An Investigation of how Visual Arts can be used to teach Mathematical Concepts of Space and Shape in Grade R

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ABSTRACT

The impetus for this study came from the findings of an evaluation of a Maths and Science through Arts and Culture (MStAC) Curriculum Intervention undertaken with Grade R teachers registered for a BEd(in-service) qualification at Rhodes University, South Africa. The intervention aimed to enrich Grade R teachers' teaching of mathematics. Post-intervention classroom observations showed that, in spite of the intervention, teachers' classroom practices did not change, and they were not using visual arts to teach mathematical concepts. This, together with the lack of research in the field of mathematics in early childhood, particularly in South Africa, motivated this research, a case study, which investigates how visual arts can be used to teach space and shape conceptualization in Grade R.

I designed a research intervention underpinned by a constructivist model of teacher professional development located in reflective practice (Borko & Putman, 1995; Zeichner & Liston, 1996; Wilmot, 2005). Guided by Stacey's (2009) notion of an emergent curriculum, I designed a three phase research intervention which involved selected Grade R teachers undertaking classroom-based research. Phase I built awareness around the notion of creativity; Phase II focused on making meaning of children's behaviour and interests; and Phase III applied the knowledge and ideas from the Phases I and II to the teaching of space and shape.

As an interpretive research study, it closely examines the participating teachers' perceptions, experiences and reflections which were articulated in reflective reports and assignments. Following action research processes, the participant teachers engaged in the process of an emergent curriculum. They observed the behaviour interests of Grade R children, interpreted and made meaning of the evident behaviours, made decisions regarding extension activities, and planned accordingly.

The findings of the study illuminate a model of teacher professional development that can support and enhance teachers' practice. Understanding the notion of creativity and the ability

to create a classroom conducive to creativity, are necessary components for teaching space and shape through visual arts activities. An emergent curriculum approach is proposed as an appropriate pedagogy for teaching children about space and shape through visual arts activities.

This thesis is dedicated to

MARC,

DOMINIQUE

and

SARAH

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List of Acronyms

CDP	Curriculum Development Project for Arts and Culture Education and Training
CSD	Centre for Social Development
DoE	Department of Education
EC DoE	Eastern Cape Department of Education
ECME	Early Childhood Mathematics Education
ETDP SETA	Education, Training and Development Practices Sector Education and Training Authority
MStAC	Maths and Science through Arts and Culture
NCS	National Curriculum Statement
NQF	National Qualifications Framework
SAQA	South African Qualifications Authority
ZPD	Zone of Proximal Development

CHAPTER ONE
Introduction

"Words are, of course, spoken to do things as well as to say things – they have practical and social impact as well as a communication function." (Hodder, 1994, p. 394)

1.1. Introduction

Throughout the ages human beings have felt the desire to represent their understandings of the world around them through art. All civilizations and cultures have developed their own art forms, from the earliest petroglyphs and rock art, to modern metal sculptures, tattoos and graffiti. The representation of understandings is a basic desire, and from the time that a child first begins to scribble and enjoys the marks that she makes, she starts to become aesthetically aware (Heberholz and Heberholz, 1975).

1.2. Background to the Study

As a teacher of young children for many years it always fascinated me how proficiently young children could show their understandings of the world around them through creative art activities. Einarsdottir, Dockett and Perry (2009) explain that whereas in the past, children's drawings and expressions of meaning through art were assessed according to the level of realism they displayed, more recently researchers consider them instead as expressions of meaning and understanding. In my own practice I discovered that if the children I was teaching were provided with a range of interesting materials and encouraged to use them, they were eager to paint, stick, model or draw to express their meanings and understandings. I found that creative art activities could be used cross-curricularly to extend young children's learning, and I often used this as a teaching strategy. My classroom was an area rich in the children's expressions of their understandings. With a multitude of art works constantly on display, the indoor learning environment was aesthetically pleasing and conducive for children's expressions through art and play.

Later as a teacher educator, I noticed that in many of the Grade R classrooms where I observed teachers, there was little evidence of children's expressions of their understandings and meanings.

Classroom displays predominantly consisted of magazine pictures cut out and glued to paper to represent the theme for the week. Hardly any paintings and drawings were displayed. The provision of art materials may be a challenge in poorly resourced schools; however I contend that a lack of resources is not the only reason why children are not being encouraged to express themselves through visual art.

The teachers I observed narrowly adhered to the Department of Education's requirements relating to the curriculum and assessment tasks which needed to be completed in terms of the National Curriculum Statement (NCS) (South Africa, Department of Education, 2002a). For many teachers, creative arts activities were not implemented cross-curricularly, and thus did not form part of the literacy, numeracy and life skills learning programmes which had to be taught in Grade R (South Africa, Department of Education, 2002a). However, I knew from my own classroom experience that visual arts activities can be used to enhance and extend conceptual understandings throughout the curriculum. For example children who had been learning about birds would spontaneously create their own birds from feathers, beads, sticks and clay if a variety of materials were made available for the children to select from, and if I, as the teacher, had provided an ambience conducive to children's expressions of meaning.

My interest in visual arts being a tool for enhancing learning was brought to the fore when I conducted an evaluation of the curriculum intervention programme – "Maths and Science through Arts and Culture" (MStAC) in which my Bachelor of Education (in-service) Foundation Phase (BEd) class participated. I was commissioned to do this evaluation by the Jim Joel Education and Training Fund (Schäfer, 2009). The evaluation formed the backdrop to, and created the impetus for this study. The findings of the evaluation (Schäfer, 2009) showed that in spite of participating in the programme which consisted of a workshop, a manual and a kit of materials, when they returned to their classrooms the teachers did not use visual arts for children to express their understandings and for enhancing learning. My puzzlement and curiosity to investigate further gave rise to this study, the aim of which is to understand how the concepts of space and shape can be taught through visual arts activities in Grade R.

1.3. Research Goal and Questions

The goal of this research study is to investigate how visual arts can be used to teach the concepts of space and shape in Grade R. Because of my work as a teacher educator of Grade R teachers, I took the decision to frame the investigation around how teachers can use visual arts to *teach* space and shape, rather than on how children *learn* through visual arts. A shift in focus from children's learning to teachers' professional development and capacity building shaped the questions which evolved and subsequently framed my research project. These were as follows below.

How can a curriculum intervention in a BEd in-service teacher education programme, which adopts and models an emergent curriculum approach, develop teachers' understandings of:

i. how to make meaning of children's behaviour interests;
ii. how to plan their curricula around those interests;
iii. how to use visual arts to enable and enhance children's learning about space and shape; and
iv. how action research processes can promote their development as reflective and reflexive practitioners?

1.4. Research Methodology and Methods

Given that the goal of this study was to investigate, with a view to understanding, how a curriculum intervention in a BEd in-service teacher education programme at one university could promote teachers' understandings of how to use visual arts to teach Grade R children about space and shape, an interpretive orientation was selected. This orientation prompted an emergent ontology which built on the participants' understandings and development during the study. As constructivism is concerned with the different constructions of reality that individuals and groups have, I selected a constructivist approach (Cresswell, 2007; Guba and Lincoln, 1994). This case study focused on a specific case: a group of Grade R teachers studying towards a BEd Foundation Phase degree.

The findings of the evaluation of the curriculum intervention (described in Section 1.2) prompted the study, which started with a critical review of the curriculum intervention (Chapter Two). For

this research study, a further curriculum intervention was designed – the research intervention, which took place over three contact sessions, lasting five days in total. It was divided into Phase I, Phase II and Phase III. Data was generated through the teachers' assignments, focus group discussions and video-recordings of their presentations. The three phases were built around an emergent curriculum process, in which teachers are required to observe children's behaviour interests, make meaning of their behaviour, and then make decisions on how to plan curricula accordingly, taking children's interests into account.

Phase I started by introducing the teachers to the notion of creativity and the significance of an appropriate environment and opportunities for children to show their understandings and make meaning.

Phase II was designed around making meaning of the children's visual representations, and making decisions for future learning activities.

Phase III of the emergent curriculum process comprised the teaching of space and shape using visual arts activities.

Rich data was generated from the teachers' assignments, their collections of children's work, photographs, and the video-recordings. This was analysed and the findings were discussed in terms of the goals for each phase.

1.5. Significance of the Study

When I started this research study, I became aware of the dearth of research available in the area of

- Grade R curriculum and pedagogy;
- Grade R teacher professional development; and
- early years' mathematics teaching, especially in the context of South Africa.

Ginsburg & Amit (2008) and Ginsburg, Lee & Stevenson Boyd (2008) remind us that little is known about early years mathematics teaching. Ginsburg et al. (2008) go on to recommend extensive in-service training and support programmes for early years' teachers; and supporting research on learning potential in children, teacher knowledge, teaching, assessment and evaluation methods in order to improve mathematics teaching.

> Research providing an understanding of good teaching – that is, teaching that is probably atypical – can serve to inform our views of quality Early Childhood Mathematics Education (ECME). (Ginsburg et al., 2008, p. 16)

In the same way, this research study provides some understanding of Grade R professional development; Grade R mathematics teaching in the area of space and shape; and Grade R curriculum and pedagogy. It also makes evident the inadequacies in the teachers' mathematical knowledge and pedagogy.

This study sheds light on how a curriculum intervention in an in-service teacher education programme was developed to support teachers on how to use visual arts to teach space and shape in Grade R classrooms. It also illuminates how the teachers who participated in the study were inducted as classroom-based researchers. The processes associated with an emergent curriculum approach – observation, making meaning, making decisions, planning and reflecting entail certain teacher dispositions amongst teachers – namely curiosity, awareness and collaboration. It is my view that by having these dispositions and engaging more profoundly with the children they teach, the teachers become more aware of the interests and needs of children, and are thus able to plan and teach more effectively around those needs. Fairbanks et al. (2009) argue that teachers require more than professional knowledge about teaching in order to become 'thoughtfully adaptive'. They suggest that 'thoughtfully adaptive' teachers have a vision and seek to do more than merely impart curriculum knowledge (p. 161). By implementing a particular intervention programme which encourages the development of the dispositions of curiosity, collaboration and awareness, it is my hope that the intervention programme has succeeded in producing more 'thoughtfully adaptive' teachers.

1.6. Limitations of the Study

As a case study, my research is confined to a small group of Grade R teachers studying towards a BEd (in-service) degree at a university in the Eastern Cape, in South Africa. There are several reasons why the results of this study may have limitations and these will be briefly mentioned.

Firstly, this group is unique in that they are the first in-service early childhood practitioners teachers who have been provided with an opportunity by Rhodes University to complete their BEd

degrees by using their diplomas as an entry into the course. One significant aspect of an in-service course is that the participants do not have opportunities to explore and experience other schools and contexts, and this may influence their practices. The majority of the participants completed their own schooling in poorly-resourced schools, and they are currently teaching in poorly resourced schools.

Another possible limitation is that I relied on the teachers' interpretations for my data. They could have interpreted the data differently to the way I intended, and in the same way I could have interpreted their understandings differently to the way they intended. However, as an interpretive researcher, I was interested in their understandings. This means that this study is unique in many ways and not directly transferable to other groups.

1.7. The Structure of the Dissertation

This section provides an overview of the chapters of this research:

- **Chapter One: Introduction**

This chapter has provided an introduction to the dissertation. The purpose of Chapter One has been to describe the context of the research. The research goal and questions are mentioned, and the methodology is briefly outlined. A synopsis of the structure of the dissertation is presented.

- **Chapter Two: Critical Review of the Maths and Science through Arts and Culture (MStAC) Curriculum Intervention**

Chapter Two outlines the MStAC curriculum intervention programme which formed the backdrop to the study. It sets the scene in that it provides insight into the participant teachers' viewpoints and experiences regarding the teaching of mathematics. The evaluation of the MStAC curriculum intervention, including the workshop, the manual and the teachers' practices is described, and the findings are discussed. This critical review became the impetus for my research.

- **Chapter Three: Theory Informing the Research Intervention**

In Chapter Three the literature which forms the theoretical framework behind the study is explored. The theory examines how children learn, and in particular how they learn about space

and shape. Further on, the chapter examines appropriate pedagogical practices for Grade R and outlines curriculum approaches. Lastly, the notion of teacher professional development is explored, with its implications for this research intervention.

- **Chapter Four: Research Design and Methods**

Chapter Four contains a detailed description and justification of the interpretive research orientation and case study method used in the study's research design. The three phases of the research process are explained and issues of validity and research ethics are discussed.

In Chapters Five, Six and Seven the findings of Phases I, II and III of the research are presented and discussed. Each chapter is described briefly:

- **Chapter Five: Analysis and Discussion of the Findings: Phase I**

The findings of Phase I, which was focused on developing teachers' understanding of creativity and being cognizant of children's behaviour and interests are presented and discussed.

- **Chapter Six: Analysis and Discussion of the Findings: Phase II**

The process of making meaning of children's behaviour and visual representations which formed Phase II of the research intervention is described. The findings and discussion of what emerged in terms of the goals for Phase II are presented.

- **Chapter Seven: Analysis and Discussion of the Findings: Phase III**

Phase III draws together the emergent curriculum process and the teaching of the concepts of space and shape through visual arts activities to enhance and extend learning. The findings from Phase III are presented and discussed.

- **Chapter Eight: Conclusions**

The research study is likened to a woven mat, in which threads from the findings of the previous three chapters are woven together. The themes which were introduced during Phases I, II and III are discussed. Recommendations are suggested, according to the findings from each phase. The limitations of this study are described and the significance of the research is discussed. As the threads are drawn together, lessons to be learnt from this research intervention are suggested. The chapter ends by mentioning the implications of this research for future studies.

CHAPTER TWO
Critical Review of the Maths and Science through Arts and Culture (MStAC) Curriculum Intervention

"Research is a messy business. It has to be because the issues we face and the questions we tackle are so varied and we have to address them in unique ways." (Newby, 2010, p. 641)

2.1. Introduction

This chapter describes and critically analyses what emerged from the MStAC curriculum intervention. It begins with an evaluation of the programme. My role as an evaluator of the intervention programme is explained, and the teachers who participated in the intervention are described. Then, a critical review of this intervention – which provided the impetus for the research study – is given. The emergent trends and patterns are revealed, and the themes which led to my research questions are identified. Insights gained from the evaluation of the intervention are then described in order to set the scene for the research study.

2.2. Overview of the MStAC Curriculum Intervention

The Maths and Science through Arts and Culture curriculum intervention programme was developed by the Curriculum Development Project for Arts and Culture Education and Training (CDP) as a response to what the CDP perceived as a dearth of creative education and stimulation for teachers. The emphasis on mathematics and science was a "natural development" (Schaer, May 2009 interview) from the previous programmes emphasizing creative arts that they had conceptualized. The ultimate goal in the MStAC curriculum intervention programme was for practitioners to be "able to plan the integration of maths and science concepts through the arts, and prepare and organize creative and stimulating maths and science areas and theme tables…" (CDP, 2009, p. 1). The MStAC programme consisted of a three-day workshop, a manual and a starter kit for implementing mathematics and science activities through the medium of arts and culture.

