about mathematics. I believe that working on teachers' subject knowledge is a key issue to improve teachers' practices and learning outcomes. School managers (head teachers and inspectors) and parents also play an important role in increasing teachers' awareness of the importance of mathematics if they themselves are aware of the importance of the subject. If the parents are aware it will make them look for a school that has a high quality programme for teaching mathematics which in turn will force the school managers to work hard to prepare their teachers with adequate qualifications to meet the parents' expectations.

7.2.1.2 Higher Level Engagement with Teaching

The increase in teachers' subject knowledge for mathematics not only reflected positively on teachers' awareness of the importance of mathematics but also improved the level of their engagement with teaching. At the pre-intervention stage, most of the teachers compared mathematics unfavourably with literacy lessons and reported that they found themselves more engaged with literacy than mathematics. Finding purposeful, interesting and attractive materials to teach mathematics was not an easy job for the teachers especially if we take into account the teachers' lack of subject knowledge and lack of adequate training for mathematics and this age range. Hence, it is not surprising that the teachers were less engaged with their mathematics teaching.

Previous research has established that effective teachers not only know the subject matter but also know how to teach it (pedagogical content knowledge) (Ball and Bass, 2000; Kennedy, 1998; Lee, 2010; Shulman, 1986). Good quality mathematics teaching is a result of high-level pedagogical knowledge along with effective teaching strategies (Carpenter et al., 1989; Slavin, 2009). The more the teachers know about the subject, the more interactive teaching and learning is possible but if the teachers lack knowledge of the subject they are more likely to use rote teaching approaches (Aubrey, 1995).

The current study seems to agree with previous studies in that teachers' subject knowledge and pedagogical knowledge was seen to positively or negatively affect the quality of their teaching. At the pre-intervention stage, the negative impact of teachers' lack of mathematics subject knowledge and pedagogical knowledge was obvious and had the following effects in terms of the teachers' classroom practice:

- teachers adopted a teacher-centred approach;
- teachers followed the same steps to present the new mathematical concept in each lessons, which made lessons very repetitious and tedious for both teachers and students;

- mathematics was presented in a very isolated way, which meant that teachers and students were unable to see the purpose of learning mathematics and neither were they able to find the connections between different mathematical concepts.

On the other hand, at the post-intervention stage, the improvement in teachers' engagement level with teaching mathematics was remarkable. Whilst the researcher acknowledges that this may have partly been due to the novelty effect of the intervention nevertheless, the preparatory workshop undoubtedly gave the teachers greater insight into mathematics and pedagogical knowledge and therefore provided a different (more engaging) perspective on teaching mathematics to young children. When the researcher presented the first story, it helped the teachers to realise that teaching mathematics does not have to be boring, meaningless and irrelevant - as they had previously thought. All these factors reflected positively when the teachers themselves used the stories in their teaching and found that the stories made teaching mathematics more purposeful partly because the stories presented a problem-solving format for the mathematics and at the same time linked mathematics to everyday life situations.

To summarise, teachers' subject knowledge and pedagogical knowledge are very important elements for the success of the teaching process. The more the teachers know about the subject, the more they will be able to engage with the learning process. Also, using stories as a method to teach mathematics helped the teachers in this study to be aware of the importance of mathematics and to be fully engaged with the teaching process. As a result, the teachers became more able to help their pupils to gain understanding and to be able to use this successfully in different situations.

7.2.2 Attitude, Confidence and Enjoyment

The pre-intervention stage of the current study revealed that most of the teachers had a negative attitude toward mathematics. This attitude had a negative impact on the teachers' confidence in their ability to teach mathematics which, in turn, reflected negatively on their enjoyment.

Many researchers have highlighted the role of teachers' attitude toward mathematics in influence teaching practice (Aubrey, 1994a; 1994b; Ernest, 1989; Ernest, 1996; Ginsburg et.al, 2008; Lee, 2005), which consequently affects students' attitude toward mathematics (Abu-Jaber and Al-Shawared, 2010; Ernest, 1996; Lee, 2005; Zacharos et al., 2007). Teachers' attitudes and beliefs about mathematics play an important role in choosing the appropriate mathematics content, teaching method, and interaction with the student (Ng et al., 2008).
Research has found that teachers with higher levels of mathematical anxiety feel less confident in their abilities to teach mathematics (Ball, 1990; Bursal and Paznokas, 2006; Buxton, 1981), and also that those teachers pass on their fear of mathematics to their students (Furner and Berman, 2005; Gresham, 2007; Lee & Ginsdurg, 2007; Sloan et al., 2002; Wood, 1988).

The findings of this study concur with the previous research, as the teachers' negative attitudes toward mathematics and lack of confidence in teaching mathematics reflected negatively on their classroom practice. The pre-intervention observations showed that teachers were following exactly the same steps to teach each new mathematical concept. Unfortunately, they were adopting teacher-centred approaches without making any connection between new and previous knowledge, as well as failing to relate mathematical knowledge to everyday situations. It was clear that some teachers were teaching mathematics because they had to teach it and not because they wanted to teach mathematics. It was also clear that teachers only helped the students to gain limited insights (mostly factual) and not the skills of using and applying mathematics.

As highlighted previously, the preparatory workshop helped the teachers to gain useful theoretical insights, and using the stories translated the theory into practice. Using the stories to teach mathematics made the subject more interesting, engaging and applicable to real-life situations (Murphy, 2000; Price, 2009; Tucker et al., 2010). At the same time, using the stories helped the teachers to move from a teacher-centred to a child-centred teaching approach making the lessons more interactive and enjoyable. Using stories helped the teachers to present mathematics in familiar everyday contexts which also helped to make the teaching process more purposeful. Moreover, the variety of attractive materials that were available for the teachers to use for example, the illustrated stories, concrete materials, Reema's model and worksheets made mathematics lessons full of joy and fun.

The teachers' confidence may also have been increased by having the opportunity (during the pre-intervention interview) to share their fears and weaknesses in teaching mathematics compared to teaching other subjects. The researcher was an impartial listening ear and the preparatory workshop also provided an alternative approach for the teachers to consider as well as insights into the theories of teaching and learning embedded in the work of Piaget, Vygotsky and Bruner.

In summary, teachers' subject and pedagogical knowledge are very important elements for achieving success in the teaching process. If teachers fully understand the subject that they have to teach, it will support them in choosing appropriate ways to deliver it to their students. An increase in teachers' subject knowledge will impact positively on their attitude towards the subject which then reflects positively on teachers' confidence, making teaching the subject more enjoyable and the learning outcomes more purposeful.

7.2.3 Classroom Practice

The pre-intervention stage of the current study highlighted a number of aspects that negatively affected teachers' classroom practice. For example, the teachers reported a lack of in-service mathematics training programmes as well as a lack of teaching resources and a standardised curriculum. However, using the stories to teach mathematics to pre-school children had a positive impact on classroom practice most notably in relation to:

- planning and teaching mathematics
    - Objectives
    - Creativity
    - Bringing maths to life;
- interactive teaching and learning;
- the teaching process and learning outcome.

Each of the above points will be discussed in detail in the following sections to show how using stories helped to improve classroom practice.

7.2.3.1 Planning and teaching

7.2.3.1.1 Planning and Teaching: objectives

At the intervention stage, using the stories to teach mathematics had a significant impact on clarifying the teaching objectives for the teachers as each story had an attachment that contained a detailed lesson plan which included the main objective, facts, skills, concepts, attitudes and appreciation of mathematics that the teachers might introduce in the lesson. As a result of being more clear about the *purpose* of each lesson as well as the possible *teaching strategies*, the teachers found their mathematics teaching more enjoyable. In this way, this study agrees with the finding of Slavin (2009) who highlighted that effective teaching strategies make significant differences to the quality of teaching.

Clear objectives were a very important element in helping teachers to develop successful teaching processes. At the post-intervention stage, teachers seemed to be more knowledgeable and understanding about the learning objectives and had high expectations of the learning outcomes. All ten teachers talked about how using stories as a method to teach mathematics and adapting the teaching focus to include facts, skills, concepts, attitudes and appreciation, helped them to teach effectively as well as increasing their confidence in their teaching abilities.

In summary, using the stories as a method to teach mathematics had a positive impact by making the mathematical objectives clearer for the teachers; broadening the range of content presented in each lesson to more than one mathematical concept at a time, and making connections to the uses of mathematics in the everyday world. In this way, the current study also agrees with Griffiths and Clyne (1991) who found that using stories to teach mathematics contributes to building clear understanding of mathematical concepts.

7.2.3.1.2 Planning and Teaching: Creativity

As indicated previously, pre-intervention, the teachers were teaching mathematics by following a more traditional didactic teaching approach where they followed exactly the same steps and format to present new number concepts to children without taking the children's previous experience into account or connecting mathematics to the children's daily life experiences. Children were not encouraged to participate in the lessons or to actively construct their own knowledge or to make connections between different mathematical concepts. Teachers were not confident or creative enough to move away from the routine teaching 'script' which meant their practice was very unimaginative and predictable echoing Boaler's (2009) study whereby mathematics teaching was dull and lacking in joy or creativity. The pre-intervention evidence of this current study also concurs with the previous studies of Ginsburg et al., (2008); Graham et al.(1997); Ball, (1995) which stressed that many pre-school teachers use a method that is narrow and limited in mathematical content.

On the other hand, improving the teachers' attitudes (Aubrey, 1994a; Ernest, 1989; Lee, 2005), subject knowledge and pedagogical knowledge (Aubrey, 1994b; Ball et al., 2005; Brophy, 1991; 1989; Carpenter et al., 1989; Lee, 2010; Shulman, 1987; 1986), as well as using stories as a method to present mathematical concepts (Heuvel-Panhuizn & Boogaard,2008;Shatzer,2008; Whitin;1992) and to support creative thinking (Jennings & Terry,1990), helped the teachers in this study to teach mathematics by following an interactive learning approach which was more interesting, relevant to the children's own experiences and creative.

I believe that teachers cannot teach creatively unless they fully understand the subject, teaching theories, and teaching pedagogy. Understanding the subject will increase teachers' positive attitudes; understanding the teaching theories will increase teachers' confidence in their teaching ability; and understanding the teaching pedagogy and methods will increase the enjoyment and creativity. Any weakness within these three elements will cause flaws in the teaching process and learning outcome.

7.2.3.1.3 Planning and teaching: Bringing Maths to Life

As highlighted previously, at the pre-intervention stage the teachers believed mathematics to be a dull and irrelevant subject and they adopted a didactic approach to teaching their lessons. Many researchers highlight the teaching strategy that teachers use as the main reason for making mathematics a difficult subject. These researchers call for teachers to move away from teaching by telling and towards a constructivist approach (e.g. Draper, 2002; Grant, 1998; Noddings, 1993). Also, some researchers stress that teachers need to use an appropriate pedagogical approach that is suitable for pre-school children (Ginsburg et al., 2005; Williams, 2008).

The post-intervention findings of the current study noted a significant change in the teachers' beliefs and attitudes towards mathematics teaching. They had begun to appreciate the value of teaching mathematics to young children and now found it a subject that was 'full of life'. This change of perception emerged from their experiences of using stories to teach mathematics (NCTM, 1989; O'Neill et al., 2004; Shatzer, 2008; Van& Elia, 2012). Using the Reema and Maha stories had a positive impact on the teachers' views of mathematics and helped them to see the relationship between mathematics as a subject and as a discipline for supporting everyday life which reflects the work of researchers such Heuvel-Panhuizen et al., 2009; Whitin, 1992 who highlighted the impact of using stories to provide a meaningful context for maths. At the same time, presenting mathematical concepts within a story format that followed a problem-solving structure (Fox & Surtees, 2010; Pound& Lee, 2011; Robitaille & Taylor, 1997; Williams, 2008) contributed to making the teachers shift from a didactic to an interactive teaching approach. Moreover, using Reema's figure as a visual object that displays different mathematical concepts also prompted children's thinking and reasoning and, equally, importantly, brought mathematics to life for both the teachers and the children.

In summary, my study found that using stories as part of their teaching repertoire had a positive impact on teachers' beliefs and attitude towards mathematics, which in turn reflected positively on the teachers' practices, as well as helping them to see mathematics as a living subject.

7.2.3.2 Interactive Teaching and Learning

The findings of the current study showed that teachers at the pre-intervention stage adopted a traditionally didactic approach to their mathematics teaching. The teachers' role was only to present the information and the children's role was only to receive that information without any outwardly active participation in the learning process. At the intervention stage, the situation completely changed, as mathematics lessons became highly interactive not only between the teachers and the children but also between the children themselves.

Many researchers have highlighted the importance of the social context of learning which supports the student in constructing new knowledge based on their prior knowledge (Aubrey, 1993; Brune, 1996; Clements & Sarama, 2004; Dunphy, 2009; Haylock & Thangata, 2007; NCTM, 2000; Pound, 1999; Williams, 2008). Unfortunately, the didactic approach to teaching adopted by the participating teachers at the pre-intervention stage limited the students' role to merely those of passive listeners. This approach also limited the opportunities for teachers to make connections to individual children's prior knowledge and to using and applying mathematics which inevitably had a negative impact on the quality of teaching and learning.

The findings of this study agree with previous studies in relation to the importance of interactive teaching and learning. For example, using the stories in their teaching provided teachers with the means to encourage the children to actively participate in the learning process and to construct and apply the necessary ideas to solve the problems embedded in the stories (Whitin 1992). The stories' content ensured that the lessons were more relevant to the children as young learners (Heuvel-Panhuizen et al., 2009) and provided the teacher with definite prompts for discussion via the dilemmas and problems faced by Reema and Maha.

In summary, it can be demonstrated that high quality teaching of mathematics requires adopting a teaching approach that encourages interactive learning to help children construct their knowledge and understanding and to use and apply mathematical ideas and reasoning. Using stories as an integral feature of mathematics teaching helps to reach this target and as a strategy it is interesting, purposeful and enjoyable for both teachers and children and helps them to build a positive attitude toward mathematics.

7.2.3.3 Teaching Process and Learning Outcome

At the pre-intervention stage of this study, most of the teachers were dissatisfied with the teaching approach that they followed to present mathematical concepts to pre-school children. Adopting a didactic teaching approach prevented the teachers from creating links between mathematical concepts and ways of thinking and their uses in everyday problem-solving: using and applying mathematics. Previous studies have highlighted the importance of presenting mathematical concepts within real-world applications, and teaching children the skills and processes needed for successful problem solving (Boaler, 2009; Robitaille & Taylor, 1997). Many studies emphasise the importance of building new knowledge on previous knowledge to ensure high-quality mathematics education (e.g. Aubrey, 1995; Boaler, 2009; Ginsdurg et al., 2005; Williams, 2008). Previous studies also stress the importance of shifting from teaching by telling to a constructivist teaching approach (Draper, 2002; Haylock & Thangata, 2007).

Post-intervention, the teachers reported an increase in their level of satisfaction with their teaching indicating that the stories had been a significant factor in enhancing their satisfaction. At the same time, the teachers were pleased with the level of the children's engagement with most teachers highlighting the role that the stories played in increasing children's involvement in the mathematics sessions.

The previous studies which focussed on using stories to teach mathematics, found that the stories helped to connect mathematical concepts with real-world situations (Whitin,1992), supported deeper and creative thinking (Elia et al.,2012; Jennings & Terry,1990), and increased positive attitudes toward mathematics (Hong, 1996; Jennings et al.,1992). The findings of the current study are in line with these studies, for example, at the intervention stage, teachers explained how the use of the stories helped to make mathematics sessions more purposeful by connecting the learning processes with everyday problems and prompting the children to think and reason at a deeper level.

A comparison of the outcomes of the teaching that the teachers adopted at the pre-intervention and post-intervention stages showed an improvement in children's understanding and use of different thinking skills. Mapping the comparison against Bloom's Taxonomy for thinking (1956) identifies the following differences:

- At the pre-intervention stage, the teachers were focused entirely on transmitting information and so the children could only operate at the first 'knowledge' level of Bloom's Taxonomy. At this level, the children were limited to recalling and remembering information only when the teachers provided them with practice examples.

- During the intervention stage, using the Reema and Maha stories encouraged teachers to discuss the story problem with the children, therefore encouraging them to reflect, analyse (especially to reason), and connect ideas. In this way, the teachers succeeded in helping the children to reach higher levels of thinking. The model of Reema acted as a transitional object for the children's thinking, helping the children to see mathematical concepts visually and to draw the necessary connection between different mathematical concepts, as well as between mathematical concepts and everyday life.