The participants in the MStAC intervention were in-service teachers enrolled in their second-last year of study towards a BEd degree at Rhodes University. They all work in Foundation Phase (Grade R to Grade 3) classes in a variety of different contexts including community-based pre-schools with Grade R classes, Grade R classes attached to state primary schools, and independent schools. Some of the schools are poorly resourced; others are moderately equipped, whilst others are resource-rich. The school fees range from no-fee paying schools, to R1000.00 per month. The teachers are part-time students who attend BEd lectures during weekends and school holidays at Rhodes University in Grahamstown. Although the BEd class consists of 18 teachers from Grade R to Grade 3, and the whole class took part in the CDP's course, I only evaluated nine of the twelve Grade R teachers for the evaluation report on the intervention programme. This was because I was only able to complete nine out of a possible twelve classroom-based evaluations within the timeframe imposed by the Jim Joel Education and Training Fund – the organisation who commissioned the evaluation.

Table 2.1 gives a profile of the different types of schools in which the participants were based. The table shows that four of the participant teachers were from community-based pre-schools with Grade R classes, six teachers taught in no-fee paying state schools with Grade R classes, and two were from independent schools. All of the participant teachers were women. Two of the teachers were teaching in an urban area, and the majority was from Grahamstown, a semi-rural town in the Eastern Cape. Three schools were situated in rural areas.

Table 2.1: Profile of the participant teachers and their schools

	Type of school	School fees per month	Age	Gender	Location
1	Community-based pre-school with Grade R class	R130	41	F	Semi-rural
2	Community-based pre-school with Grade R class	R120	34	F	Semi-rural
3	Community-based pre-school with Grade R class	R100	48	F	Semi-rural
4	Community-based pre-school with Grade R class	R150	35	F	Semi-rural
5	State primary school	no fees	25	F	Urban
6	State primary school	no fees	29	F	Semi-rural
7	State primary school	no fees	50	F	Semi-rural

8	State primary school	no fees	26	F	Rural
9	State primary school	no fees	35	F	Rural
10	State primary school	no fees	29	F	Rural
11	Independent pre-school	R1000	25	F	Semi-rural
12	Independent primary school with Grade R class	R1000	26	F	Urban

2.3. Rationale for the MStAC Curriculum Intervention

The aims of the intervention programme were for the teachers:

- to learn how to use appropriate techniques for the facilitation of active, creative learning;
- to offer a variety of creative maths and science activities in which children can discover basic principles;
- to understand how to develop creative activities within thematic journeys;
- to provide opportunities for creative and critical thinking and problem solving using mathematical experiences within the learning and natural environment;
- encourage children to develop their own approaches to working with numbers, and
- set out a variety of activity spaces for individual work, pairs, small groups and large groups. (CDP, 2009, p. 1)

2.3.1. Goals and Pedagogical Approach

The CDP's goal was for the participating teachers to be able to "plan the integration of maths and science concepts through the arts, and prepare and organize creative and stimulating maths and science areas and theme tables …" (ibid.). Further, the intervention aimed to

> show the teachers how to teach the skills of observing – particularly in the natural world, comparing, patterning, classifying, measuring, inferring, experimenting, predicting, communicating and problem solving. (ibid.)

The CDP's strong emphasis on "innovative techniques, materials and skills for use with young children" (CDP letter, 2009, p. 2) was evident in the way that the workshop was conducted. A constructivist approach was used, with group discussions and shared constructions of

understandings. During the workshop all activities were presented as they would be to young children, and the participants were encouraged to explore, discover and experiment as young children would. The workshop venue was arranged with colourful display areas so that the teachers could initiate similar displays in their own classrooms.

2.3.2 The Intervention Process

The CDP presented the workshop in Grahamstown during March 2009. Classroom observations followed two to three months later. The manuals and starter kits were presented to the teachers at the end of the workshop.

Practical ideas for implementation were evident, like the buckets for washing equipment and hands, drying areas for activities, ideas for storage and display of collage materials, and teaching resources made from waste materials. Use was made of both inside and outside areas. Mostly, waste materials were used for the activities, and at all times the student-teachers were shown how to make innovative use of waste materials. Figure 2.1 shows workshop participants engaged in constructing polyhedrons from straws.

Figure 2.1: Participants engaged in a problem solving activity using straws to construct polyhedrons

At the end of the workshop, each participant was given a manual entitled *Maths and Science Programmes through Arts and Culture in ECD/Grade R Curricula* (2009) by D. Thomas & P. Lindsay, as well as a Maths and Science starter kit containing a packet of plastic bags; a bundle of straws; 6 jars of coloured powder paint; 6 paint brushes; 1 kg salt; a ball of string; a packet of cornflour; 4

small tubs of glue and 6 pairs of scissors. The intention was that these materials would be used in the implementation of the activities the teachers had learnt about during the workshop.

2.3.3 My Role in the MStAC Curriculum Intervention as an Evaluator

As an observer during the workshop, I took on the role of "observer as participant" described by Gold (1958) in Merriam (1998 p. 101). My activities as researcher were known to the group. I participated in the workshop activities with the rest of the group, but also made field notes and took photographs [MF 4][1]. The teachers had all started their studies at the CSD at least three years previously, with the NQF Level 5 National Diploma in ECD, so we were familiar with each other, although I had only been teaching them on the BEd in-service FP course since the previous year. Our familiarity meant that the teachers trusted me as their mentor and lecturer. They were also aware that I was a student too, having embarked on research for my Master's degree, and felt a certain solidarity towards me. This seemed to strengthen the trust between us.

2.4. Evaluation of the MStAC Curriculum Intervention

After the teachers had attended the workshop, I conducted an evaluation of the curriculum intervention. The terms of reference for the evaluation were primarily to examine whether the CDP's brief had been met.

2.4.1 Methodology

The terms of reference required that each part of the MStAC intervention programme be examined, in order to ascertain whether the whole curriculum intervention had achieved its goals. The evaluation had a qualitative orientation and data was gathered through interviews, questionnaires, field notes, classroom observations and a desk-top manual evaluation. Table 2.2 illustrates how data was gathered to inform the evaluation. The methodologies were designed to gain a clear picture of each stage of the intervention programme – the workshop, use of the starter kit and the manual. Different types of data were generated through each evaluation method.

[1] [DF] and [MF] refer to Data Files and Materials Files - the data management system for this research project. See Table 4.1 in Chapter Four.

Table 2.2: Goals and Evaluation Methods

GOAL	DATA GATHERING METHOD
evaluate the programme developer's and workshop facilitator's perceptions of the Maths and Science through Arts and Culture curriculum intervention	semi-structured interviews with the programme facilitator, and the director of the CDP
evaluate the participants' perceptions and experiences of the intervention	pre- and post- workshop questionnaires were completed by the participants
evaluate the workshop	field notes and photographs were taken during the workshop
evaluate the manual in terms of the programme's goals	desk top evaluation of the manual classroom
evaluate how the workshop's ideas and activities are being implemented	observations of the Grade R teachers

2.5. Findings of the Evaluation

The findings from each of the data collection methods are examined here.

2.5.1 What emerged from the Interviews

I interviewed the Programme Facilitator and the Director of the CDP in order to understand the background to the development of the Maths and Science through Arts and Culture curriculum intervention programme. The semi-structured interviews allowed the interviewees to elaborate on the ideas they felt passionately about. Data was gathered through audio-recorded interviews, which were transcribed [MF 3].

For both the Director and Programme Facilitator, the MStAC programme was a natural development of the previous workshops and manuals in creativity and art that the CDP had developed. As an organization which focuses on creativity and the arts, they were able to use the MStAC programme as a platform for many of the activity ideas that the CDP had developed over the years. They also felt that the arts are a natural, holistic response to the world:

> … it's so integrated, that kind of discovery. So it's always kind of been there whether kids are working with natural materials or whether they're counting or using the easels or making artworks – there's always a process of enquiry and

there's always a fascination in engaging with the world (Schaer, May 2009 interview)

The interviews affirmed the CDP's passion for the arts and their endeavours to weave opportunities for creativity and the arts into the practices of Grade R teachers. They hoped that using the Arts and Culture Learning Programme and linking it to maths and science would enable teachers to feel some of the passion and enjoyment that the CDP feel for the arts, and that this intervention programme would inspire them to introduce more creativity into Maths and Science teaching and learning.

2.5.2 What emerged from the Questionnaires

▪ Pre-workshop questionnaires [MF 1] were designed to discover what the teachers' perceptions of mathematics, science, arts and culture were, what their previous experiences of teaching these learning areas were, and what their problem areas were in the teaching of mathematics and science. Questionnaires were handed out before the workshop and the participants were asked to complete them before the workshop began. This resulted in a 100% response. In addition, the CDP also asked the students to write about their expectations of the workshop and I used data from these responses too. The questionnaires were divided into four sections:

- Understandings about mathematics and science, arts and culture;
- Knowledge about the place of mathematics and science, arts and culture in the school curriculum;
- Responsiveness of learners to mathematics, science, arts and culture; and
- Teaching strategies for mathematics and science, arts and culture.

The analysis of the questionnaires revealed the following:

- ***Understandings about mathematics and science, arts and culture:***

The participants described mathematics as being about 'number', 'problem-solving', 'counting', 'addition', 'subtraction' and 'operations'. Many mentioned the importance of 'critical thinking'. Only three respondees mentioned the concept of 'space' in this context. The 'natural world' and the use of the senses were suggested as being important. Creative expression and creativity were

seen as important facets of the arts, and various art forms were alluded to - like music, dance, sculpture, drawing and painting. Creative expression was seen to be an important part of Arts and Culture. Some teachers mentioned respect for other cultures and valuing your own culture as being important.

- ***Knowledge about the place of mathematics and science, arts and culture in the school curriculum:***

Most of the teachers claimed that mathematics is important and necessary as it is part of "everyday life and everywhere." It should be included in the curriculum so that "people get better jobs" (Questionnaire respondee, 2009) [MF 1]. A teacher explained that "arts and culture is about our differences and backgrounds, things that we do in our cultures, the way we do them, and creativity of doing it." [MF 1]

- ***Responsiveness of learners to mathematics, science, arts and culture:***

The questionnaire asked what the children were least/most responsive to, and also what they found the most difficult/easiest to learn. The table below shows which concepts the teachers felt that their learners were most responsive and least responsive to, and what their learners found easiest and most difficult to understand. As is evident from Table 2.3, data handling is revealed as the concept that the teachers felt that children had the most difficulty understanding and were the least responsive to.

Table 2.3: Responsiveness of learners to mathematics concepts

CONCEPT	MOST RESPONSIVE TO	EASY TO UNDERSTAND	LEAST RESPONSIVE TO	DIFFICULTY UNDERSTANDING
Numbers, operations and relationships	11	5	1	3
Patterns, functions and algebra	5	3	3	2
Space and shape	9	4	0	0
Measurement	8	4	4	0
Data handling	2	0	5	6

The responses revealed that several teachers themselves do not understand some of the concepts in the mathematics that they are required to teach:

> *It's worse with data handling. Maybe I can't do it myself.* [MF 1]
>
> *Data handling is not commonly used in our daily lives and our homes, so it's a strange concept from them that doesn't make sense.* [MF 1]

The table also shows that the teachers felt that children are the most responsive to space and shape, and they find these concepts the easiest to understand. Most mentioned that concepts like counting, number recognition and measuring occur naturally in the children's lives and therefore they use them and understand them more easily.

> *I think it's because from morning until they go home we talk about numbers, and also when they are playing they play they measure ingredients and you can hear them playing with water talking about measures my is full yours is empty or half. In sandpit making small and big cakes.* [MF 1]

Some of the reasons which the student teachers gave for children being less responsive to certain concepts included: the *"language barrier"*; *"they like playing with water more"*; "*I am not sure how to introduce it to my learners*"; and *"[as] a student teacher I do not spend or concentrate much on these concepts as I do not enjoy these concepts."* [MF 1]
From these responses, one may infer that the teachers felt a certain degree of insecurity about teaching mathematical concepts.

- ***Teaching strategies for mathematics, science, arts and culture:***

Responses revealed that some teachers understood that working with concrete objects was seen as necessary to help the children learn. Number and shape games, finger plays and rhymes, Audiblox, worksheets, washing line activities, dice games, educational games, counting, measuring, hop-scotch, water and sand play, playdough, collage and sorting activities were mentioned. Many teachers explained that if teaching was "effective", the children would easily learn the concepts. To teach mathematics, the following methods were described as being used: dice patterns; dominoes; visual perception (how many, big/small objects), graphs, baking activities, singing, clapping and drumming games, water play, measuring height, feet, hands, sand play and worksheets.

According to the questionnaire responses, strategies to teach the arts involve singing, dancing, painting, box constructions, playing games, colouring in of pictures, glueing, printing, spatter

painting, rubbing, blow painting, cutting and pasting, collage, drawing, modelling playdough, tearing, dye-washing, threading, weaving, traditional dancing, baking, puppet shows and woodwork. According to the teachers, these activities enable children to learn to express their ideas, use their imagination, learn about colours, experiment and explore, learn to think for themselves, learn more about their culture, improve their fine-motor control, *"take responsibility for their own mess"*, *"develop their thinking skills" and "to have fun"* [MF 1].

The final question asked how the student teachers felt about using creative arts activities for teaching mathematics and science concepts. Five teachers did not respond to this question, but seven responded positively.

> *Good for children to grasp concepts by having hands on with concrete apparatus using 5 or 7 senses and this will definitely help with their self-esteem and enthusiasm to learn. Why? Because it's fun and they can all do it.* [MF 1]
>
> *To learn new ways in which to teach maths and science; to be able to walk away with some form of information/knowledge to use at school; to learn on how to experiment and discover a new art on how to teach new concepts.* [MF 1]
>
> *I hope to gain well planned interesting activities that will assist in learning, teaching and assessment that will take place inside and outside the classroom. I would also like more ideas on how to make appropriate learner material. Ideas for activities as well as theme/context that will last.* [MF 1]
>
> *I hope that I will get more new ideas for me to go back to my class and implement what I was taught to the children to make their learning fun, interesting, enjoyable for them to learn the concepts and for me to get more inspiration to teach!* [MF 1]
>
> *Fun, exciting, NEW! ways and activities to make children positive and enthusiastic about learning and finding out new information everyday. This will affect children's enthusiasm of learn [sic], going to school in the future.* [MF 1]
>
> *How to make maths a more learning and fun area; to teach my learners to enjoy the subject as well as myself.* [MF 1]

All the teachers were excited about learning how to teach mathematics and science through Arts and Culture. The emphasis on 'fun' suggests that some teachers could be equating 'creativity' with 'fun'.

Data was gathered from the workshop expectation forms which the CDP gave the teachers to complete:

> *I hope that I will get more new ideas for me to go back to my class and implement what I was taught to the children to make their learning fun, interesting, enjoyable*

for them to learn the concepts and for me to get more inspiration to teach! (Expectation form response, 2009)[MF 1]

…is to be confident how to use Arts and Culture through Maths and Science [sic]. I was not sure how to teach Maths the correct way, so I wish I can be more relax [sic] when I'm doing Maths and Science through Arts and Culture. [MF 1]

To learn more about who I can use Art in teaching Maths, because I not very creative. [MF 1]

- Post workshop questionnaires [MF 2] ascertained whether the teachers' expectations had been fulfilled and the outcomes of the workshop met. Many mentioned actual activities and behaviours learned from the workshop that they wanted to implement in their own classrooms.