In summary, using the Reema and Maha stories plus the model of Reema had a positive impact on the teaching process and learning outcome. This positive impact was noteworthy in relation to the teaching approach, the quality of the interaction between the teachers and the children, the quality of the connection between mathematical concepts and everyday contexts, and the quality of children's learning and thinking skills.

7.3 Research Question 2

What is the impact of teaching mathematics through stories on pre-school children's *learning*: engagement and enjoyment, understanding, application and thinking skills?

7.3.1 Engagement and Enjoyment

At the pre-intervention stage, the findings from the teacher's interviews, the children's interviews and the mathematics session observations illustrated that most of the children were not fully engaged in their mathematical learning as they did not enjoy the mathematics sessions as they found them to be 'boring' particularly when compared to literacy sessions. Conversely, at the intervention stage, using stories had a positive impact on both children and teachers' engagement with the mathematics learning process which in turn increased enjoyment. Using stories to teach mathematics helped the children to become actively involved in learning (Whitin, 2002) and also made the subject purposeful, interesting and enjoyable for them (Hong, 1996, Jennings et al. 1992).

The teaching resources that the teachers used pre-intervention were extremely limited and the children rarely engaged in any hands-on activity with concrete materials. Hardly surprising then, that the children lacked interest and motivation in mathematics lessons. However, once the teachers began to use the stories with the children, their attention was engaged by the characters and the problem-solving storyline. The children were drawn in to learning by identifying with the Reema and Maha characters and the problems that they faced. The children were encouraged to discuss the stories amongst themselves (as well as with the teacher) and not simply listen passively to the teacher.

The content and events of the stories increased the children's motivation to 'discover' the problem and to find possible solutions which then reflected positively on the children's enjoyment of the session. At the same time, using a series of stories that contained the same characters appealed to the children and made them look forward to finding out about the further adventures of Reema and Maha.

In summary, the children actively engaged and enjoyed the learning process once the teachers integrated the stories into their teaching along with an interactive teaching approach. The Reema and Maha stories were designed to appeal to young children by reflecting their cultural heritage and incorporating dilemmas for the central characters that the children would recognise from their own family lives. In this way, the children were motivated to help Reema and Maha solve their problems and, in so doing, the children were using and applying their mathematical knowledge and developing their reasoning skills. Thus, the improvement in children's engagement and enjoyment had a positive impact on their attitude toward mathematics which is developed further in the next section.

7.3.1.1 Child Attitude toward Mathematics Lesson: Feelings about Mathematics

At the pre-intervention stage, most of the children showed a negative attitude toward mathematics as none of them said that they strongly liked mathematics; all their responses were *like*, *ok* and *dislike*. On the other hand, at the post-intervention stage, the children showed a much more positive attitude toward mathematics lessons as their responses were mostly *strongly like* and none of them said *ok* or *dislike*.

The negative impact of adopting a didactic approach to teaching has been highlighted in a number of previous studies (e.g. McGrath, 2010; Pound & Lee, 2011; Ryan & Williams, 2007; Smith & Price, 2012). In particular, using a traditional approach has a negative impact on motivation and performance (Ryan & Williams, 2007). Additionally, classroom issues, parental pressure, and mismatching teaching and learning methods are some of the reasons for children's negative attitudes toward mathematics (Copley, 2000; McGrath, 2010). As a result, many studies call for a shift from traditional methods to teaching mathematics by adopting problem-solving approaches (Ginsburg et al., 2008; McGrath, 2010; Pound & Lee, 2011; Williams, 2008).

The current study agrees with the previous studies in that, teachers at the pr-intervention stage were using few resources in their didactic teaching, presenting mathematical concepts in isolation and with few opportunities for the children to use and apply their understanding. Hence, children found mathematics lessons uninspiring which created a negative attitude toward mathematics. At the same time, the mothers' attitude toward mathematics could also be another reason why the children lacked motivation and a positive attitude towards mathematics. Although it is hard to generalise from the responses from only three mothers nevertheless, all three mothers who participated in the study showed a negative attitude toward mathematics and cared more about literacy. Teachers and parents play an important role in helping children to build a positive attitude toward mathematics and, unfortunately, at the pre-intervention stage it was clear that most of the teachers had negative attitudes toward mathematics as did three of the mothers.

The improvement in children's attitudes toward mathematics at the intervention stage seems to stem from the changes to the teaching style. Adopting an interactive approach encouraged the children to participate in the learning process, engage in constructing new knowledge and utilise their reasoning skills. Moreover, using the Reema and Maha stories helped the children to see mathematics as a useful way to solve real life problems and an interesting and useful tool that they could use during their play. Reema's model, as a transitional object to encourage thinking, played a significant role in increasing children positive attitude toward mathematics as it helped them to see the different mathematical concepts visually as well as drawing the necessary connections between concepts and prompting their use of mathematical vocabulary.

7.3.1.2 Child Favourite Subject in School

Using the Reema and Maha stories had a positive impact on making mathematics the favourite subject for some of the children. At the pre-intervention stage 12% of the children mentioned mathematics as their favourite subject, whereas, the percentage changed to 78% after the intervention. Undoubtedly, the change in the teachers' approach to teaching mathematics during the intervention and the subsequent change in attitude towards mathematics amongst the children was a significant factor in the high percentage of children favouring mathematics at the post-implementation interview stage. As already noted, using purposeful and attractive materials to present and teach mathematics impacted positively on the children's enjoyment and helped them to built positive attitudes toward mathematics. At the same time, the intervention teaching approach, whereby the children's role changed from passive to active learners, along with the everyday world problem-solving in the storyline of the Reema and Maha stories also impacted positively on the children's engagement which is likely to have prompted them to rate the mathematics lessons more highly post-intervention.

As has already been noted, many studies stress the importance of using a problem-solving format to teach mathematics to encourage children to be involved in the learning process, as well as recognizing and using mathematics concepts and skills in their daily lives (e.g. Cockcroft, 1982; Draper, 2002; McGrath, 2010; Pound & Lee, 2011; Smith & Price, 2012; Williams, 2008). At the same time, using stories to teach maths has a positive impact on children's achievement and interest (Jennings et al., 1992) and Hong (1996) found that using stories improved children's mathematics practices particularly in number combination, classification and shape tasks.

The current study reflects the findings of the previous studies in that the Reema and Maha stories helped both teachers and children to understand the role of mathematics in everyday problem-solving. The children were enchanted by the problems faced by Reema and Maha which challenged their thinking and enhanced their motivation. And finally, using Reema's model helped to increase enjoyment in mathematics as the children showed a high level of interest toward the model especially when the teachers asked them about the concepts that appeared in the story and challenged them to identify where to place the new concepts in Reema's pockets.

In summary, the changes to the teachers' classroom practice (adopting an interactive learning approach, using interesting, purposeful, and relevant materials including the stories, concrete materials and Reema's model), had a positive impact on the children's engagement and attitude toward mathematics which, in turn, raised the status of mathematics as the children's favourite subject.

7.3.1.3 Children as Active Participants in Learning Learners

At the pre-intervention stage, the children's role was passive and they simply followed the teachers' direction with minimal participation in the lesson or encouragement to use their thinking and reasoning skills. However, at the intervention stage, the children's role changed from passive to more active participants. This change was significant as evidenced in the post-intervention interviews with teachers and children as well as the observations of the mathematics sessions (described in detail in Chapter Six.) The change in teachers' practices from didactic teaching to interactive teaching plus using the Reema and Maha stories, provided the children with an opportunity to engage with the learning process and become active participants in their own learning.

Previous studies highlight the importance of using an interactive learning approach (e.g. Aubrey, 1995; Draper, 2002; National Council of Teachers of Mathematics, 2000; Pound, 1999; Pound & Lee, 2011; Slavin, 2009; Williams, 2008). Moreover, many studies stressed the positive impact of using stories as a method to teach mathematics (Hong, 1996; Jennings et al, 1992; Moyer, 2000; O'Neill et al, 2004; Van & Elia, 2012). Stories help to provide children with a meaningful context for learning mathematics (Mooren, 2000; Murph, 2000). Furthermore, children's literature can motivate students (Usnick & McCarthy, 1998); provide a model, illustrate a concept, pose a problem, and stimulate an investigation (Griffiths and Clyne, 1991); as well as offer an environment in which children can actively construct mathematical knowledge (Phillips, 1995).

The findings of the current study concur with the findings of previous studies in that the teachers changed their teaching approach to be more interactive thereby enhancing the participation of the children. Using the Reema and Maha stories played a significant role in presenting mathematics in an empowering way which helped the children to see mathematics as a subject full of interesting and enjoyable activities. Furthermore, it also helped the children to use their thinking skills more effectively while they tried to help Reema and Maha to solve their problems. All this helped to change the children's role from passive learners at the pre-intervention stage into active participants during and after the intervention.. Using the stories helped the children to explore mathematical ideas through the events of each story as well as through discussion with each other and with their teacher.

7.3.2 Enhancing Children's Understanding

Integrating stories into mathematics lessons positively impacted on children's learning in three ways: improving children's perceptions of the 'bigger picture' of mathematics; developing children's awareness of mathematics, and enhancing children's use of mathematical language.

7.3.2.1 Improving Children's Perceptions of the 'Bigger Picture' of Mathematics

The findings from the children's interviews and classroom observations at the pre-intervention stage showed that most of the children lacked a clear understanding of the 'bigger picture' of mathematics. According to the children at the pre-intervention stage, mathematics only involves learning to count and to write numbers. However, the situation completely changed at the intervention stage so that during the post-intervention interviews the children's understanding of mathematics now included not only numbers, shapes and colours but also money, time, addition, size, length, subtraction, position, division and classification.

This development in children's perceptions of a 'bigger picture' of mathematics was a reflection of the change of teaching approach from teacher- centred to child-centred including the use of the Reema and Maha stories. The series of five stories involved a broader range of mathematical ideas compared to the curriculum content experienced by the children during the pre-intervention stage. Ginsburg et al (2008) and Graham et al (1997) found that teachers limited their focus in early years mathematics teaching to counting up to 20 and common shapes but the intervention in this study supported the teachers in broadening the curriculum content.

The importance of covering the "big ideas" of learning mathematics has been highlighted by the National Council of Teachers of Mathematics (2000). Teaching mathematics based on a problem-solving approach helps children reach a deeper understanding of mathematics as it helps them with investigating, analysing, and reasoning (Ginsburg et al., 2008; NCTM, 1989; Williams, 2008). Story situations often have mathematical concepts naturally embedded in them. Whitin & Wilde (1992) found that stories allowed children to see maths as a common human activity. Moyer (2000) highlighted that mathematics in the familiar context and structure of literature allows children to see the subject as an important part of their daily lives. Also, Murphy (1999) stressed that many children can easily understand difficult mathematical concepts when they are presented within the context of a story and illustrated through graphs, diagrams and other visual displays.

The findings of the current study agree with the previous studies in that moving to a child-centred approach and using stories as part of that approach helped the children to develop a bigger picture of learning mathematics. Reema and Maha's stories encouraged positive discussion between the teachers and the children in order to solve the problems, which impacted positively on the children's understanding and learning outcomes. Also, using a model of Reema (where the different mathematical concepts were displayed attractively on her pockets) helped the children with a powerful visual image of a wide range of mathematical concepts and made recalling the information for children very easy. Also Reema's model acted as a transitional object for the children's reasoning and thinking skills thereby helping the children to develop connections between mathematical concepts and to use and apply their developing understanding in the problem solving scenarios of the stories.

To summarise, improving teachers' understanding of mathematics, changing their teaching approach, using stories as a method to teach mathematics, and using

Reema's model all had a positive impact on children's perceptions of the 'bigger picture' of mathematics. The children's perceptions of mathematics expanded from only number and shape to include money, time, addition, size, length, subtraction, position, division and classification.

7.3.2.2 The Children's Awareness of the Use of Mathematics in Everyday Life

The findings from the pre-intervention stage of this study showed that children's use of mathematical concepts in their daily lives involved little more than writing numbers with teachers at school and with their mum at home as 'homework'. However, the children's responses in the post-intervention interviews included different uses of mathematical concepts in their daily lives, such as drawing, knowing the time, buying, solving problems, building, dialling numbers, adding, comparing size, classifying, sharing, subtracting, knowing the date, comparing length and knowing the weight of something. Comparing the children's knowledge of the possible uses of mathematical concepts in their daily lives at pre and post-intervention stages showed an increase in the number of applications from three at pre-intervention to seventeen applications at the post-intervention stage.

Research studies have highlighted the importance of stories for building children's awareness of the ways in which mathematics is used in everyday life, thereby connecting school mathematics to real world maths (Hellwig et al, 2000; Moyer, 2000; Murphy, 1999; Whitin & Wilde, 1992). Jennings et al (1992) stressed the importance of applying concepts in real-life problem situations.

The findings of the current study agree with previous studies as the teaching approach and teaching materials that were used in the intervention helped the children to develop an understanding of the relationship between the mathematical concepts that they learned in school and their applications in everyday settings.

7.3.2.3 Using Mathematical Language more Accurately

The increase in children's positive attitudes, enjoyment, understanding and awareness of the use of mathematics in everyday life increased their confident and accurate use of mathematical language. Changing the teaching approach at the intervention stage to be more interactive encouraged the teachers to use more discussion in the classroom, which helped to develop the children's thinking skills and improved their mathematical vocabulary. This improvement in children's use of mathematical language was not only exclusive to the mathematics sessions but was also evident in their interactions at free-play time, for example, when playing in the blocks, drama or art areas. The Reema and Maha storylines centred on a problem which, in turn, prompted discussion of the problem and encouraged the introduction and development of mathematical vocabulary.

In this way, the findings of this study reflect the work of Moyer (2000), who stressed that mathematical concepts are often tied to the language children use to express ideas, and stories can provide further opportunities for discourse, in turn promoting children's oral language skills, their ability to communicate mathematically and their understanding of new mathematical vocabulary. Gailey (1993) identified that as students listen and talk about mathematical ideas both mathematical and language skills develop together. Capraro and Capraro (2006) also found that literature enhanced the mathematical learning outcomes for students and helped them to develop mathematical vocabulary.

In summary, changing the teaching approach from didactic teaching to an interactive teaching approach helped to develop useful discussions between the teachers and children which provided opportunities to improve the children's use of mathematical language. Also, using the Reema and Maha stories provided teachers and children with purposeful problem-solving contexts rich with mathematical ideas that encouraged children to use mathematical language accurately as they looked for solutions and shared their thinking.

7.3.3 Thinking Skills

The findings of the current study showed an improvement in children's thinking skills whereby children used thinking and reasoning skills quite naturally during the mathematics discussions at the intervention stage. Providing a model of Reema immediately engaged the children's attention and gave them a transitional object to support the development of their thinking. A detailed comparison of the enhancement of the children's thinking skills pre- and post intervention has already been provided in section 7.2.3.3 in this chapter. Nevertheless, it is worth reiterating that the importance of providing problem-solving contexts in order to challenge children's thinking and reasoning skills cannot be underestimated as reflected in the findings of this study and previous research (National Council of Teachers of Mathematics [NCTM], 1989; Wilkins, 2008; Williams, 2008). Problem-solving in mathematics can provide children with realistic and purposeful contexts that help their imagination and investigations and develop their analysing, reasoning and communication skills. Whitin & Wilde (1992) propose that using stories to present mathematics encourages children to be mathematical problem solvers, as the original story or problem can act as the basis for numerous *related* problems.

The Reema and Maha stories provided real world problems that the children could easily relate to and the opportunity to discuss the problems was built into the format for the intervention lessons. The children were able to make suggestions and compare ideas as to the best way to solve the problems and the stories prompted the children to make connections across different mathematical skills and concepts. The improvement in the children's learning outcomes emerged from the change of teaching approach whereby the children were no longer restricted to passively learning factual content or only practising skills.

7.3.4 Using and Applying Mathematics Ideas

Previous research studies stressed the importance of improving children's abilities to connect mathematics with their daily practices (Boalor, 2009; McGrath, 2010; Pound and Lee, 2011; Thompson, 1999). Williams (2008) also emphasised that children should experience a broad range of contexts in order to explore, enjoy, learn, practise and talk about their developing mathematical understanding. At the intervention stage of this study, children showed an ability to use and apply mathematical ideas outside of their mathematics sessions; for example, during free-play at corner time, circle time and meal time. During the free-play corner time observation, children showed that they not only enjoyed the Reema and Maha stories but that they also used the same problem-solving techniques adopted by the characters in the stories to solve their own problems in their play (as detailed in Chapter Six.) Leitze (1997) made clear that using stories helps children to see mathematics in everyday situations whilst NCTM (1989) state that using a meaningful problem-solving contexts helps children to link their knowledge to different kinds of daily situations. The findings of this study certainly resonate with the work of both authors.