I will have to change my attitude and behaviours towards certain things. I will also have to involve parents for example asking them to bring empty bottles, boxes to use for materials. (Post-workshop response, 2009) [MF 2]

Most teachers expressed greater confidence in the teaching of concepts and implementation of the activities.

Maths is fun, you do not need fancy resources in order to implement it. When you look around maths is everything in your class and also in the playground. [MF 2]

I have learned that I don't have to stress planning separately, but can integrate and teach maths and science through art. I have learned the importance of all the creative tables and some creative ideas to keep learners alive. [MF 2]

Some teachers mentioned problems they anticipated encountering if they tried to implement the activities – like lack of time, mixing paint and lack of available resources. Some mentioned that they would like more ideas about songs in the implementation of cultural activities. These are some of the comments on what the teachers liked best about the workshop:

The workshop was fruitful and well-organized. I felt free to explore what I want that was best for myself, and my learners. [MF 2]

I enjoyed doing our painting the most, it took me into another world and I never knew painting would do that. I also loved learning about what do for maths and all the art ideas and theme and discovery table ideas. [MF 2]
Everything was great to me. I enjoyed every bit of it, each and every day I was looking forward especially that LO (Learning Outcomes) and AS (Assessment Standards) were not a threat to me. [MF 2]

Responses to the questionnaires led me to conclude that the teachers understood that mathematics and science are important and necessary learning areas in the curriculum, but that

many seem unsure about some of the concepts themselves. There seemed to be a lack of confidence regarding using Learning Outcomes and Assessment Standards according to the National Curriculum Statement (NCS). Most teachers felt that integrating mathematics and science with arts and culture would be an effective way for the children in their classes to learn.

2.5.3 What emerged from the Classroom Observations

Letters were sent to school principals informing them of my visit [MF 5], and that I would be observing and taking photographs for the purposes of the evaluation report [DF 6]. I promised to protect the identities of the children, student teachers and schools. Because of the time frame for the completion of the evaluation report, only nine of the Grade R student teachers were reported on.

Evidence of the uptake of the workshop ideas was gained from observations of teaching and activities which occurred whilst I was there, and also from the art work displayed on the walls of the classrooms. I took photographs of classrooms and of the teaching and learning activities. I observed the teachers in order to assess whether the goals of the intervention had been achieved in practice. I wanted to see whether: the teachers used appropriate techniques for the facilitation of active, creative learning; offered a variety of creative mathematics and science activities (using the materials they had been given in the starter kits); used themes as a teaching strategy for developing creative activities; provided opportunities for creative and critical thinking and problem solving using mathematical experiences within the learning and natural environment; encouraged children to develop their own approaches to working with numbers; and set out a variety of activity spaces for individual as well as group work.

Firstly, I noticed that most of the children's displayed work showed little evidence of creativity. Worksheets and teacher-drawn templates formed a large part of the children's work. Some of the materials from the starter kits had been used to work on templates and worksheets. Figure 2.2 illustrates some teacher-drawn templates onto which the children glued collage materials. Some teachers had used many ideas from the workshop, like collections of plastic bottles and eye-catching displays of interesting objects.

Figure 2.2: An example of pre-drawn templates onto which the children have glued collage materials.

> … many ideas from the CDP programme [are] being put into practice. Washing facilities, collage materials, display and drying area were very well organized – according to the CDP manual and workshop. More creative opportunities could have been provided – for instance the children were told to paint houses and they were given house outlines with pre-cut collage materials for pasting. This resulted in the children painting stereotypical houses (very much like the one the teacher had drawn)… Some worksheets were displayed in the classroom. (Schäfer, 2009)

One Grade R class had an "anything table" where a variety of collage and construction media was displayed. Children could do anything they wished in this area. On the day I observed them, a group of children used foil pie containers, glued wood shavings into them and then put some egg shells into their nests. The theme and discussion on "Sing a song of sixpence" had inspired the children to make these. The climate in the pre-school was one where recognition was paid to the children's own construction of meanings. Children's attempts at writing – both letters and numbers – were displayed, and teachers were able to mediate further learning activities by taking cognizance of the children's learning.

Only one pre-school acknowledged the children's own mathematical mark making – the writing corner displayed children's attempts at writing letters and numbers. In many classrooms I visited there was little or no opportunity for collaboration or fantasy play where children construct their

own knowledge in meaningful contexts. Some of the teachers had used activities directly from the manual and from the workshop, whilst in six of the nine other classrooms there was no evidence of what had been learnt about learning maths and science through arts and culture.

2.5.4 What emerged from the evaluation of the Manual

As one of the tools in the implementation of mathematics and science activities through arts and culture, the manual *Maths and Science Programmes through Arts and Culture in ECD/Grade R Curricula* (Thomas & Lindsay, 2009) needed to be perused. The manual's purpose is to build on what was learnt at the workshop by giving theoretical background, further creative activity ideas, and ideas for implementing the activities according to the National Curriculum Statement (NCS).

The manual, with its wealth of practical ideas, appears to be an excellent resource for Grade R teachers. The activities are relevant for the teachers who will be using them, and the manual takes into account the fact that most of the teachers work and live in poorly-resourced environments by suggesting the use of waste and natural materials. Although the manual was found to be accessible, relevant, unbiased and appealing, it was nevertheless not being used by most of the teachers that I visited.

2.6. Critical Review of what emerged from the Evaluation

Although the MStAC intervention programme was seen as meaningful by the teachers (as noted from their comments on the questionnaires), some clearly found it difficult to implement the ideas effectively. The key finding during my evaluation of the MStAC curriculum intervention was that classroom practices had not significantly changed. This section gives a critical review of the findings, and attempts to unravel possible trends, patterns and themes emerging from the findings.

The critical review of the intervention programme begins by revealing the trends and patterns which emerged during the evaluation process. Broad trends are then condensed into more specific themes which propose reasons for the lack of uptake of the intervention programme. Finally, the findings from the critical review of the intervention programme are synthesised and the questions around which I designed a further intervention programme, are stated.

2.6.1 Emergent Trends and Patterns

Carruthers & Worthington (2006) contend that effective implementation requires more than resources, and this seemed to be true of this intervention in that even though the teachers were given the manual and materials and had attended the workshop, there was little evidence of implementation of these ideas in their classrooms. As I pondered on the evaluation process I had engaged in, I became aware of certain trends:

- From their initial responses to the questionnaire and during the workshop, many of the teachers seemed somewhat daunted by the teaching of mathematics and science. They explained that they did not understand some concepts (e.g. data handling), and seemed to concentrate on teaching the concepts they did understand e.g. counting and numbers. Classroom observations confirmed that the teachers lacked confidence about teaching mathematics concepts.
- The teachers seemed unsure of their role in teaching Grade R children mathematical concepts. I did not observe the teachers actually teaching a lesson on a mathematical concept. Rather, apparatus was provided for children to freely discover the concepts through incidental learning. This was clearly a Piagetian model described by Carruthers & Worthington (2006) as constructivist, where children are encouraged to discover and explore their environment. However, little mediation or scaffolding of learning took place.
- Classrooms where attention was paid to the children's construction of meaning were most conducive to the implementation of the MStAC programme ideas. In these environments, there were opportunities for the children to construct meaning in many ways, from fantasy play to free drawing and writing.
- Overall, there were not enough opportunities for children to collaborate and construct meaning in social contexts. Consequently, creativity and the children's own expressions of meaning were not valued. It was evident that pre-schools which did not form part of primary schools and who thus had the most control over their programme were most conducive to making meaning in different ways.
- The evaluation of classroom activities concluded that most of the teachers seemed to be "driven by the curriculum, rather than the developmental needs of the children they

are teaching" (Carruthers & Worthington, 2006, p. 20), hence the use of inflexible formal worksheets and templates, and the general lack of opportunities for the children to draw freely. As Worthington and Carruthers (2006) stress, worksheets promote "performance learning" where children complete them for the teacher, rather than "mastery learning" where they gain understanding of concepts. According to Worthington and Carruthers (2006) they also tend to make evident what children do not know as opposed to what they do know e.g. children spend more time doing activities like colouring in, rather than maths. Figure 2.3 shows a worksheet where a child has coloured in various shapes, perhaps suggesting that they do not understand how to count. However, this is not necessarily the case. The child may simply have felt like colouring in more than the stipulated number of shapes. Teachers generally did not seem to notice children's efforts at meaning making.

- Formal worksheet tasks were provided as 'art'. Art seemed to be interpreted as any activities using resources like crayons, paint, and paper rather than opportunities for children to express themselves creatively.
- Another observation which revealed that teachers had limited understanding about how children need to construct meanings in order to learn, was the lack of opportunity for socially constructed learning. Research shows that children are more challenged in self-initiated playful contexts (Vygotsky, 1978) but there were few opportunities for children to collaborate with each other, either spontaneously whilst engaged in classroom activities, or in more formal teacher-organised group contexts.

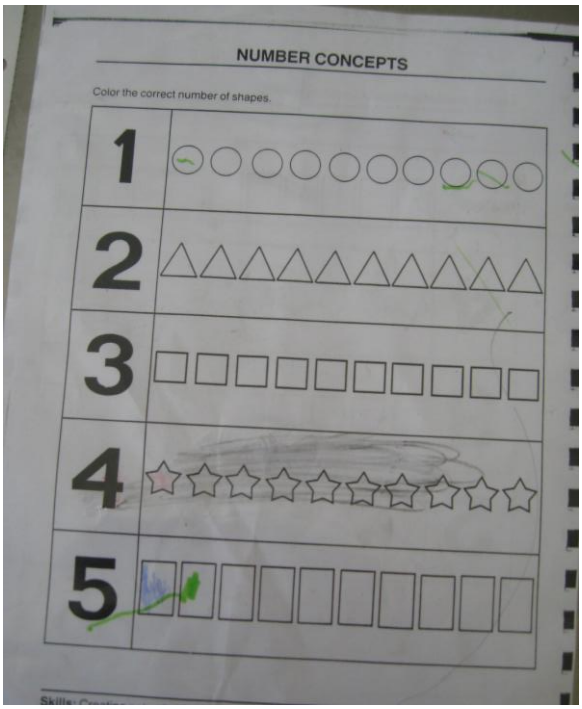

Figure 2.3: An example of a worksheet where the child has not been given the opportunity to construct her own meaning

2.6.2. Emergent Themes

The trends and patterns discussed in the previous section pointed to several emergent themes. These will be explored here, with possible reasons:

- **Teachers' knowledge about how children learn best**

The arrangement of some classrooms and the activities that were prepared for the children, revealed that the teachers had limited understanding about the sort of environment that is best for children to learn in, and how to organise an environment which is conducive to learning. Also, they lacked knowledge of appropriate learning experiences for Grade R children. The MStAC programme had demonstrated many ideas for using resources for making mathematics exciting and interesting, and encouraged the teachers to engage with the resources and materials, but gave little guidance on how to scaffold and mediate learning whilst using the resources. The teachers may have left the workshop with the notion that learning would take place incidentally. For instance, 'discovery boxes' were demonstrated at the workshop – shoeboxes containing mathematical and scientific apparatus, like measuring cups and sand, etc. – and teachers were

shown how to make them and present them to their learners, but not how to build on their knowledge and experiences.

▪ Teachers' mathematical knowledge and understanding

Many teachers felt insecure about teaching mathematical concepts. One of the reasons for this could be a result of unfortunate or unpleasant experiences of mathematics when they were at school which some teachers expressed informally to me. They were aware that mathematics is needed for "everyday living" (Questionnaire respondee, 2009) but were apprehensive about teaching the concepts. This, coupled with a general lack of knowledge about mathematics, resulted in very little transmission of mathematical knowledge or excitement about the topic and its possibilities.

▪ Teachers' buy-in to the curriculum intervention

This curriculum intervention programme had shown how resources and equipment could be used for the teaching of mathematics and science through arts and culture. When I observed them in their classrooms, the teachers provided apparatus and materials for self-discovery by the children, but did not engage with them when the children were using the equipment. Ginsberg and Amit (2008) state: "It is no longer enough for teachers to introduce activities or projects, exciting as they may be, in an unplanned way. Instead, they need to employ a *curriculum* " (p. 274). The National Association for the Education of Young Children (National Association for the Education of Young Children) and National Council of Teachers of Mathematics (NCTM) (2002) in a position statement, confirm that mathematics education "... needs to go beyond sporadic, hit-or-miss mathematics ..." (p. 11). In many instances, it seemed that the teachers, in an effort to teach "informally", were not teaching at all but leaving learning to chance. This may be a unique characteristic of early years' educators, as suggested by Ginsburg & Amit (2008), who address this:

> In general, programmes for young children tend to downplay "academics" and focus on play and helping children to develop social skills, self-control and emotional maturity. (p. 274).

On the other hand, children were generally given insufficient opportunities to construct meanings by drawing freely or engaging in fantasy play. By giving children worksheets to complete or

templates to decorate, some teachers seemed to feel that children were learning more than if they created their own symbols. There was little evidence of co-construction of understanding through collaboration between children, or between the teacher and children. Gifford (2005) explains that in order for children to learn mathematics successfully, teachers should:

- demonstrate and instruct,
- make connections and explore,
- discuss and use mathematical language,
- pose problems, encourage predictions and give feedback,
- confront errors and misconceptions, and
- model and encourage reflections on thinking.

This resonates with Vygotsky's notions of scaffolding or mediation (Vygotsky, 1978; Berk & Winsler, 1995; Wertsch, 2007) and co-construction of meaning (Worthington and Carruthers, 2006).

▪ Teachers' perceptions of Creativity

Some of the teachers seemed to be caught between the technicist approach of the Department of Education (DoE) with their ready-made lesson plans, worksheets, Learner Attainment Targets (LAT's) and Formal Assessment Tasks (FAT's), and a more creative approach where credibility is given to children's own construction of meaning. Many researchers, such as Worthington and Carruthers (2006), Matthews (2006), Hope (2008) and Athey (2007) have shown how the marks children make and the self-initiated games they play with mathematics are vitally important in their conceptualization and ability to do mathematics in higher grades. Most of the teachers did not attend to children's own expressions of meaning, or use these to extend their learning and conceptual knowledge.

▪ Teachers' views of Curriculum

Jansen (2003) and Graham-Jolley (2003) both explain that although a curriculum should be participatory, with partnerships between education authorities, parents and communities, this is seldom the case. In practice, the curriculum offered in classrooms is often top-down, with teachers prescribing to instructions from departmental officials. As a result, most of the teachers

were teaching strictly according to directives and pre-published lesson plans from the Department of Education.

2.7. Insights

My initial intention in the evaluation report was to investigate a curriculum intervention programme – that of using arts and culture as a tool for implementing mathematics and science activities in Grade R. I wanted to understand the meanings and understandings that are developed through using this strategy. My initial belief was that a programme such as this would enhance the teachers' practices.

However, as I worked on the evaluation report on the implementation of this intervention programme, I realised that many teachers did not fully utilise what they had learnt from the programme. The evaluation revealed that Grade R teachers did not implement mathematical concepts through arts activities because:

- they lacked the mathematical subject knowledge to do so,
- they did not understand how children learn mathematics,
- they lacked confidence and the ability to develop and design appropriate activities,
- they did not appreciate the significance of creativity in children's learning and development, and
- they lacked the pedagogical skills necessary to do so.

These insights prompted the impetus for further research. This study investigates how visual arts can be a vehicle for teaching space and shape during Grade R.

2.8. Synthesis

From the critical review of the findings of the MStAC intervention, I realised that I would need to delve more deeply into pedagogy and learning with my students (the BEd teachers). This became the impetus for this research, a critical case study which seeks to investigate, with a view to understanding, how visual arts can be used as a tool for teaching space and shape. A secondary goal was shaped by a transformative agenda, namely changing teachers' practice and enhancing teachers' competencies as reflective practitioners through classroom based action research.

The questions which would guide the development of a further intervention programme were:

How do children learn?

How should Grade R children learn about space and shape?

How should Grade R teachers teach space and shape?

What sort of curriculum is needed for the teaching of space and shape?

What sort of professional development do teachers need in order to design appropriate activities for teaching mathematics through visual arts activities?

These questions are explored more deeply in the following chapter. Figure 2.4 below illustrates the questions framing the development of the research intervention programme.

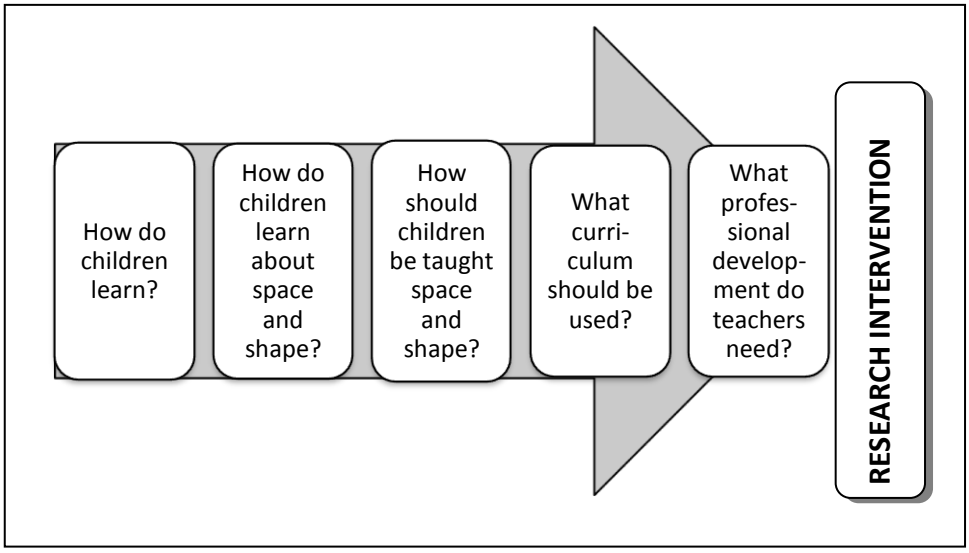

Figure 2.4: Orienting questions for the research intervention

2.9. Conclusion

Chapter Two described the MStAC curriculum intervention that took place with BEd in-service FP third year students at Rhodes University. The findings of an evaluation of the curriculum intervention have been reviewed and the significance of the emerging patterns and trends has been discussed. The themes that emerged from the critical review revealed the areas which would require deeper understanding during the research process. A synthesis gave rise to specific questions which form the theoretical framework of my study (hereafter referred to as the research intervention), and which will be examined in Chapter Three.

CHAPTER THREE
Theory Informing the Research Intervention

"Researchers have seldom studied the process of teaching at the preschool level." (Ginsburg & Amit, 2008, p. 275)

3.1. Introduction

My own experiences of teaching young children and noticing how competently they expressed their learning through visual arts activities, formed convincing evidence that these activities are appropriate for children's expressions of meaning and for conceptual development. The critical review of the MStAC curriculum intervention showed that the teachers were not using visual arts to teach mathematical concepts, and this inspired me to conduct further research. The main finding of the critical review, namely that in spite of the curriculum intervention, teachers' classroom practice did not change, convinced me that the study would need to focus on Grade R teachers' professional development. The findings of the review also informed the choice of the critical, transformative research methodology used in this study.

This chapter starts by examining teacher professional development and how it is relevant to how children learn, and in this context, how they learn about space and shape. Appropriate pedagogies and curricula for the teaching of these concepts in a Grade R classroom are discussed. The study draws from cognitive theoretical perspectives, namely schemas, representation through visual arts, creativity and the notion of an emergent curriculum. This research intervention investigates teachers using visual arts as a medium for the teaching of the concepts of space and shape in Grade R. Chapter Three reviews theoretical perspectives informing the study.

3.2. Guiding Framework for the Research Intervention

The evaluation and critical review described in Chapter Two convinced me that a different model of teacher development was required, as the MStAC workshop focusing on resources and superficial understandings of pedagogy and curriculum did not succeed in transforming teacher practices. This section sets out the guiding framework for the research intervention which I designed for this study, based on a model of teacher professional development.

Borko & Putnam (1995) propose that teacher professional development requires instruction in three knowledge domains - general pedagogical knowledge, subject matter knowledge and pedagogical content knowledge. Guided by their ideas, the research intervention that I devised, encompassed these three knowledge domains. Table 3.1 illustrates how the three knowledge domains are framed by my research questions.

Table 3.1: Theoretical framework of teacher professional development

KNOWLEDGE DOMAIN	**INSTRUCTION**
General pedagogical knowledge	How children learn How children learn about space and shape
Subject matter knowledge	Space and Shape
Pedagogical content knowledge	Curriculum Pedagogy

Based on this framework, the following questions are discussed in this chapter:

- What sort of professional development do teachers need in order to design appropriate activities for teaching mathematics through visual arts activities?
- How do young children learn?
- How do young children learn about space and shape?
- How should teaching and learning about space and shape take place in Grade R?
- What sort of curriculum is appropriate for using visual arts to teach and learn about space and shape in Grade R?

The following sections therefore contain a review of the literature relevant to teacher professional development, learning, space and shape, pedagogy and curriculum.

3.3. Teacher Professional Development

> Professional growth in education is considered as a process of change in teachers' mental models, beliefs and perceptions regarding children's minds and learning. (Mevarech, 1995, p. 152)

Hargreaves (1995) makes the point that for many people, good teaching involves only knowledge and skills development. Courses, materials, workshops and training programmes are some of the ways which increase knowledge and skills. However, focusing only on technical competence is not enough to transform practices and results are seldom permanent. This was my experience (described in Chapter Two) when the MStAC curriculum intervention did not result in transformed practices. Hargreaves confirms this:

> Even when new techniques have demonstrable merit, training in them may be ineffective when it does not address the real conditions of teachers' work, the multiple and contradictory demands to which teachers must respond, the cultures of teachers' workplaces, and teachers' emotional relationships to their teaching, to their children, and to change in general. (Hargreaves, 1995, p. 26)

He further suggests that integrating several dimensions of teacher professional development e.g. moral purpose, political strategies and emotional aspects can result in a more holistic professional developmental programme. Collaborative communities can enhance professional growth (Hargreaves, 1995, p. 27).

But professional growth does not occur only through an input of conceptual knowledge. Lunenberg & Korthagen (2009) suggest that professional teachers have need of practical wisdom, theory and experience. They further show that either of these components can be used as entry points in a teacher education programme, and propose that teachers should have a broad variety of experiences, theory and practical wisdom. Connecting the three components and developing insight into these connections through reflecting, can be extremely challenging for novice teachers (Lunenberg & Korthagen, 2009, p. 238).

Reflective practice is mentioned by Tillema & Imants (1995) as a prerequisite for growth in competence. They describe teaching as a 'craft' which develops over time through reflective practice. They suggest that development programmes should acknowledge previous learning, as well as present new knowledge in a coherent form so that it becomes assimilated with old

knowledge. Tillema & Imants (1995) further maintain that knowledge can either be presented and left to the teacher to assimilate it; or else the teachers' experiences can be introduced and referred to during training. In this model, there is more collegial collaboration between teachers, sharing experiences and making meaning and reflecting. Teacher growth and development is more likely to occur.

3.3.1 Models of Teacher Professional Development

As explained in section 3.2, teacher professional development includes several components. This section examines some models of teacher professional development. Whether they have been teaching for many years, or are newly qualified, Mevarech (1995) suggests that when teachers learn new skills or knowledge they all go through the same stages. She describes the stages of professional growth:

Survival: Teachers learn a new skill or gain conceptual knowledge, and have to discover how to implement it in the context of their own classrooms. They regard the new knowledge as a technique and some try to implement it rigidly as if following a recipe. Mevarech (1995) proposes that when new knowledge is closely related to what teachers already know, it is relatively easy to assimilate the two. However, if the new knowledge contradicts previous practices, a decline in performance may result.

Exploration and Bridging: Teachers are still more concerned about the technical aspects of the innovation and how the innovation affects them, rather than how it brings about changes in children's learning. Teachers more readily become involved in self-selected innovations rather than having new methods imposed on them, and if they are involved in decision making at their schools they take greater responsibility for the outcomes.

Adaptation: Teachers apply pedagogical content knowledge and adapt it to their own contexts. They are able to collaborate with colleagues, and planning is done with long-term objectives in mind.

Conceptual change: Teachers discover that their role involves more than the technical transmission of knowledge. Their assumptions change and they apply the innovation in a "reflective, dynamic way" (Mevarech, 1995, p. 161). This confirms Vygotsky's (1978) notion of socio-cultural learning. With interactions between teachers and with the greater community (principals, mentors and children) conceptual change can occur.

Mevarech (1995) cites Posner, Strike, Hewson & Gertzog's (1982) four conditions which are likely to bring about conceptual change: *Dissatisfaction* with present circumstances; an *intelligible* new concept which teachers understand; a *plausible* new concept which makes sense in the circumstances; and a *fruitful* new concept which shows that it can solve the problem.

Several models of teacher development are put forward by Huberman (1995), with the Open Collective Cycle deemed most similar to the emergent curriculum cycle which my research intervention would be based on. The Open Collective Cycle takes into account resources from outside the group which affect the development of teachers, and it allows for teacher interactions and shared understandings. Huberman's Open Collective model of teacher professional development is based on an action research model (Hopkins, 1994). The research intervention I designed (see Chapter Four) includes elements of this approach as it involves input of conceptual knowledge, experimentation, and reflection by the teachers at each phase.

Janse van Rensburg & Mhoney (2000) criticise the cascade model for teacher professional development, which includes short workshops and procedural knowledge rather than teachers' conceptual knowledge (or understanding 'why') – as was the case in the MStAC curriculum intervention – and maintain that a model such as this does not enable teachers to transform their practices (p. 45). The notion of using a constructivist approach to teacher professional development is taken further by Wilmot (2005), who contends that

> [t]he trend is towards the development of teachers as reflexive practitioners, critical inquirers and classroom-based action research, and toward the elaboration of constructivist models for teacher development (p. 83)

Janse van Rensburg & Lotz Sisitka (2000) present a Spiral Model from the *Learning for Sustainability Project,* based on constructivist pedagogy, critical pedagogy and a social constructivist epistemology. Their Spiral Model includes drawing attention to the contexts in which teachers find themselves; the active participation of the teachers in the process; learner-

centred teaching and enabling teachers to become action researchers in their own classrooms. I was cognizant that my research intervention would need to take my research goals into account as well as research into teacher professional development, mentioned above.

Figure 3.1 shows the model of teacher professional development which is based on reflective practice through an action research process. The three knowledge domains (general pedagogical knowledge, subject matter knowledge and pedagogical content knowledge (the 'what?')) intersect to form the research intervention, whilst the entire process rests on an action research process (the 'how?'). Borko & Putnam (1995) further emphasise that the boundaries between these categories are indistinct, in that a teacher's knowledge and beliefs about how children learn is interconnected with knowledge of how to teach that subject. This is represented in Figure 3.1 by the overlapping areas of the circles showing the three types of knowledge proposed by Borko & Putnam (1995) as necessary for teacher growth.

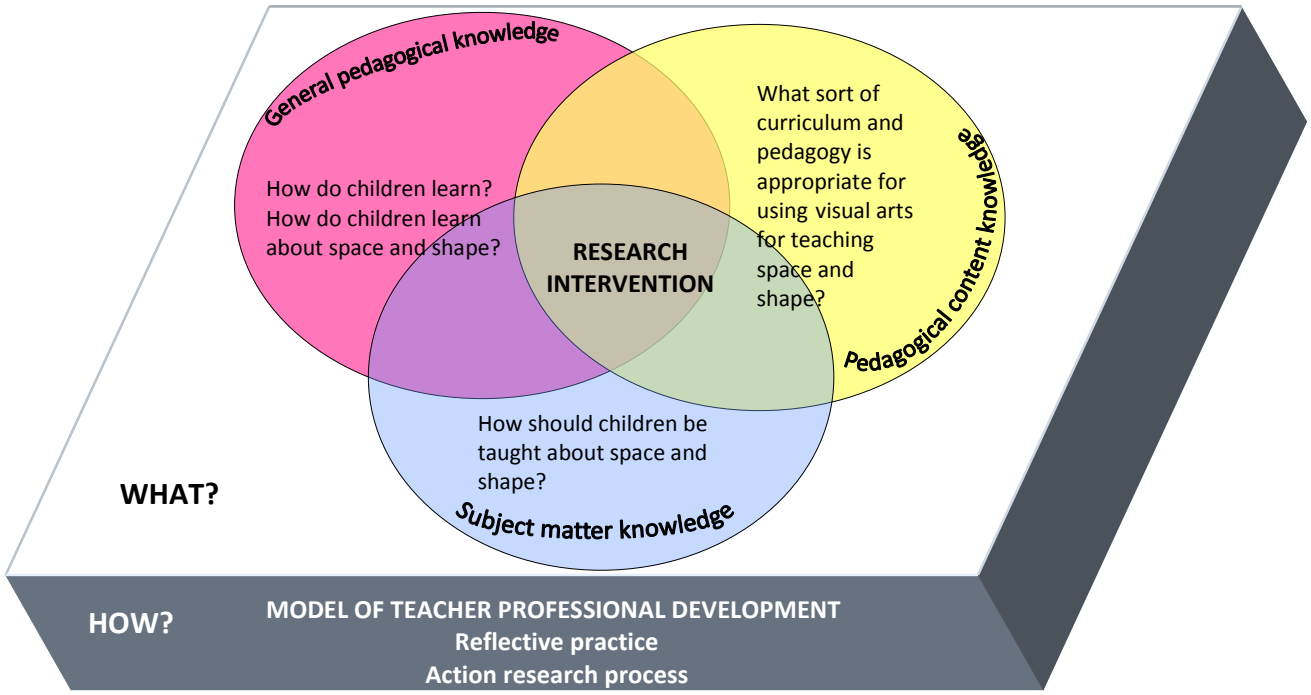

Figure 3.1: The model of teacher professional development underpinning this research intervention

3.3.2 Reflective Practice

Reflective teaching is "a rejection of top-down forms of educational reform that involve teachers only as conduits for implementing programmes and ideas formulated elsewhere" (Zeichner & Liston, 1996). Jansen (2003) concurs that teachers often do not understand that practice should direct policy and not vice-versa. My experience of the South African Qualifications Authority (SAQA) designed learning programmes in which the teachers had taken part to qualify at Level 4 and Level 5, involved no reflective activities. The teachers with whom I was working were accustomed to the top down approach where they were required to conform to the Department of Education's regulations. They therefore had had little experience in reflective practice.