Hellwing et al. (2000) also highlighted the important role of stories in helping children to draw meaningful connections between mathematical knowledge that they receive in the classroom and their practices outside the classroom. Children using and applying their mathematics knowledge and understanding in other daily periods is a remarkable sign of improvement in their understanding of the mathematical concepts. The careful modelling of everyday problem-solving approaches embedded in the content of the Reema and Maha stories had a positive impact on increasing children's use and application of different mathematical ideas and skills.

7.4 Concluding Remarks

This study has illustrated the impact of using stories to teach mathematics to pre-school children (5-6 years old) in Saudi Arabia. The main purpose of this study was to design and monitor the impact of a teaching intervention which encourages interactive teaching and learning. A qualitative, constructivist, technical action research approach was the theoretical framework adopted. Three different tools (questionnaire for teachers, semi-structured interviews with teachers and children pre- and post-intervention and classroom observations) were selected to gather data to answer the following two research questions:

- What is the impact of teaching mathematics through stories on pre-school *teacher practices*: subject knowledge, attitude, confidence and classroom practice?
- What is the impact of teaching mathematics through stories on pre-school *children's learning*: engagement and enjoyment, understanding, application and thinking skills?

From the evidence presented in previous chapters and discussed in this chapter it can be concluded that using the five especially designed stories to teach mathematics had a positive impact on teachers' subject knowledge, attitude, confidence, enjoyment and classroom practice. Also, using the five stories to teach mathematics had a positive impact on the children's engagement and enjoyment, mathematical understanding, thinking skills and use and application of mathematical ideas. The research intervention had a positive impact on the teachers, children, and the teaching and learning process however, this study is not without its limitations which will be outlined in the following section.

7.5 Limitations of the Study

- This study was based on a qualitative research approach, as discussed in Chapter Four. This kind of research approach required in-depth data which necessarily involved a small sample (10 teachers, 50 children, and 3 mothers). Consequently, any generalisations based on this study can only be tentative.

- Due to Saudi cultural constraints, both teachers and parents were female hence the perceptions of male teachers and fathers are absent from the study. This necessarily limits the applicability of the findings to other cultural contexts.
- Only three mothers responded and participated in the current study which is not a sufficient sample size to claim that an accurate picture of Saudi mothers' understanding and attitudes towards mathematics is presented nor how much their views influence the teaching of mathematics.
- This study only covered three private schools in one city. It did not include the public schools or other private schools in other cities. This might limit the benefits of the findings.
- The period of the data collation was short (almost five months), and an extended period of gathering evidence for the study might have provided the researcher with more in-depth understanding and greater insights.
- I followed several steps to reduce any influence of my current and previous experience regarding how research data was collected and interpreted. However, it cannot be known to what extent the research results may be effected by the researcher. In my case I had multiple roles in this study of being the main researcher, story writer and previously a pre-school teacher. Playing all these three roles in the research could have some effect on the research. Within the research literature (Bell, 2005; Creswell. 2009) it is acknowledged that bias is an issues faced by researchers, however I minimised this as far as possible as highlighted on Chapter Four section 4.8.

7.6 Contribution to Knowledge

There is little research on the impact of using stories to teach *pre-school mathematics* in the Kingdom of Saudi Arabia, the UK or internationally. In Saudi Arabia, for instance, research relating to teaching mathematics in general and to pre-school in particular, is very limited and not easy to access. Based on my knowledge, this study is the first that has investigated the impact of using stories in the teaching of pre-school mathematics in the Saudi Arabian context by using five stories that were designed specifically for teaching mathematics to young children. This thesis, therefore, aims to fill the knowledge gap by making the findings widely available.

7.7 Personal Learning

Carrying out the current study provided me with enhanced knowledge and understanding of mathematics in general and, mathematics teaching and learning in pre-school settings in particular. At the same time, I have gained insights into effecting change in teaching practices; and about using stories as a method to teach mathematics to pre-school children. My personal learning arising from the current study can be divided into three parts: my personal learning as a researcher, my personal learning as a teacher, and my personal learning as a parent. The following are explanations about my personal learning from the current study:

7.7.1 Personal Learning as a Researcher

Reading different studies for the review of literature for this study helped me as a researcher to improve my knowledge and understanding about:

- the importance of mathematics as a subject and discipline;
- the importance of teachers' subject knowledge, attitudes, beliefs and confidence for teaching mathematics effectively;
- using stories as a method to present mathematical concepts to pre-school children and the impact of using stories to teach mathematics on teachers' practices.

  My personal learning journey as a researcher also:
- enabled me to study research methods and methodologies and their practical implementation which provided me with valuable experience as

well as improving my skills for developing different research tools, collecting, organising, analysing and interpreting data.

7.7.2 Personal Learning as a Teacher

The current study not only added to my knowledge as a researcher but it also helped me to improve my knowledge as a recognised teacher of the pre-school stage in Saudi Arabia. Reading through the literature as well as carrying out the intervention to improve the pre-school participant teachers' practices helped to increase my knowledge about:

- the importance of teachers' subject and pedagogical knowledge and attitudes in improving the quality of the teaching process including helping children to build a positive attitude towards the subject;
- the importance of adopting a child-centred approach to help children to become involved in the learning process as well as helping them to construct new knowledge based on previous knowledge.
- the importance of adopting a problem-solving strategy to teach mathematical concepts to pre-school children as it encourages them to use different thinking skills as well as helping them to relate mathematics to their daily lives.

At the same time, undertaking this study has helped me to realise the value of action research to support practising teachers in maintaining their professional development by systematically examining their approaches to teaching. For this study, I was able to examine the impact of using stories to teach mathematics to pre-school children and appreciate (from analysing the research evidence) the positive impact of using stories in mathematics teaching, making mathematics more purposeful, enjoyable and relevant.

7.7.3 Personal Learning as a Parent

And finally, carrying out the current study helped me to improve my personal knowledge as a parent as it helped me in the following:

- Improved my knowledge about the importance of mathematics for children's later achievement.
- Clarified the role of parents in increasing children's positive attitudes towards mathematics as well as helping them to connect mathematical concepts and ideas to their daily lives.
- Highlighted the importance of co-operation between parents and teachers to enhance children's mathematics learning.

7.8 Study Implication within the Saudi Context

This research is the first of its kind to use stories to teach mathematic to pre-school children within the Saudi context. After careful consideration of the findings of the present research and the literature review, this research suggests that:

- Pre-school teachers need special in-service training programmes to provide them with the necessary knowledge and understanding to increase their mathematics subject knowledge and pedagogical knowledge in order to improve their mathematical teaching practices by helping them to understand different approaches to teaching.
- Professional mathematics training centres should be established to run different workshops and training programmes for teachers, parents, and head teachers to improve standards and effectiveness.
- A mathematics national curriculum for the early learning stage needs to be written to clarify the key objectives for teaching mathematics, to identify the central mathematical concepts and to set standards to be followed. Adopting a framework of facts, skills, concepts, conceptual structures, attitudes and appreciation would provide teachers with an in-depth understanding of mathematics teaching which would increase the quality of the teaching and learning outcomes.

- An increase in the number of mathematics sessions taught in pre-schools should be considered to give the teachers the opportunities to teach mathematics in an interactive way.
- The use of stories should be adopted as integral to the method of teaching mathematics at the pre-school stage and as a way of encouraging teachers to move from a teacher-centred to a child-centred teaching approach.
- Pedagogical and instructional materials should be improved to contribute towards enhancing teaching mathematics to pre-school children. Designing and using transitional objects such as the model of Reema would motivate children to participate in the learning process as well as supporting the development of reasoning and thinking skills.
- Parents need to be made more aware of the importance of mathematics and the important role they can play in helping their children to achieve better mathematics learning.
- Regular inspections of the teachers by the inspectorate would facilitate the evaluation of teachers' practice in mathematics and identify training needs for teachers.

7.9 Recommendation

The current research has investigated the impact of using stories in pre-school mathematics teaching. The results of the study have led to some recommendations that could be applied not only in Saudi Arabia but in other Arab countries or internationally. The following are the key recommendations that have been generated based on the results of this study's intervention:

- Review pre-school teachers' pre-service training programmes to make sure that they provide the teachers with the necessary knowledge and skills to secure a good foundation as qualified teachers which in turn will improve the quality of mathematics teaching and learning outcomes.
- Provide in-service teachers with continuous professional development programmes to update them with the latest information about mathematics

teaching practices, as well as to help them cover any possible gaps that they may have in their own knowledge and understanding.

- Adopt the use of stories as integral to teaching mathematics to pre-school children in order to help them to learn mathematics in a meaningful, enjoyable and relevant way.
- Present a workshop to parents to clarify the importance of mathematics for their children's later achievement, as well as providing them with a full explanation of the appropriate ways and steps to support children's mathematics learning.

All the above recommendations are equally applicable in Saudi Arabia and in addition there are three recommendations specifically applicable to SA and other Arabic communities as following:

- Give the subject of mathematics the same attention and importance as literacy by increasing the number of weekly sessions.
- Establish a mathematics national curriculum for the early learning stage that includes counting numbers, calculating simple addition and subtraction problems, and describing shapes, spaces and measures to help both teachers and children to see the big idea of teaching and learning mathematics.
- Present a workshop to the Ministry of Education's inspectors to emphasise the importance of teaching mathematics to pre-school children in relation to their later achievement; to highlight the importance of learning mathematics as a subject and a discipline in this technological era, and to gain their support and cooperation in establishing a mathematics national curriculum for the early learning stage along with increasing the number of mathematics sessions.

7.10 Issues for Future Research

During this study, the following issues emerged as worthy of further investigation:

- The influence of parents' requirements on changing the vision and objectives of private schools.

- Parents' lack of awareness of the importance of mathematics as a subject and discipline for everyday practices.
- Parent-school relationships and communication including the influence that parents have on the school curriculum.
- The process and content of pre-service training programmes for pre-school teachers in SA.
- The best approaches to the provision of varied continuing professional development programmes for pre-school teachers (workshops, seminars, action research, long and short courses.)
- Training for mathematics teachers and evaluation of their classroom practice as newly qualified teachers.

7.11 Final Thoughts

"*…young children's future ability to think mathematically, like other aspects of their development, depends heavily on the experiences, social interaction and accompanying language that children meet in these formative years*." (Pound, 1999, p: 6). Concentrating on the strategies and methods used to present mathematic to pre-school children is a key issue for teaching mathematics successfully. For that, "*children's literature can be used as an effective classroom vehicle for motivating children to persist at mathematical tasks and to reason mathematically and to make sense of their real world*" (Hong, 1996, p: 480). Moreover, presenting mathematics to children within the familiar contexts and structures of stories allows them to see mathematics as a fundamental part of their daily lives (Moyer, 2000). To conclude I quote Moseley (2010):

> *"…..Children love stories- the most difficult of classes will usually settle down for a story. We can exploit this simple fact across the curriculum, using stories as a vehicle for giving information and consolidating understanding at any point within a given topic. This is just as true in mathematics. An appropriate story can be used to support the introduction and development of a concept, to set a problem to be solved and to consolidate learning"* (p: 16)

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Appendices

Appendix A: Overview of Education in Saudi Arabia

- **Some of the Prophet's conversations to seek and urge knowledge**

The basic constitutional law of Islam is Quran and Sunnah. The Sunnah comes from the life of Prophet Mohammed and display the interpretation of some of the things that did not come in detail in the Quran. The Quran and Sunnah are two sides of the same coin.

As the Quran contains many verses urging to seek knowledge, Alsunnah (the prophet life) has many examples that urge seeking knowledge, for example

In the first battle that took place between Muslims and Quraish, there were lots of prisoners in the hands of the Muslims, which gave a real chance to show the importance of education in Islam. Prophet Muhammad, blessings and peace be upon him, asked the prisoners to teach ten Muslims for their freedom. Here, is evidence for us of the importance of education in Islam. The Messenger of Allah, peace be upon him, did not demand prisoners with money or trade or goods, even though the Muslims were in need of money after all companions have left the Prophet and his followers to the Medinah, leaving behind their money and their business, but instead asked for what was the most expensive and most valuable. They asked for education, instead identifying what is real wealth. With education and knowledge, you can get the money and prestige because the fundamental goal of the creation of man is the revival of earth, and the revival and architecture of earth requires human beings to be equipped with education and knowledge, and, thus, fight the ignorance that is the root cause of all crises that may pass on humanity.

Islam's position on education and knowledge is that, whether young or old, seeking knowledge leads to an extended length of human life, and is not exclusive to a particular stage, age or category. Islam did not call only to learn forensic or religion science that may have come to the minds of some, but it reached out to all the sciences, whether it is maths, astronomy, geology or medicine. Therefore, we see Muslim scholars in all fields, such as medicine, chemistry, astronomy, calculus and maths. Today, no one can mention Medical research and Clinical care without mentioning Al-Razi and Ibn Sina, Mathematician, astronomer and geographer without mentioning Al- Khwarizmi , and Philosophy without mentioning Al-Farabi. (Al-Syed, 2011)

Therefore, we can say that Islam is not a religion of worship only, but a religion of knowledge, education, and it encourages scientific research. Even in the presentation of science, Muslim individuals were keen to provide and deliver information in a manner suitable for learners. It was reported that Ali, may Allah be pleased with him, said *address the people up to the level of their minds*. With this statement, he gives us the way and approach that we should not stray from them because he tells us how to submit information for a child differently from the mode of delivery for an adult. Bruner said in modern science that any information could be provided to a child no matter how difficult if this information was presented in an appropriate manner to the thinking of the child. (Bruner, 1960)

➢ The Objectives of the Intermediate Stage

The intermediate stage is designed to enable the Islamic faith in the hearts of students to be the main engine of all their actions and their behaviour in addition to providing expertise, knowledge and information, which qualifies them to pursue science and move to the subsequent phase. The objectives of this stage are:

- Enable the Islamic faith in the student, and made him responsible of his behaviour and actions and the development of the love of God and piety, and fear in his heart.
- Provide the student with the appropriate expertise and knowledge to become familiar with public assets and the basic principles of culture and science.
- Encourage the student to research and gain knowledge, and accustom him to reflect on those around him, and encourage the use of the scientific method of thinking.
- Develop the mental abilities, talents and capabilities of the student, and provide support for his pledge to guidance and discipline, and provide him with everything possible to develop his skills.
- Raise the student on the basis of social life dominated by the Islamic brotherhood, cooperation and appreciation of responsibility.
- Train the student to serve his society and his homeland, and cultivate a spirit of advice and dedication to the governors of the order.
- Stimulate student enthusiasm to restore the glories of the Muslim nation to which he belongs, and learn to work through the splendour and dignity, and in the face of misleading rumours, and resistance to alien principles.
- Familiarize the student with the use of leisure time and investment in beneficial actions.
- Strengthen the awareness of the student to face rumours, false doctrines, and subversive and alien principles.

- Prepare the student to continue his education in further levels of education. (Ministry of Education, 2013)[17]

In this stage, we find that concentrating on the fundamentals of the foundations of Islamic faith has the greatest attention, because a strong foundation for building individuality and working towards providing him with the viable personal decency would lead to the extraction of individuals who are loyal to their nation, collaborators with others, productive, and have the desire to discover and seek knowledge.

➢ The Objectives of the High School Stage

This represents the highest stage in compulsory public education in Saudi Arabia. It may be seen as the final stages of education for some, so it should be formulated in a way that its objectives include the preparation of the student for working life and the family, and at the same time there will be particular targets for the continuation of some others to pursue higher education. The objectives of this stage are:

- Support the Islamic faith in order to achieve loyalty to God alone, and work shall be exclusively for Allah, and with respects Islamic faith.
- Enable belonging to and achieving the fulfilment of the Islamic nation and the Kingdom of Saudi Arabia, and the religious consciousness of the place it occupies in the hearts of Muslims, as well as appreciation of their responsibilities.
- Provide students with the basic concepts of Islamic culture that makes them proud of Islam, proud to promote the Islamic faith and strive to defend it.