Zeichner & Liston (1996) confer with Dewey that reflection is not linear. It responds to problems holistically. Three attitudes are fundamental to reflection: open-mindedness, responsibility and wholeheartedness. This implies honesty about oneself, a readiness to try new methods, learn from one's mistakes, and make recommendations for the future. Teachers also bring their own practical theories to teaching. These are a result of personal experiences, transmitted knowledge and values. For effective reflective practice to occur therefore, teachers should be aware of their own personal theories.

> Reflective teaching entails a recognition, examination, and rumination over the implications of one's beliefs, experiences, attitudes, knowledge and values as well as the opportunities and constraints provided by the social conditions in which the teacher works. (Zeichner & Liston, 1996, p. 33)

Three levels of reflective practice are advocated by Handal and Lauvas (Zeichner & Liston, 1996). All three are necessary and are dependent on previous levels.

P1 - Action (the base of the pyramid) involves daily teaching, asking questions and evaluating.

P2 - Planning and Reflection (the second tier of the pyramid) concerns the teacher considering why and what they do. They act on their reflections.

P3 - Ethical and Moral Considerations (apex of the pyramid) entails teachers reflecting on the moral and ethical basis of their actions.

Another model of reflective action is put forward by Griffiths and Tan (Zeichner & Liston, 1996). It involves five phases, with each phase bringing about reflection at a deeper level. They are rapid reflection, repair, review, retheorising and research.

In their research, Mena Marcos, Sánchez & Tillema (2008) put forward the notion that reflective practice does not have to always be cyclical and recursive, in order for it to be effective. Teachers seem to reflect on their practice and articulate their reflections in a variety of different ways. Mena Marcos et al. (2008) caution that teacher educators need to be conscious of many types of reflection.

This section has discussed various models of teacher professional development and reflective practice, and their relevance to my own research design, which will be elucidated in Chapter Four. The following five sections discuss the areas of instruction according to the different knowledge domains, as illustrated demonstrated in Figure 3.1 – learning, space and shape, pedagogy and curriculum.

3.4. Learning

According to the Eastern Cape Department of Education (2009a), "[c]hildren are born to learn" (p. 23). In my experience, observing young children actively learning reveals how integral learning and cognition are to the nature of a young child. Cognition is defined by Ford (2005, p. 7) as involving perception, attention, language, reasoning and memory. Children use their developing cognitive ability to organize their experiences and make sense of them (von Glaserveld, 1995). They do this actively, with their peers and with adults (Fleer, 2010).

Theories of cognitive development help us to make sense of our observations of young children (Berk, 2006). Recent brain research has confirmed many of the notions and findings of constructive cognitive theorists such as Piaget and Vygotsky, and it has consequently also re-affirmed what is considered developmentally appropriate practice for teaching young children (Rushton and Larkin, 2001; National Association for the Education of Young Children, 1996). As active learners, young children draw on "direct physical and social experience as well as culturally transmitted knowledge to construct their own understanding of the world around them" (National Association for the Education of Young Children, 1996, p. 7).

Researchers such as Piaget and Vygotsky (Piaget, 1937; Piaget & Inhelder, 1967; Vygotsky, 1978; Athey, 2007; Wood, 1988; Cohen, 2002) have shown that the formation of concepts begins at

birth, so this study is based on theories which show how learning occurs both developmentally and socio-culturally. Conceptualization in young children can thus not be separated from development, and although Piaget and Vygotsky viewed learning and development differently, their theories are both relevant to this study. Vygotskyan and Piagetian notions regarding learning, and the development of space and shape concepts are examined in detail. Bruner (1986; 1990) also offers insight into how young children interpret and represent their learning and his theory of iconic representation is briefly overviewed. It will also be shown how Fleer's theory (Fleer, 2010) on cultural-historical learning is significant to this study. Constructivist learning theories are relevant to my research, and thus a number of these will be examined. The relevance of these to children's learning and thinking about space and shape in a Grade R context is discussed.

Recent literature speaks about children having "power and agency in their own right" (Anning, 2009). But the idea of the child with previous learning experiences who actively constructs knowledge originated in the theories of both Piaget and Vygotsky (Piaget, 1937; Piaget, 1951; Piaget, 1959; Piaget, Inhelder & Szeminska, 1960; Piaget & Inhelder, 1969; Inhelder & Piaget, 1964; Wood, 1988; Vygotsky, 1962; Shayer, 2003). These theories are explored in the following section.

3.4.1 Piaget's Theories and their Significance to the Research

As a biologist and logician, Piaget looked for consistencies in children's problem-solving and searched for explanations into how children learn and develop. His theory of genetic epistemology showed that infants and children do not think in the same way as adults do, and to this end Piaget devised four discrete stages of development, with each stage denoting a more advanced level of thinking (Piaget & Inhelder, 1969; Meadows, 2005; Ford, 2005; Wood, 1988; Cohen, 2002; Campbell, 2006). Much significance has been attached to Piaget's theory of stages, but Piaget himself did not understand the stages to be static or universal (Piaget & Inhelder, 1969; Kohler, 2008, p. 168; Duckworth, 1973).

Piaget explained the integration of new knowledge into existing knowledge as *assimilation*; the modification of existing knowledge in response to new experiences as *accommodation*; and the

attempt to balance assimilation and accommodation as *equilibration* (Piaget, 1969; Wood, 2005; Campbell, 1997). Thus, development for Piaget did not depend on an accretion of experiences, skills and knowledge. Each stage built upon the previous ones and made the child capable of new and different ways of constructing knowledge with a more advanced level of thinking (ibid).

In Piagetian thinking, stages do not depend on an accumulation of knowledge, but on cognitive development. Each stage includes structures from the previous stage, as new cognitive structures gradually take precedence (Piaget & Inhelder, 1969; Kohler, 2008; Duckworth, 1973). The first two Piagetian stages – the *sensorimotor stage* and *pre-operational stage* apply to this research, therefore these will be examined in greater detail, whilst the later stages will only be briefly mentioned:

- **The Sensorimotor Stage**

According to Piaget, during the *sensorimotor* stage from birth to around 2 years, infants rely on their senses to receive information about the world around them, and they act reflexively on it without thinking of consequences (Piaget & Inhelder, 1969; Campbell, 1997, p 10). The sensorimotor stage starts with the infant responding reflexively in an uncoordinated fashion (Piaget & Inhelder, 1969; Kohler, 2008; Duckworth, 1973). Later she starts to realise that objects exist outside of her body and starts to search for hidden objects (Kohler, 2008, p. 173). The understanding of object permanence enables the development of a spatial concept as the infant is starting to *visualize* objects. By acting purposefully on her surroundings, the toddler starts developing *schemas* to produce more effects and responses.

Visualisation develops as the transition occurs between *sensorimotor* thinking and *representational* thinking. Physical actions do not always need to be carried out as the toddler remembers her past experiences and can use existing schemas to experiment further (Kohler, 2008).

- **The Pre-operational Stage**

During the *pre-operational stage* (approximately 2 – 7 years) children start to represent their experiences using language and imagery. During the stage of *symbolic thought t*he child "acquires

the ability to represent things that are not directly perceived, with the help of symbols and signs" (Kohler, 2008, p. 176). It occurs when a child realizes that a symbol can represent an object, event or relationship (Piaget, 1951). *Deferred imitation* takes place through the repetition of schemas. It is mostly spontaneous in nature (Kohler, 2008, p. 177). *Symbolic play* results when imitation is transferred to other situations, and occurs in symbolic games. The child learns to attribute meaning to objects in symbolic play (Piaget, 1951). Drawings, according to Piaget, are imitations of reality and are part of symbolic play (Kohler, 2008; Piaget, 1951). Mental images develop through visualization of external objects, events or experiences. They are used as tools to think about the perceived object. Mental images involve sensory experiences like taste, smell, touch, sight and listening (ibid). Dreams and fictions are like symbolic play because images are used as a means of expression (Kohler, 2008, p. 180; Piaget, 1951). Verbal signs of language gradually take the place of other means of symbolization. Piaget differed from Vygotsky in his argument that language is but one representational tool amongst the others mentioned above, and implied that as such it does not influence the development of thought and cognitive structures (ibid.).

- ***Intuitive thought***

During the second part of the pre-operational stage, intuitive thought develops. In his writings on how concepts develop, Piaget explained that "… intuitive thought is exactly intermediary between preconceptual and operational thought …" (Piaget, 1951, p. 286). Children at this stage are able to anticipate and think about possibilities, but cannot yet classify objects in more advanced ways. Children who have reached the *concrete operations* stage, begin to understand the use of logic when dealing with problems, and have learnt that equal quantities of objects can take up different amounts of space (conservation). The stage of *formal operations* means that children are capable of more abstract thought (Wood, 2005; Campbell, 1997). Although Piaget's stages are not limited to specific ages, the achievement of each stage is necessary in order to enter the next one.

Some of the criticisms of Piaget's theories are that they are stage-specific and domain-specific, and they pay little attention to the social nature of learning. But although Piaget is perhaps best known for his stage theories, many authors contend that the stages are not his most important contribution to theories of learning (Shayer, 2003). Piaget used stages as "a tool for taxonomising thought and tracking children's progress" (Campbell, 1997, p. 2). Donaldson for instance, proposed that the language used may have inhibited the children's ability in certain tasks that

Piaget set them (Donaldson, 1963; Cohen, 2002; Wood, 1988). Isaacs, cited in Kohler (2008, p. 91) suggested that Piaget's questions were too abstract, and that the children should rather have been confronted with authentic, meaningful problems. Other authors show that Piaget did in fact acknowledge the social nature of learning and that Piaget's theories are in many ways similar to those of Vygotsky (Shayer, 2003; Campbell, 2006).

The notions of cognitive structures and schemas are significant for this study, and they will be mentioned briefly here:

- ***Cognitive structures***

For Piaget, knowledge was concerned with change and transformation. He differentiated between *operative* and *figurative* knowledge. Operative knowledge is the understanding of how things change and what could happen, whilst figurative knowledge is concerned with static things and external appearances e.g. visual images and language (Piaget, 1959; Athey, 2006, p. 114; Campbell, 1997, p. 7). Piaget felt that operative knowledge was more important than figurative knowledge, because through the use of operative knowledge, cognitive structures change and both the child and the environment are involved in the process (Campbell, 1997, p. 7). Piaget's statement that "[t]hought is internalized action" (Piaget, 1937, pp. 357) implies the importance he attached to operations as active constructions of meaning (Wood, 1988, p.19; Athey, p. 113).

Language for Piaget was "a consequence and a factor of thinking" (Vergnaud, 1990, p. 18), but action (being the result of operative knowledge) was more important (Campbell, 1997). The significance of language in the construction of meaning in a social environment was not recognized by Piaget (Piaget, 1959; Evans & Jones, 2007; Campbell, 1997, p. 14).

- ***Schemas***

Schemas are cognitive structures which develop through interaction with the environment. Piaget's schemas are significant because they are a manifestation of operative knowledge (Campbell, 1997, p. 7). Sensorimotor action schemas are the simplest cognitive structures, and these are constructed as young children learn about the space around them and respond through movements (Piaget & Inhelder, 1969; Athey, 2007, p. 50; Carruthers & Worthington, 2006; Bruce,

2006; Gifford, 2005; Kohler, 2008). Thus, they develop through interactions and experience. Piaget described schemas as follows:

> Cognitive structures contain within them elements of 'perception', 'memories', 'concepts' and operations'. These are linked together in various types of connections. The connections may be spatial, temporal, causal or implicatory. Structures can be organic, as in very early behaviour, or static or dynamic. (Piaget, 1971b, quoted in Athey, 2007, p. 139)

Schemas are types of reactions which reproduce themselves and can be generalized in many different contexts (Piaget, 1969). My research will investigate whether and to what extent *schemas*, as natural responses to environmental stimuli, can be extended through children's learning about the concepts of space and shape; and how learning about space and shape can be enhanced by using innate schema.

3.4.2 Vygotsky's Theories and their Significance to the Research

Whereas Piaget regarded development as leading learning, Vygotsky claimed that learning leads development (Vygotsky, 1962; Vygotsky, 1978; Berk & Winsler, 1995). He argued against the linear stages posited by Piaget, as he felt that learning and development are a relationship between the child and society (Anning, 2009), and that learning is socially constructed (Vygotsky, 1962; Vygotsky, 1978; Wood, 1988; Cohen, 2002; Bodrova & Leong, 2003). He held that development is "a joint endeavour between the child and its care takers" (Ford, 2005, p. 13). Learning occurs when the child participates in the activities of his/her community (Vygotsky, 1978; Berk & Winsler, 1995; Evans & Jones, 2007). This is also alluded to by socio-historical theorists such as Hedegaard (2001) and Fleer (2010).

- **The Zone of Proximal Development**

In keeping with the social nature of cognition, Vygotsky introduced the idea of the *zone of proximal development* (ZPD) which is the distance between what the child is able to do alone and what he can achieve with help from more knowledgeable others (Vygotsky, 1978; Wood, 1988; Cohen, 2002; Ford, 2005; Meadows, 2005). 'Scaffolding' or 'mediating' learning through moving the ZPD thus occurs within a social context (ibid.), but not necessarily through instruction by adults alone (Holzman and Newman, 2007). Shayer suggests that collaborating peers are able to create a collective ZPD from which individuals are able to draw (2003, p. 472). Siraj-Blatchford (2009)

speaks about the relationship between the teacher and child as one of 'sustained shared thinking' (2002). She suggests that in order for learning to result, there should be a 'balance between teacher-initiated and child-initiated group work and play activities …' (Fleer, 2010). Fleer (2010) uses the term 'conceptual play' as a more structured environment, with the teacher taking on the role of mediator in sustained shared thinking with the child. The child's interests and prior experiences should be taken into account, for learning to be effective (ibid.).

- **Representation**

Vygotsky demonstrated that fantasy play is essential for cognition because it is through their imaginations that children start to understand and use symbols like language and objects in their play (Vygotsky, 1978; Bodrova &Leong, 2003). During play, the Zone of Proximal Development can be reached (Holzman & Newman, 2007) because " [i]n play, a child always behaves beyond his average age, above his daily behaviour; in play it is as though he were a head taller than himself" (Vygotsky, 1978, p. 102). Children impose rules on themselves when playing and are able to accomplish more than they otherwise would (Berk & Winsler, 1995). However, Fleer (2010) explains that many early childhood teachers understand this to mean that they only need to prepare the environment for children to learn successfully through self-discovery. She iterates that it is necessary for teachers of young children to actively engage with them:

> Early childhood teachers need to reclaim their professional expertise as active agents in children's learning, and not be seen as passive providers of materials to foster developmental milestones, where the latter role not only de-emphasises their place in children's learning but also positions them badly within the mix of professions who now interact together to provided services to children and families. (Fleer, 2010, p. 41)

- **Language**

Vygotsky showed that language is one of the ways in which children use symbols to represent their knowledge and that it is vital for the development of thought (Ford, 2005). Language develops when children interact with others. In describing Vygotsky's ideas, Vergnaud (2003) says

> … words and symbols, sentences and symbolic expressions are indispensable cognitive instruments for the transformation of implicit operational invariants into concepts and theorems. The most important cognitive function of language is to contribute to the identification of relevant features as objects. (p. 20)

As they solve problems, children use 'private speech' – talking aloud about what they are doing. Language becomes a 'tool for thought' as children engage in private speech. Later, private speech becomes internalized. As it becomes self-communicative, the language changes structurally. This is called interiorisation (Berk & Winsler, 1995; Vygotsky, 1962). Vygotsky's implication that children learn through active construction reflects Piaget's ideas (Piaget, 1951; Piaget, 1959; Piaget, Inhelder & Szeminska, 1960, Piaget & Inhelder, 1967; Piaget, 1973). This is highly significant for my research, which is based on the premise that children construct meanings about space and shape through specific activities.

3.4.3 Bruner's Theories and their Significance to the Research

Another social constructivist, Bruner (1986, 1990) emphasizes that meaning making is a cultural endeavour and that it plays a central role in human action. He proposes that culture shapes the interpretations people make of the world around them. At the same time, people strive to represent their understandings in symbolic forms. Language is one of them. According to Bruner, *enactive learning,* (learning by doing) leads to *iconic representation* where children produce their own representations (like drawings, modellings or paintings) of their understandings, and later they use *symbolic representation* where symbols like language and writing are used for representation (Bruner, 1986; Hayward & Fraser, 2003).

It is against the background of the learning theories mentioned above, that a closer analysis of how children learn specifically about space and shape is considered.

3.5. Space and Shape

> Every properly functioning human being transforms the visual signals that he receives from outside into structured, meaningful entities. Without the perceptual ordering of his sense response into images of things in space, man cannot orient himself. Without shaping his physical environment in accordance with these images, he cannot survive. His capacity to structure his environment according to his needs – that is, his ability to work out a rapport with his world – determines the quality of his life. (Gyorgy Kepes, quoted in Heberholz and Heberholz, 1975, p. 3)

To a greater or lesser degree, space surrounds everyone. An awareness and understanding of space is vital because it enables one to interpret the world from a spatial perspective, to move

around in it and to act upon it (Shaw, 1990). An understanding of space and shape is required for disciplines as wide-ranging as science, technology, construction, art and sport. Measurement, number and geometry are dependent on an understanding of space and shape concepts (Ryan and Williams, 2007, p. 79). Reading and writing also demand space and shape recognition skills (Golbeck, 2005).

3.5.1 The Development of Space and Shape Conceptualisation

Babies' first geometric experiences involve rolling around, moving, changing position and crawling (Andrews, 1996). Infants start to "notice events and hypothesise about cause and effect within minutes of their arrival" (Pound, 2003, p. 3). As described in the previous section, Piaget described babies' first actions as reflexive uncoordinated responses. As they realize that objects are not part of themselves, babies reach out to grasp them. They learn to sit up and move around objects in different ways, each time viewing their environment from a different perspective. In this way, they learn about distance and directionality and these skills help them to negotiate space and objects when they start to walk (Pound, 2003). Young children's first spatial experiences are thus dynamic and involve movement, orientation and re-orientation of objects (Andrews, 1996; Cross, Woods & Schweingruber, 2009). These understandings and explorations are essential for becoming active members in their own communities (Pound, 2003).

As Piaget postulated, children adopt schemas or spatial movement patterns as they experience the space around them (Piaget, & Inhelder, 1969; Athey, 2007; Gifford, 2005, Carruthers & Worthington, 2006; Bruce, 2006; Cross et al., 2009). Piaget suggested that actively developed schemas are responsible for controlling human behaviour (Piaget et al., 1960). Numerous authors (Athey, 2007; Gifford, 2005, Carruthers & Worthington, 2006; Bruce, 2006; Cross et al., 2009) suggest "identifying and supporting children's schema" (Gifford, 2005, p. 111) in order to extend their learning about space and shape.

Although very much interrelated and connected, the concepts of shape and space develop in different ways, and the progression in learning about each of these will be described in the following sections.

3.5.2 Shape

Learning about shape first happens intuitively, through children's instinctive explorations of the world around them. This is the learning that children bring with them to school. Ginsburg et al. (2008) iterate that from birth, children develop informal mathematical ideas that are "surprisingly broad, complex and sometimes sophisticated" (p. 3). Therefore, the socio-cultural contexts of home learning should be valued, recognized and built upon (Carruthers & Worthington, 2006).

Shape and space concepts conform to rules of equivalence (similarity) and transformation (difference or change) and it is this conformity which ensures the linking of number and shape and space into part of the subject of mathematics (Haylock & Cockburn, 2008; Cross et al., 2009). Recognizing similarities and differences between properties is an integral part of learning about shape (Gifford, 2005, p 106). Haylock & Cockburn substantiate this by explaining that understanding space and shape involves "*classifying* shapes and *changing* shapes" (2008, p. 179), and that "these ideas of transformation and equivalence underpin almost all geometric experiences" (2008, p. 181). Learning about the properties of shapes involves distinguishing between differences and similarities in their properties. Some of these are learnt intuitively, through children's experiences of handling shapes at home and at school. For instance, a child may understand that a shape is curved, but may not know the language to describe it. Other shape properties, such as the number of sides a particular family of shapes has, need to be taught (Gifford, 2008; Cross et al., 2009).

Understanding what the properties of shapes are and what distinguishes one shape from another is as important as the actual shape names (Gifford, 2005). Hand in hand with properties, children need to learn correct vocabulary (ibid.). Some of the properties which Grade R children should be taught are whether shapes are 2 or 3 dimensional, curved, flat, straight or round; the numbers of vertices, edges and faces they have, and the numbers of corners and sides. They should also understand the meanings 'right-angled', 'parallel', 'equal', and know the names of the faces which form the sides of 3-D shapes (ibid).

Mathematical language differs from everyday language and if children learn the correct terminology from an early age they are more likely to be successful mathematics learners

(Laborde, 1990; Ryan and Williams, 2007). This is particularly significant in the South African context where according to policy (South Africa. Department of Education, 2002a), Grade R learners should be taught in their mother tongue but mathematical concepts are often taught in English.

> Recognising patterns in rules and relationships is another important aspect of learning about shape, and young children discover these by investigating and exploring shapes, fitting them together and taking them apart (Gifford, 2005, p. 108).

Piaget researched the visualization process in young children (Gifford, 2005; Piaget & Inhelder, 1951; Piaget et al., 1960) which begins with the idea of *object permanence* (ibid). When an object rolls out of sight, a young child has to hold a mental representation of it in order to find it. It is only when young children can visualize the real object that they are able to substitute it with other objects or symbols in their games (Berk & Winsler, 1995). So when a representation of an object can be evoked in its absence, visualization takes place (Hershkowitz, 1990, p72).

- ***Progression in learning about Shape***

Piaget showed that young children recognize the topology of shape before they understand shape properties (Piaget & Inhelder, 1967; Piaget et al., 1960), but Clements & Battista indicate that new research does not always support this idea (1992, p. 425). "Rather, it may be that ideas of all types develop over time, becoming increasingly integrated and synthesized." (Clements & Battista, 1992, p. 426) Children can recognize shapes from an early age (Clements & Battista, 1992; Clements, Swaminathan, Hannibal & Sarama, 1999). Regular shapes are more easily recognizable, whilst asymmetrical shapes are more difficult to identify (Clements et al., 1999; Cross et al., 2009). Gifford gives an example of two-year olds who 'post' regular shapes into matching holes (2005, p. 112).

Piaget & Inhelder (1967) demonstrated that an understanding of shape follows a definite order and starts with physical manipulation of shapes. Only when children can "identify a variety of examples in different orientations and discriminate between examples and non-examples" (Gifford, 2005, p. 113), can they be said to understand the concepts of geometric shapes. According to Piaget, the ability to represent shapes by drawing or modeling them only occurs later when a concept of a shape has developed. He describes this ability an example of operational thought (Clements & Battista, 1992; Piaget & Inhelder, 1969).

Shape conceptualization is developed through recognition of shapes, learning the language of shapes, shape classification, understanding angles and construction (Gifford, 2005). Cross et al. also suggest activities involving "composing and decomposing shapes from other shapes (2009, p. 194). The progression through each of these is discussed in the following sections:

- ***Recognising shapes***

Shape classification involves more than simply naming the shapes. The van Hiele model of concept development in geometry shows how an understanding of shape develops (Ryan and Williams, 2007; Clements &d Battista, 1992; Clements et al., 1999). Van Hiele's levels have the following characteristics:

- the levels are discrete and different from each other;
- they are sequential and hierarchical;
- memorization is not a factor in progression through the levels;
- concepts understood implicitly at one level become explicit at the next level;
- the movement from one level to the next is due to teaching and learning experiences;
- each level has its own language. Language is also crucial for moving through the levels (Hershkowitz, 1990; Clements & Battista, 1992).

Level 1: Visualisation and recognition: Shapes are identified by their appearance and not by their properties. Children at this level are not able to explain why shapes are different.
Level 2: Analysis: Rather than seeing shapes as wholes, children start to see them as collections of properties and are able to name the properties.
Level 3: Abstraction: Shapes are ordered according to their properties. Attention shifts to the relations between properties. e.g. the square is a type of rectangle. Children are able to classify a shape even though they might not look symmetrical or regular.
Level 4: Deduction: Formal reasoning through logical interpretation of axioms, definitions and theorems.
Level 5: Rigour: An understanding of formal deductions and the use of proofs and different mathematical systems. (Ryan & Williams, 2007; Clements & Battista, 1992; Hershkowitz, 1990).

Clements & Battista (1992) and Burger & Shaughnessy (1986) note that most children and many adults do not move beyond Level 2.

- ***The Language of shape***

As children first become aware of shapes, they use informal language to describe their properties e.g. “pointy corners”. Descriptions like these show that children are becoming aware of shape properties, but it can also limit their thinking about shapes if they are not taught a “mathematical voice”. Ryan &Williams describe how everyday words have different meanings in the mathematics classroom for example “square”, “face”, “edge”, “line”. “The *mathematical voice* comes to be recognized as an element of a new ‘game’ of ‘doing mathematics’ or better, ‘talking mathematics’ that takes place in the mathematics lesson.” (2007, p. 83)

- ***Classifying shapes***

Gifford (2005, p. 116) suggests that rather than learning complicated systems of classifying shapes, children should rather focus on an awareness of shape properties. Opportunities to discuss, play with and compare a variety of shapes will promote an understanding of shapes and facilitate classification when children are ready to do so. Freudenthal defines mathematics as activity. Rather than learn rules, children should therefore learn through activities (1971, p. 413). He confirms that correct terminology assists children in the classification of shapes (Freudenthal 1971, p. 424).

- ***Understanding Angles***

Angles are one of the properties of shape which children learn, and some researchers feel that it develops later than understandings of the other properties. Gifford cites Goodnow (1977), who found that children intuitively prefer right angles, but find it difficult to identify them (2005, p. 117). Walking around shapes helps to give children an understanding of angles (Gifford, 2005, p. 117).

- ***Constructions***

Blockplay reveals much about young children’s understandings of shape. Research done at the Blockplay Project (Gura, 1992 in Gifford 2005, p. 117) showed that young children randomly chose shapes for building. When buildings fell down they showed surprise. Older children used smaller blocks to make bigger shapes, they made towers and used symmetry. As children’s shape

conceptualization develops, they progress from linear constructions, to 2-dimensional, and then to 3-dimensional buildings.

Block constructions reflect children's intrinsic understandings of shape and space. Clements (2004) described the progression in constructions thus:

- Precomposing (using one block to represent an object)
- Piece assembling (using one block to form part of an object)
- Picture making (using several blocks to form one item)
- Shape composing (selecting blocks to make something intentionally)
- Substitution composers (deliberately putting shapes together to form units) (Gifford, 2005, p. 119)

3.5.3 Space

As young children take in information about the space around them, their sense of spatial perception depends on past experiences of space and on the development of their perceptual abilities (Del Grande, 1990). Although authors describe spatial learning in different ways, they all agree that spatial sense does not depend on a single ability, but rather on multiple sensory input – touch, smell, sound, body position as well as vision (ibid.). Del Grande cites the seven abilities mentioned by Hoffer (1977) that are necessary for spatial perception: eye-motor co-ordination, figure-ground perception, perceptual constancy, position-in-space perception, perception of spatial relationships, visual discrimination and visual memory (1990, p. 14). These abilities develop as the child interacts and perceives objects in the space around them (Piaget & Inhelder, 1969; Piaget et al., 1960). Gifford suggests the following abilities which young children need to learn about in order to develop a spatial concept:

- Positions and directions e.g. inside, outside, on top of/underneath, in front/behind, left/right.
- Movement and transformations
- Translating (sliding shapes sideways, up, down and diagonally)
- Reflecting (flipping or reversing shapes)
- Rotating (turning shapes) (Gifford, 2005, p. 109)

- ***Progression in Learning about Space***

Children become more spatially aware as they mature and understand more about their relationship to the objects surrounding them. Their first anchor is their body, which is the axis for remembering positions and negotiating the world, and gradually other reference points are used

(Golbeck, 2005, p.73). Piaget's research showed that children at the pre-operational stage of development were not able to see things from different perspectives (Piaget et al., 1960; Cohen, 2002). But other researchers, like Donaldson, illustrate that children can understand how things look from different viewpoints (Donaldson, 1963; Cohen, 2002).

Children need therefore, to develop spatial understanding in relation to themselves (position) and then in relation to objects surrounding them (location) (Gifford, 2005, p. 120). As they negotiate the environment, toddlers develop a sense of direction. Research shows that young children are able to understand fixed positions (above/below; inside/outside; over/under; between) more easily than relative positions (left/right; in front/behind; forwards/backwards). When objects are small or far away, young children also find it difficult to identify their positions in relation to each other (Gifford, 2005; Cross et al., 2009).

The process of navigation involves visualization. First of all children remember landmarks, thereafter they are able to construct routes between the landmarks. Older children start to understand the concept of scale and can position themselves on a map, recognize features on a map and draw maps (Gifford, 2005). Haylock & Cockburn argue that spatialisation entails understanding how space changes shapes. When children are learning about shapes they are sometimes expected to focus on transformations whilst at other times, they need to focus on equivalences (2008, p. 179). Through experience and teaching they learn which is appropriate in each situation. Transformations take several forms and these are described below.