[17] http://www.moe.gov.sa/Pages/educationPolicy.aspx

- Develop the capacity of students and their preparations, which appear in adolescence, and to direct them in the light of the general concept of Islamic education.
- Understand youth care and treatment of intellectual and emotional problems from an Islamic perspective, and help young people get through adolescence successfully, in the face of subversive ideas and misleading trends.
- Configure the right experiences and appropriate skills to make the student's daily life appropriate for a true Muslim.
- The development of social qualities needed in dealing with the Muslim community, such as cooperation and self-sacrifice in the way of Allah and seeking His pleasure, and the organization of work and wise planning.
- Development of scientific reasoning in the student's achievement and the spirit of research and experience, as well as the use of scientific methods and study to develop the right research and study process.
- The support of other students to work in the fields of life and meet the needs of the country's skilled manpower required by the development plans.
- Provide encouragement for students who are able to continue to study in the institutes and colleges for various disciplines.
- Promote family awareness to build a believer Muslim family.
- Faith in the unity of the Islamic nation and its global mission and function of civilization.
- Build positive awareness for the student in order to face any subversive ideas and shaded trends.
- Provide an opportunity for students who are able and prepared to continue studies in higher education in all disciplines.(Ministry of Education, 2013)[18]

[18] http://www.moe.gov.sa/Pages/educationPolicy.aspx

As can be seen from the objectives, it is deemed important to prepare the student and to inculcate the Islamic faith in all aspects of their daily life in parallel to setting the student on a pathway to scientific knowledge and understanding. In this way, the Kingdom of Saudi Arabia uses the educational system to achieve a nation equipped with both Islamic and secular knowledge.

➢ Functions of the General Secretariat of Pre-school

- Preparation of plans and programs for pre-school, and oversee the implementation, monitoring and evaluation.
- Participation in the preparation of pre-school needs and the requirements of those programs requirements and teaching aids and suitable buildings.
- Conditions and controls selection of teaching staff and administrative workers in pre-school and work to organize rehabilitation programs, training and cooperation with the relevant authorities.
- Participate in efforts in the field of care for children educationally, culturally and healthy cooperation with the relevant authorities and regional, international, Arabic and private organizations.
- Participating in the development of programs early detection and intervention for children with special needs and gifted, and work on the training competencies required for the activation of these programs and coordination with the relevant authorities.
- Work to attract private sector investment and stimulate participation in the spread of pre-school and reduce government spending in this relationship.
- The preparation and development programs family and community awareness of the importance of pre-school in the child's development and future of education and educational.
- Involve in the collection and organization of statistical information and the development and updating of databases to provide educational indicators (such as public spending, and the intensity of the season, and the volume of expenditure, and the cost of education per child ... etc) and

their use in decision-making and action on stage to verify the quality of education and the extent of its spread.

- Cooperation and coordination with universities and other ministry-related with pre-school phase, such as the Secretariat of the Special Education, and private education, buildings and school equipment and colleges of education, and the preparation of teachers to achieve the integration required to implement the Ministry's plans in pre-schools.
- Identification of training needs and the administrative and technical requirements of the Secretariat and the follow-up provided.
- Preparation of periodic reports on the activities and accomplishments of the Secretariat and performance constraints, and ways to overcome them and submit them to the Educational Affairs agent.
- Carry out any other tasks assigned to them in the area of competence

- **Appendices B: Questionnaires, Interviews, Observation and Consents**

Teacher Questionnaire

1 Teacher name…………………………..

2 What is your qualification (certificate)?

a. High school ☐ Bachelor ☐ Others …………………

3 If you have a bachelor degree, what is your specialization?

a. Early learning ☐ other ………………

b. If it is other please specify…………………………..

4 If you do not have early learning qualification (certificate), did you attend any training courses?

Yes ☐ No ☐

If the answer is yes please list these courses below

………………………………………………… .

…………………………………………………

…………………………………………………

5 How long you have been teaching early learning stage?

…………………………………………………………

6 How do you find teaching maths?

Interesting ☐ Acceptable ☐ Challenging ☐

If your answered acceptable or challenging list the reasons below

i. ……………………………………………………………….

ii. ………………………………………………………………..

iii. ……………………………………………………………...

7 What are your techniques or strategies for teaching math for your students?

Traditional way (teacher-centred) ☐ Interaction way (student-centred) ☐

8 What are your resources in teaching mathematical concepts?

(You can choose more than one)

White board ☐ Pictures ☐

Books ☐ Models ☐

Items from the child's real life

Others

……………………………………………………………………………
…….

9 Do you use children's literature in any way rather than teaching language?

Yes ☐ No ☐

If your answer yes, can you please give some example:

………
……..

Teacher Interview questions (Pre- Intervention)

Interview sections:

Teacher background and experience

1. What are your thoughts and feelings about being a teacher in a pre-school centre?
2. Since you started teaching, what type of training programme/s have you taken to improve your teaching, skills, and subject knowledge?

Prompts:

- School training.
- Workshop.
- Further qualifications

Teacher philosophy of education (teaching, learning, teaching young children)

1. What is your philosophy of learning?

Prompt:

- How do you think children learn best?

2. What is your philosophy of teaching?

Prompt:

- How do you approach your teaching?

3. In your view, what are the particular challenges of pre-school in comparison to later educational stages?

Prompts:

- Children's readiness for learning.
- Preparation for learning

4. Which parts of the daily program do you like the best? Why?

<u>Teaching maths</u>

1 What do you think about the mathematics subject in general? How do you find it?
2 What do you think about the mathematics period? How do you find it?
3 Can you tell me in general about the parents' attitude towered mathematics subject in general?
4 What is the procedure that the inspector and head teacher follow to evaluating your teaching way on mathematic subject?
5 Can you tell me in general about the children's attitude when they are attending the mathematics period?
6 What is your approach to teaching maths? Why have you chosen this approach?

Prompts:

- Interactive.
- Dictation.

7 What methods do you use to present mathematics concepts to children?

Prompts:

- Using concrete objects.
- Using books.
- Using pictures.

8 Within your teaching, can you tell me the exact steps you follow to present new mathematical concepts to children?
9 Do you try to make any connection between children's prior knowledge and the new knowledge that you present when you teach mathematics?
10 Can you tell me how the children respond to the strategies you use to teach maths?

Prompts:

- Enjoyment
- Learning

11 If the child finds a new concept hard to understand, how do you help him/her get it?

Prompts:

- Further explanation
- Give some examples.

12 Do you use any other opportunities to use mathematics concepts or mathematics vocabulary other than in the mathematics period? If so can you give me an example?

13 Do you teach maths in a way which relates it to everyday experience? If yes, can you give me an example?

14 Do you think the current maths curriculum meets the children's needs?

Prompts:

- Suitable for their age.
- Helps children to see maths around them.

Use of story

1. As a pre-school teacher, when do you use story?

Prompts:

- Circle time.
- Story time.

2. Do you think it is important to read stories in school? If so why?
3. Can you tell me about the children's attitudes when you tell them a story?
4. Do you use story as a method of teaching in any subject? What do you think about this approach?
5. What do you think about using story to present mathematics concepts to pre-school children? Does it make any difference?
6. Have you ever done this? If so, does it make any difference? If not, what do you think of this approach?

Closing question

1. Are there any things you want to talk about that we have not covered in the interview?
2. What do you think of the interview process?

Teacher Interview questions (Post- intervention)

Teacher attitude and practice

1 What do you think about the mathematics subject in general? How do you find it after using stories?

2 What do you think about the mathematics period? How do you find it after using stories?

3 Within your teaching and using stories, can you tell me the exact steps you follow to present new mathematical concepts to children?

4 Do you think in somehow using stories helped you to improve your practise? If so, how? If no, why?

5 After using stories, do you try to make any connection between children's prior knowledge and the new knowledge that you present when you teach mathematics? If so con you give me an example?

6 After using stories, if the child finds a new concept hard to understand, how do you help him/her get it?

Prompts:

- Further explanation
- Give some examples

7 After using stories, do you use any other opportunities to use mathematics concepts or mathematics vocabulary other than in the mathematics period? If so can you give me an example?

8 After using stories, do you teach maths in a way which relates it to everyday experience? If yes, can you give me an example?

Child's attitude

1. After using stories, can you tell me in general about the children's attitude toward mathematics?
2. What about their attitude when they are attending the mathematics period?

Prompts:

- Happy
- Exciting
- boring

3. Can you tell me how the children respond to the stories as a method to teach Mathematics?

Prompts:

- Enjoyment
- interacting

4. Do you think using stories as a method to present and teach mathematical concepts meets the children's needs in this stage?

Prompts:

- Suitable for their age.
- Helps children to see maths around them.

Closing question

1. Are there any things you want to talk about that we have not covered in the interview?

Children Interview Questions

Interview sections

- ***Attitudes to school and daily programs***

1 Can you tell me about your school, how do you find it?

Prompts:

- Enjoyable.
- Boring.