- ***Translation***

Translation involves sliding, without turning shapes into different positions. Examples of shape translations are patterns on wallpaper, fabric, tiles and wrapping paper where the same shape is repeated in different positions. A concept of direction is needed to recognize translations (Haylock, 2008, p. 182; Gifford, 2005, p. 123). Vocabulary required for learning about translations would include *here, there, further, closer, higher, lower, above, below, in front of, behind.* Figure 3.2 shows an example of translated shapes.

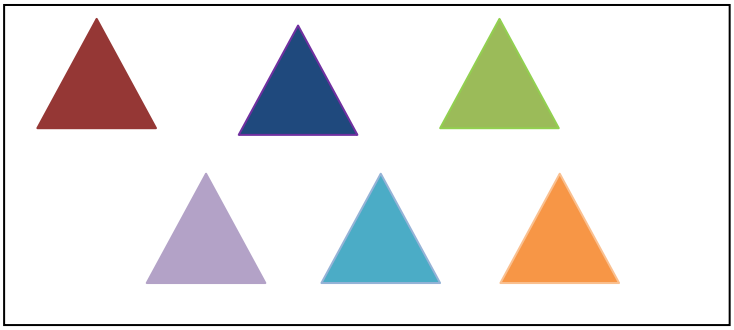

Figure 3.2: A set of shapes produced by translation

- ***Reflection***

Identical shapes are flipped over and reflected symmetrically. Symmetry can occur within a shape, like a regular rectangle with a mirror line, or between different shapes (Haylock & Cockburn, 2008, 186). Children start by reflecting patterns sideways and only later on manage to make symmetrical patterns from top to bottom (Gifford, 2005, p. 123). Figure 3.3a shows two shapes reflected across a midline, whilst Figure 3.3b shows a shape with its own 'mirror line'.

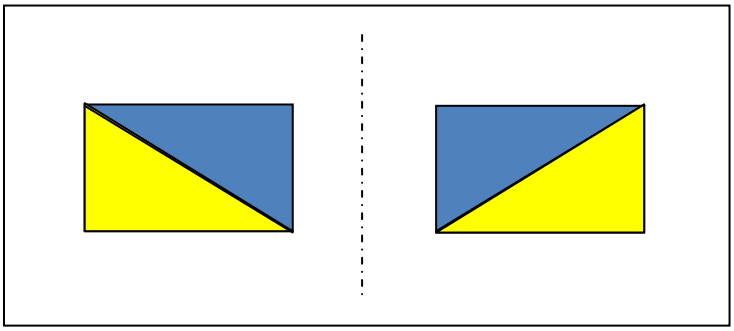

Figure 3.3a: Shapes produced by reflection

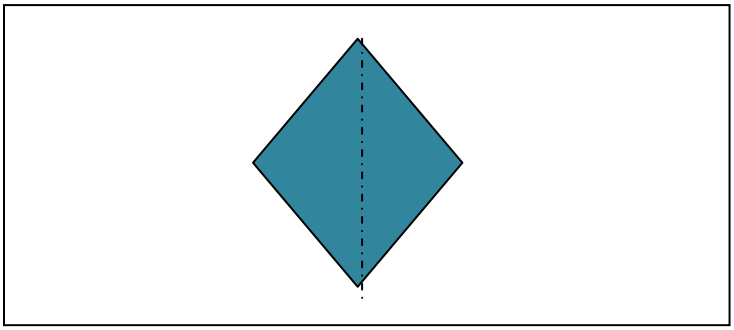

Figure 3.3b: A shape with its own mirror line

- ***Rotation***

Here position is ignored, and sameness is focused upon. The same shape is turned at various degrees (Haylock & Cockburn, 2008, p. 184; Gifford, 2005, p. 123). An illustration of rotating shapes is illustrated when toddlers insert shapes into posting boxes and older children rotate puzzle pieces to fit their spaces. Figure 3.4 illustrates rotated shapes.

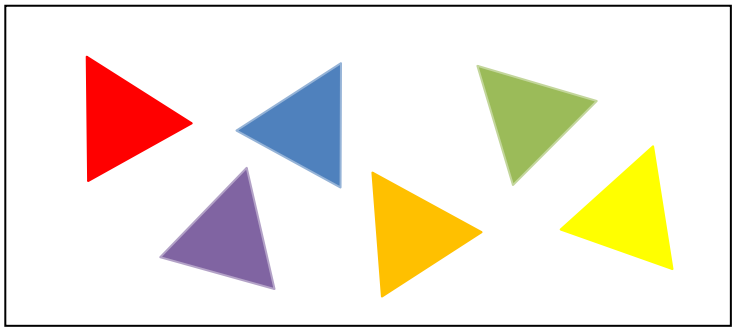

Figure 3.4: Rotated shapes at various angles

- ***Similarity***

Similar shapes have the same angles, but are larger or smaller than each other. Equivalence rather than the transformation of shapes is what should be focused on. Children use the idea of scale automatically when they copy a figure, for example from a picture or blackboard (Haylock & Cockburn, 2008, p. 188). Figure 3.5 shows similar shapes which have been scaled up or down.

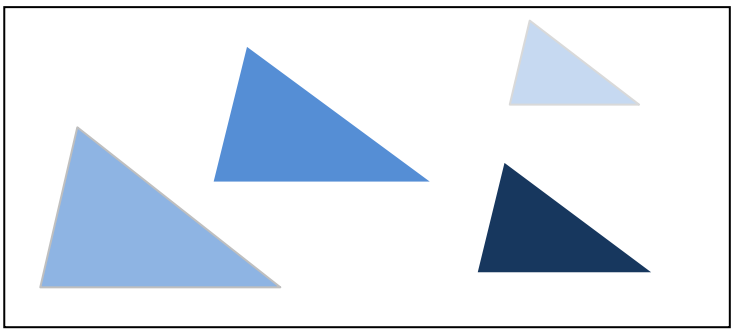

Figure 3.5: A set of shapes produced by scaling

- ***Family likeness***

Based on the notion of similarity, family likeness involves ignoring position, rotation, reflection and similarity, and classifying shapes according to shared properties like number of sides (Haylock & Cockburn, 2008, p. 192). Figure 3.6 shows a set of shapes with family likeness.

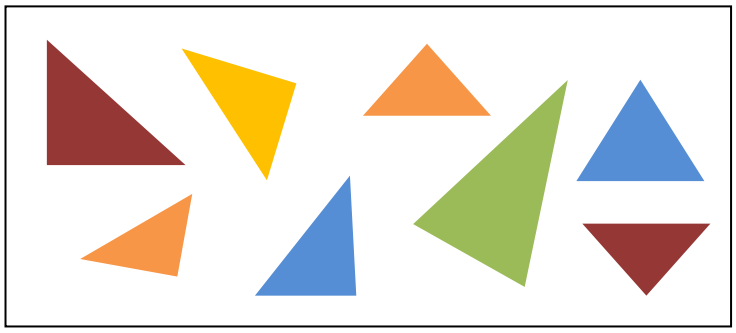

Figure 3.6: A set of shapes with family likeness

- ***Perspective***

When children see objects from different positions, perspective changes and they learn to ignore the distortions that perspective brings about. Haylock & Cockburn note that because of the three dimensional world that young children negotiate, they are often not aware of the changing image that perspective brings about and they continue to see and represent objects as if they were unchanged (2008, p. 194). Figure 3.7 shows a shape seen from different perspectives.

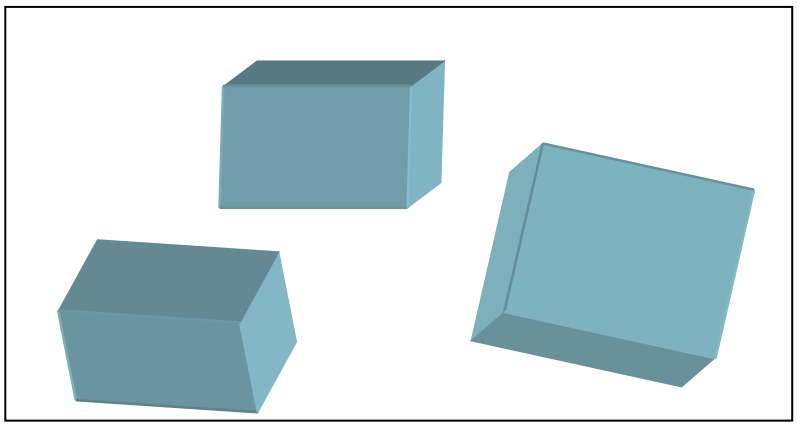

Figure 3.7: A shape seen from different perspectives

- ***Topological transformation***

A topological transformation occurs when the shape is drastically changed so that no geometrical properties remain the same, like length, parallelism, number of sides, straightness of sides or angles. Haylock & Cockburn give the example of a letter which is distorted in various ways but is still topologically equivalent (2008, p. 196). Young children are able to identify the letters as the same shape even though they look vastly different from each other, and ignore the ways in which

they are different (Haylock & Cockburn, 2008, p. 195). Topological transformation of the letter *d* is shown below in Figure 3.8.

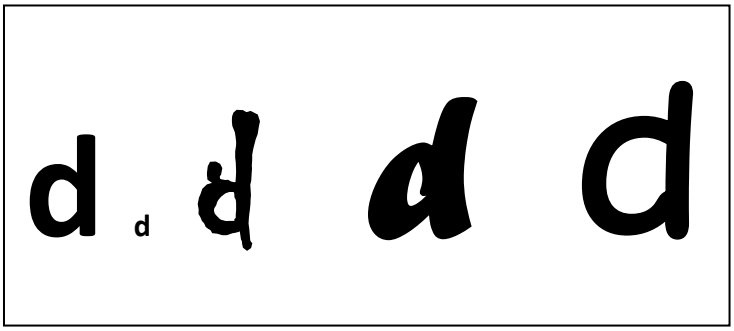

Figure 3.8: A set of topologically equivalent shapes

Children bring their experiences and perceptions of space to the school environment. A curriculum of appropriate teaching and learning experiences will reinforce earlier experiences and enrich space and shape conceptualization.

3.6. Pedagogy

> "… pedagogy is an art, whereas psychology is a science." (Piaget, 1948, p. 22, in Kohler, 2008, p. 153)

Having discussed how cognition takes place, and how an awareness and understanding of the concepts of space and shape develop, we now need to locate these ideas in the Grade R classroom. The practicalities of using Piagetian and Vygotskian theories in the Grade R classroom will be examined, and the ideas of other early learning specialists will be taken into account. The art of teaching and learning about space and shape is explored here.

As stated in Section 3.3, this research investigates constructivist theories and learning. So when designing a curriculum for teaching about space and shape, it is important to take the notion of the child as an active constructor of knowledge into account. In so doing, we need to pay heed to the knowledge that the child brings from home and the ways he or she will go about assimilating further knowledge and understanding. Piaget (1925) confirms this:

> The child has his own interests, his own activities, his own thoughts, and we must use this as our starting point for the child's education. (p. 464, quoted in Kohler, 2008, pp. 132-133).

He argued that since children's thought processes are different to adults, they should therefore be taught in different ways to adults:

> Like a tadpole, who can already breathe, but uses organs that are different from those of the fully developed frog, the child acts like the adult, but uses a mentality with varying structures, depending on the stage of the child's development. (Piaget, 1939, p. 156, quoted in Kohler, 2008, p. 133).

Further, Piaget explained that lessons should take the child's developmental level and previous experiences into account:

> A lesson will not yield results, unless it meets a need, and a need is only met when the knowledge transmitted corresponds to a reality, which the child has spontaneously experienced and tested. (Piaget, 1931, pp. 78, quoted in Kohler, 2008, p. 140)

He also suggested that children need active experiences, using concrete materials:

> It is absolutely necessary that learners have at their disposal concrete material experiences (and not merely pictures), and that they form their own hypotheses and verify them (or not verify them) themselves through their own active manipulations. The observed activities of others, including those of the teachers, are not formative of new organizations. (Piaget, 1973, p. ix)

Thus, Stacey's (2009) argument that the notion of a curriculum whereby children's previous experiences and their interests are taken into account, is based on the theories of Vygotsky and Piaget (Stacey, 2009). It is also recommended by early years' experts (Pound, 2003, Carruthers & Worthington, 2006; Stacey, 2009, Ginsburg et al., 2008). Stacey (2009) also supports the idea of building on the child's experiences by using an "emergent curriculum" which is "framed by the teacher" but "child initiated" (p. 17). "Sustained shared thinking" (Siraj-Blatchford, 2009), and scaffolding or mediating learning are central to an emergent curriculum.

> In its practice, the teacher takes on the role of facilitator, taking what is seen and heard, and bringing to children the opportunity to discover more, dig deeper, and construct further knowledge. (Stacey, 2009, p. 17)

Gifford (2005) mentions the cognitive processes which are necessary for effective learning to take place: rehearsing, making connections, representing and symbolizing, predicting, and spotting errors and incongruity. Metacognition and problem solving are used to reinforce these processes.

It is my view that all of these strategies can be explored in an emergent curriculum. These will be expanded upon in the following section.

My study therefore focuses on emergent curriculum as an appropriate pedagogy for enabling children to effectively learn about the concepts of space and shape.

3.6.1 Learning through Observation, Instruction and Rehearsal

Vygotsky asserted that learning is a social process in which "imitation and instruction play a major role" (1962, p. 188). Children's first experiences of space and shape are within their own cultures where they observe how people around them use objects (Gifford, 2005, p. 16). In their play, children practice different spatial behaviours – be they a type of dance or a technique for block building (ibid.). "With this apprenticeship model of learning, children become familiar with mathematical language, skills and tools before fully understanding ideas" (ibid). Vygotsky emphasized the role of experts in helping the child to attain the ZPD, both at home and at school; with peers and with adults (Vygotsky, 1962; Vygotsky, 1978).

The Grade R classroom should therefore provide opportunities for many diverse experiences in order to actively construct knowledge in a socio-cultural context, where communication and interaction is encouraged. Vygotsky stressed the importance of collaboration and co-construction in young children's learning (Vygotsky, 1978; Carruthers & Worthington, 2006).

Haylock & Cockburn advise: "The starting point for teaching shape and space is to provide masses of informal, unstructured opportunities to experience geometric concepts through playing and talking" (2008, p. 196). Montague-Smith suggests that children need a wide variety of natural as well as manufactured shapes. They learn to describe shapes in terms of colour, texture, features, size and differences (2002, pp. 89-91). Rehearsal would include providing opportunities for practicing schemas by allowing children to draw freely, using mathematical language, and providing opportunities for block building and practicing spatial patterns (Gifford, 2005, p. 125).

3.6.2 Making Connections and Generalizing

The development of abstraction involves being able to identify the same idea in different examples (Gifford, 2005, p. 17). Therefore a wide variety of shapes (manufactured and natural, 2-D and 3-D) needs to be available for children to sort, classify, organise into patterns and categorise.

Generalising includes the Piagetian idea of assimilation where links are made between old and new experiences so that they fit into an idea. Teachers need to provide the same idea in many different forms so that children form solid concepts (ibid.). This can be done by asking questions that link different areas of mathematics, like number and shape. Different areas of the curriculum should be integrated so that children understand the links between them.