2 What about your friend, how do you find them?

Prompts:

- Friendly.
- Helpful.

3 Which are your favourite periods in daily program? Why?

Prompts:

- Circle time.
- Corner time.

4 Which is your favourite subject? Why?

Prompts:

- Arabic.
- Math.
- Islamic study.

- ***Attitudes to maths***

1 What about the maths period, how do you find it?

Prompts:

- Enjoyable.
- Boring.

2 Do you think mathematics is useful? If so why/ why not?

3 Can you tell me when do we need to use maths?

Prompts:

- Shopping.
- Sharing.
- Playing.

- ***Attitudes to stories***

1 Which activates in school do you like the best? Why?

Prompts:

- Corner time.
- Story time.

2 What do you think of story/stories time do you like them? If so why/ why not?

3 When the teacher tells you story, how do you feel?

Prompts:

- Excited.
- Happy.

- ***Closing question***

Is there anything you want to tell me about it that we have not touched upon?

Mothers Interview Questions

Interview sections:

Parental opinion

1 Does your child enjoy the school?

Prompts:

- Their attitude.

2 From your opinion what is the important of pre-school stage in preparing your child's to the next stage?

Prompts:

- School environment.
- Strong foundation.

3 Do you know which period of the daily programs that your child enjoys the best? Why he/she enjoy it?

Prompts:

- Circle time.
- Corner time.

4 Do you teach your child at home? If so what do you teach and how often?

Maths

5 How important do you think the teaching of maths is? What are your reasons?

6 Can you tell me about your child attitude towered mathematics subject?

Prompts:

- Worry.
- Happy.

7 Did you notice if your child uses any mathematics vocabulary in informal ways? If so, can you give me an example?

8 Can you tell me if your child fined any difficulty in learning maths?

Prompts:

- Homework.
- Vocabulary.
- Solving problems.

9 Can you tell me if you find any difficulty in teaching maths for your child?

Prompts:

- Homework.
- Explanation.

<u>Story</u>

1. Do your child love story? How do you know?
2. Do you read or tell story for your child? If so, how often?
3. How important do you think using stories are? Why?
4. Do you think if we use story as a method in teaching mathematics will make mathematics more enjoyable?

<u>Closing questions</u>

1. Are there things you want to talk about that we have not touched upon?

Observation Checklist

Name of the school…………………….. Date of observation……………………

Time of observation……………………..Name of the teacher…………………...

Which techniques the teacher is using to move from one session to the next one.	
Technique that the teacher uses to introduce the new lesson.	
The body language of the teacher.	
Materials used to teach the new concept.	
The steps followed to teach the new concept	
Is the teacher making any connection between the previous knowledge and the new one?	
Is the teacher helping the children to make connection between the new knowledge and their daily life activity?	
Is the teacher keeping the children involved in the learning process?	
Is the teacher asking any reasoning questions?	
Is the role of the teacher to present the new concept to the children or help the children to discover the new concept?	
Is the teacher asking any questions that are helping the children to discover the importance of the new concept in their daily life and how can they use it affectively?	
How the children are responding to the teacher?	
Are the children enjoying the lesson?	
Is the teacher giving any chances to the children to participate through the lesson?	

Teacher	Child
....	....

Teacher consent letter

I am currently a Saudi PhD student at the School of Sport and Education, Brunel University in West London, UK. I am investigation 'the meaningful teaching of maths through stories within the Saudi Arabia pre-school content'. As part of my academic research, I would be grateful if you would be willing to be interviewed and spend some times with me to discuss your valuable experience in relation to the research area. If possible, the interview will be voice recorded and transcribed for research purposes.

Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the interview at any point. It is very important for us to learn your opinions.

Your responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the interview or the procedures, you may contact me at my email address specified below.

Your contribution into this interview would definitely help to reach our objective in investigation the meaningful teaching of maths through stories within the Saudi Arabia pre-school content.

Please rest assured that all information provided would be dealt in strict confidentiality and will be used solely for the academic purpose.

Thank you very much for your time and support.

Abeer BinAli

Abeer.Binali@brunel.ac.uk

Child Consent Letter

Dear Mother

I am currently a Saudi PhD student at the School of Sport and Education, Brunel University in West London, UK. I am investigating '**the meaningful teaching of maths through stories within the Saudi Arabian pre-school context'**. As part of my academic research, I am conducting my academic research in pre-schools in Saudi Arabia, where I will undertake few interviews with pupils, parents, and teachers. In this context, I would highly appreciate if you could kindly give your approval to conduct an interview with your child if possible, that interviews will be hold in school and in normal school hours.

Your child participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if your child feels uncomfortable answering any questions, he/she can withdraw from the interview at any point. You also have the right to withdraw their data after the process. It is very important for me to learn your child opinions.

Your child responses will be strictly confidential and data from this research will be reported only in the aggregate. Your child information will be coded and will remain confidential. If you have questions at any time about the interview or the procedures, you may contact me at my email address specified below.

Your contribution in this interview would definitely help to reach my objective in investigating the meaningful teaching of maths through stories within the Saudi Arabia pre-school context.

Please rest assured that all information provided would be dealt in strict confidentiality and will be used solely for the academic purpose.

Thank you very much for your time and support.

Abeer BinAli
Abeer.Binali@brunel.ac.uk

Mother Consent letter

Dear Mother

I am currently a Saudi PhD student at the School of Education, Brunel University in West London, UK. I am investigating '***the meaningful teaching of maths through stories within the Saudi Arabian pre-school context'***. As part of my academic research, I am conducting my academic research in pre-schools in Saudi Arabia, where I will undertake few interviews with pupils, parents, and teachers. In this context, I would highly appreciate if you could kindly give your approval to conduct an interview with you if possible.

Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the interview at any point. you also have the right to withdraw your data after the process. It is very important for me to learn your opinions.

Your responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the interview or the procedures, you may contact me at my email address specified below.

Your contribution in this interview would definitely help to reach my objective in investigating the meaningful teaching of maths through stories within the Saudi Arabia pre-school context.

Please rest assured that all information provided would be dealt in strict confidentiality and will be used solely for the academic purpose.

Thank you very much for your time and support.

Abeer BinAli

Abeer.Binali@brunel.ac.uk

Appendix C: Stories

<u>The developed stories</u>

Due to Intellectual Property and Copy Right of the developed stories and artwork, it could be ordered directly only from the researcher (abeerbinali@yahoo.com; abeer.binali@brunel.ac.uk)

Appendix D: Research Ethical Committee and Schools Approvals

Research Ethics committee approval letter

Heirz Wolff Building,
Brunel University, Uxbridge,
Middlesex, UB8 3PH, UK
Tel +44 (0)1895 266494
Fax +44 (0)1895 269769
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Abeer Binali
PhD (Education)
School of Sport and Education

14th May 2013

Dear Abeer

RE36-09 An investigation into the meaningful teaching of maths through stories within the Saudi Arabian pre-School context

I am writing to confirm the Research Ethics Committee of the School of Sport and Education received your application connected to the above mentioned research study. Your application has been independently reviewed to ensure it complies with the University/School Research Ethics requirements and guidelines.

The Chair, acting under delegated authority, is satisfied with the decision reached by the independent reviewers and is pleased to confirm there is no objection on ethical grounds to grant ethics approval to the proposed study.

Any changes to the protocol contained within your application and any unforeseen ethical issues which arise during the conduct of your study must be notified to the Research Ethics Committee for review.

On behalf of the Research Ethics Committee for the School of Sport and Education, I wish you every success with your study.

Yours sincerely

Dr Richard J Godfrey
Chair of Research Ethics Committee
School Of Sport and Education

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2011

Sponsorship letter to schools in Saudi Arabia to cooperate with the researcher

Due to confidentiality, Student Saudi ID number, and name of the schools were removed

School A approval letter

Due to confidentiality, name of the schools were removed

School B approval letter

Due to confidentiality, name of the schools were removed

School C approval letter

Due to confidentiality, name of the schools were removed

Appendices E: Story Materials and Student Work

❖ ***Reema's Figure***

Due to Intellectual Property and Copy Right of the developed stories and artwork, it could be ordered directly only from the researcher (abeerbinali@yahoo.com; abeer.binali@brunel.ac.uk)

❖ ***Some of the stories materials***

❖ ***<u>Some of the stories materials</u>***

❖ ***Some of children work at art corner***

❖ ***<u>Some of the children work at Art corner</u>***