3.6.3 Representing, Talking and Symbolizing

Vygotsky (1962) showed that language, as symbolization, is an important part of the process of abstraction. Thus the classroom should provide many opportunities for talking, discussing, collaborating, arguing and agreeing.

One of the cultural tools that children use to represent their learning is through "mark making" described by Carruthers & Worthington (2006) as the process of constructing meaning by making physical marks like scribbles and drawings to represent thoughts. Piaget also described drawings as a feature of symbolic thought (Piaget et al.,1960). These spontaneous, self-initiated marks could be "physical pigment on a piece of paper, traces of light on a screen, or images on a liquid crystal display of a digital camera" (Matthews, 2006, p. xiii). Marks can be drawings, paintings, collages or models and they may use a variety of media. They typically refer to events, people and ideas. As with the use of cultural tools, children use their marks to make their thinking visible to others (The National Strategies, 2008). Athey (2007) shows how mark making is a representation of schemas: physical schemas as described by Piaget, and mental schemas showing thought processes. For this reason it is vitally important to take note of representations and mark making as they provide insight into children's development (ibid.).

When young children start to express their thinking through visual representations, both emergent literacy and emergent mathematics result (Carruthers & Worthington, 2006). Bruner

described the emergent writing process as iconic representation (Hayward and Fraser, 2003), and Vygotsky introduced the notion of drawing as one of the ways that children use to symbolize or represent their experiences (Vygotsky, 1962; Bodrova and Leong, 2003).

A variety of materials for visual representation or mark making should therefore be available at all times: pencils, crayons, paints, chalks, sticks, charcoal, paper, chalkboards, boxes, blocks and many types of containers.

3.6.4 Predicting prior to Feedback

Predicting is a way to focus attention. It involves visualizing and using past experiences. Discovering the answer provides feedback. Mark making, or visual representation gives instant feedback and as such is especially satisfying because children can immediately see what they have created (Gifford, 2005, p. 19). Children may represent their understandings using drawings, paintings, constructions and modellings. Mathematical games like guessing shapes in a feely bag, puzzles, constructions and computer programs also involve prediction and feedback.

3.6.5 Spotting Errors, Incongruity and Misconceptions

What Piaget termed "accommodation" takes place when cognitive conflict occurs. New evidence is assimilated into already-forming concepts to broaden and strengthen them. (Piaget & Inhelder, 1969). Cognitive conflict occurs when contradictory evidence is shown, discussions are encouraged, and children are allowed to correct each other (Gifford, 2005, p. 20). An element of surprise and novelty holds children's interest (Curtis, 1998 in Gifford, 2005, p. 20). Questioning should be encouraged: "What if …?", "Why …?" and "How many different …?" (Gifford, 2005, p. 20).

Gifford also suggests providing incorrect examples of shapes, like triangles with a corner cut off, and irregular shapes so that misconceptions can be clarified (2005, p. 127). Puppets can be used to make mistakes which children need to correct (ibid).

3.6.6 Metacognition

Metacognition or "thinking about thinking" helps children to not only plan and monitor their thinking, but also become aware of strategies and thought processes required for problem solving

in mathematics. Children can be encouraged to explain why shapes have been sorted a certain way or why a certain shape is classified as a triangle. Metacognition involves many of the thinking processes already mentioned (ibid.). As Vygotsky posited, language is a cultural tool and children use it as a tool for thought. Private speech, where children talk aloud to themselves when playing is seen as an intermediate stage in the internalization process (Vygotsky, 1978; Berk & Winsler, 1995, p 37). Therefore private speech should be encouraged during the learning process because when children use their own words and ways of explaining to themselves, they are constructing meaning.

3.6.7 Problem solving

Gifford (2005) explains that it is difficult to separate problem solving from play as they are integral to each other (p. 21). Often children's play involves problems which need to be solved, and when children are given problems to solve they become a part of their play. During problem solving, children talk, predict and make connections. Vygotsky (1962; Vygotsky, 1978), Fleer (2010) and Siraj-Blatchford (2009) advocate joint problem solving or co-construction of meaning involving experts and novices. The expert could be the teacher or peers.

Fantasy play is vitally important for the development of self-regulatory behaviour, according to Vygotsky (Vygotsky, 1978; Berk & Winsler, 1995). It is during fantasy play that children learn to separate their thoughts from actions and objects; and to renounce impulsivity in favour of deliberate activities. Pretence prepares children for abstract, imaginative thinking (Berk & Winsler, 1995, p. 55). Fantasy play often involves problem solving, like constructing a farm from blocks where children need to spot similarities and differences, substitute shapes and make new connections.

By providing open-ended contexts such as an emergent curriculum, children can be encouraged to play with mathematical ideas. This involves not only providing the necessary materials and equipment for learning about space and shape, but ensuring that the ambience of the classroom is one of creativity, learning and discovery. Carruthers & Worthington (2006) state that teachers often seem to see creativity in mathematics in terms of "*specific resources* or *activities*, rather than processes" (p. 34). Concrete, practical activities are important, but children need to interpret

concrete learning into abstract terms too. The following section explores this notion more deeply, and discusses how an emergent curriculum can be carried out in a creative classroom.

3.7. The Curriculum

> Curriculum content is knowledge given educational validity by people 'in the know' and by people in power. The central feature of curriculum is knowledge … and it remains external to the knower until constructed psychologically in the individual. (Athey, 2007, p. 57)

Numerous strategies have been described above for the successful teaching and learning about the concepts of space and shape. However, this study is concerned primarily with the use of visual art as a tool for teaching about space and shape. Visual art and its relationship to mathematics will be examined, and its suitability for learning about space and shape in the Grade R classroom will be explored. In addition, an argument for an emergent curriculum involving visual arts will be given.

3.7.1 Visual Art

> Art is a means by which an individual tells others how he feels about the world. (Heberholz and Heberholz, 1975, p. 28)

Many artistic principles overlap with mathematical ones e.g. line, space, shape, measurement, pattern (Thomas & Lindsay, 2009). Drawings, as explained by Piaget (1945) form part of symbolic thought and are one of the ways in which the child uses symbols. The invention of symbols is natural and a source of great pleasure and satisfaction. Through symbols, experience is clarified and shared (Hohman and Weikart, 2002). For the purposes of this thesis, drawings are interpreted as any form of mark making or representation: writing, drawing, painting, collage or modeling, with a variety of different implements and using many different media.

Brooks (2009) explains how drawing can be not only a means of communication and expression but also a problem-solving tool. Instead of gauging children's cognitive development by means of their drawings in a linear, Piagetian way, she feels that children's representations serve a greater purpose, and that is to enhance meaning making. Visual arts are a means of representing

understanding and meaning (Hope, 2008). Representing is an essential part of the learning process because it entails identifying key spatial features in order to do it (Hope, 2008, p. 18).

Carruthers & Worthington (2006) describe how representations mediate higher mental processes. Worthington also quotes from research which shows that "high levels of cognitive challenge" (Silva et al., 1986, cited in Worthington, 2005, p. 1) result when activities are "novel, creative, imaginative, productive, cognitively complex, involving the combination of several elements …"and are deeply engrossing (Worthington, 2005, p. 1). It was found that art has "almost the highest level of cognitive challenge" (ibid.).

Many early years experts support the idea of an integrated curriculum. One of the reasons for this is that young children experience the world holistically. Vygotsky showed how emotion is tied to cognition (Vygotsky, 1978; Bodrova and Leong, 2003; Bruner, 1986) in young children. Educationists have known for many years that development is holistic, taking place physically, emotionally, socially and intellectually. This also gives support to Vygotsky and Bruner's social constructivist theories where children construct meaning socially, with the help of their peers and more learned adults (Bruner, 1986; Vygotsky, 1962; Vygotsky, 1978; Fleer, 2010).

> Brain research also supports the notion of an integrated curriculum. The thalamus acts as the sorting area, sending sensory input to the parts of the brain that deal specifically with each sense's information. Each lobe of the brain is a highly complicated network of cells, dendrites and nerves that interconnect. Learning in one lobe therefore has an effect on the other lobes and the more multi-modal activities are, the more connections between lobes result (Rushton and Larkin, 2001, p. 26).

Hope (2008) describes drawing as serving several purposes, and the chapters in her book go on to describe each of these in detail:

> ***Drawing to see:*** This is where children express their symbolic ideas through art. Graphic metacognition takes place when children make drawings in order to understand their environments. Children see the world as a narrative. Drawing is often easier and more satisfying for children than writing, even when they have learned writing skills (Hope, 2008).

Drawing to think: Here the metaphor of drawing being both a "journey" and a "container" for thoughts is used.

***Drawing to play*:** Vygotsky showed that consciousness and control appear after an action has been practiced unconsciously as in playing (Vygotsky, 1978). Playing with ideas, such as in drawing, is one of the highest forms of human activity (Hope, 2008).

Drawing to mean: This is the human urge to make one thing represent another.

Drawing to know: Making meaning through art enables understanding to take place. Athey (2007) recognizes the importance of form rather than content in children's drawings. This notion will be described in more detail in the following section.

Mark making brings together many of the ideas expressed in this thesis: the development of symbolic and intuitive thought, the desire to represent, the integration of learning, and the notion that children learn by doing.

3.7.2 Schemas

The Piagetian notion that "thought consists of internalized and co-ordinated action schemas" (Piaget, 1937) indicates that by observing children's representations of schema through their mark making, we are able to gain insight into their understandings of space and shape. These spatial movement patterns are reflected in children's mark making or visual arts activities. As a means of representation, which Piaget (1951) calls "symbolic thought" (p. 169), and Vygotsky terms "cultural tools" (Vygotsky, 1978, p. 57; Berk & Winsler, 1995, p. 20), these schemas show the child's movements in space and serve to represent their thoughts (Athey, 2007). During my own teaching years I was aware of certain patterns of behaviour and representation in young children; thus the notion of schemas resonates strongly with my practice.

With regard to schemas, Athey (2007) emphasizes that form is more important than content in the development of concepts. By this he means that the cognitive structure which a schema represents takes precedence over the object it portrays. For instance, if a child is interested in

drawing the sun, he should be extended by teaching and learning about other circles in his environment (Athey, 2007), rather than only learning about the sun. Athey admits though, that it is not known how much experience is required for a new form to be constructed (p. 115) i.e. a different way of expressing oneself. What is known is that the more diverse experiences a child has with a particular form, the more profound conceptualization will result (Carruthers & Worthington, 2006; Athey, 2007). Piaget maintained that new schemas are continuously constructed. As more experiences are assimilated, the more "extensive the schemas and the more coherent are resulting 'networks of schemas'" (Athey, 2007, p. 58).

Carruthers & Worthington (2006) describe their experiences of using schemas to initiate further learning. A child who was passionate about spirals drew them, cut them out, and often walked in spiral formations. Her mother made spiral cakes for the class to share. Gradually the rest of the class became interested in spirals too, and were allowed to explore spirals in different ways. With the teacher's support and mediation, this resulted in a plethora of activities around spirals:

> Spirals and spiral-like marks appeared on paper, in painting and drawings. They embellished drawings as hair, fingers, sun and flowers; one shape within another; as patterns and as explorations of shapes (Carruthers & Worthington, 2006, p. 49).

Through observing children closely, Carruthers & Worthington (2006) were able to map schema interests. The maps showed that each child's journey traced a similar pattern and went through the same stages. Earlier schemas were revisited, so the pattern was a zig-zag one (p. 52).

Through observing 2125 action schemas of children, Athey (2007) grouped them into eight categories. He then described them in terms of the motor level they signify; their symbolic representational level through drawings; their relationship to other functions; and the thoughts that these schema provoked. The schemas which occur most often are the most basic ones, and schemas do not occur in a rigid order. What follows is a list of schemas, arranged from the ones which occur most often to least often. Examples of behaviour germane to each schema are suggested.

Dynamic vertical schemas – Babies drop or throw things from the pram or high chair, to have them returned. Older children enjoy jumping from platforms, and are fascinated by

leaves falling from trees. They are visually represented by vertical lines, vertical scribbles, stripes and straight parallel lines.

Dynamic back and forth, or side to side – Toys are pulled or pushed along, balls are rolled and kicked, people, animals and cars move horizontally. Children point at moving objects. They walk forwards and backwards and verbalise what they are doing. They transport objects in trucks and vehicles. These are represented by horizontal scribbles, horizontal lines, horizontal and vertical differentiated scribbles, open-continuous triangles, grids, triangles, rectangles and right angles.

Circular direction and rotation – Children are fascinated by objects moving round and round, like wheels, windmills and rotating handles. They draw circular scribbles. They observe that when dancing around a maypole the ribbon becomes shorter. They ride tricycles and push carts and wheelbarrows. Children's drawings show circular scribbles, circular enclosures, core-and-radial, ovals, spirals, concentric circles, multiple loops, and helixes.

Going over, under or on top of – Making piles of objects, climbing, cooking on the stove, block building, and placing objects on top of each other are examples of this schema. Children draw heads with hair or hats on top (often these seem to float above the head). They draw boats going under bridges, a person on a bed, etc.

Going round a boundary – This schema includes making circular movements, placing objects inside and outside, tying knots, making bead necklaces, using elastic bands on a board of nails, and making fences in block play. Children often go through a stage of tying their cardigans around their waists. This schema can be represented by playdough or clay models of boundaries or including objects, drawings or paintings of rope tying objects and drawing lines around groups of objects.

Enveloping and containing – Children climb into and out of containers, and they crawl through tunnels and holes. They enjoy putting objects into containers, and wrapping up

presents. Often, young children go through a phase of painting a picture and folding it up until it forms a small envelope. They draw features inside a face enclosure.

Going through a boundary – Water moving through the boundary of a hose or funnel fascinates children. This schema is also represented by pushing objects into sand, playdough or clay, and a fascination with holes, cages and caves. Children draw animals looking through bars in cages, people getting out of buses or cars and pouring from a kettle or jug.

Thought ('internalised data' and 'telling a story') – As children mature, they use clusters of schemas to represent their thoughts. Athey (2007) says "… schemas become co-ordinated with each other and develop into systems of thought" (p. 153). They are more able to describe the space around them and represent it in their drawings. Drawings, paintings and modellings show that as they reach school-going age, children are using many different schemas to represent their thoughts (pp. 115–116).

Carruthers & Worthington (2006) have this to say about schemas:

> Schemas can be described as a child's repeated pattern of behaviour; they cannot be taught as they come from the child's own self interest; and when they are involved in a schema the level of children's involvement can be very intense. Some of this schematic thinking is represented in their drawings and form foundations for more complex structures and mathematical ideas. The schematic marks, like other mathematical mark-making, help bridge the gap between informal and formal mathematics. Supporting children's schemas feeds their natural curiosity which, in turn extends their thinking (p. 55).

It is the tenet of this research that through observing children's representations, teachers will be able to introduce further visual arts activities to deepen understandings and enhance learning. Needless to say, the development of schemas and the representations which result requires a particular type of pedagogical approach, one that values and creates opportunities for these expressions of meaning.

3.7.3 Creativity

> …to create human beings, capable of achieving new things rather than simply repeating the acts of previous generations – human beings, who are creative, innovative and full of joy in discovering new things. (Piaget, 1964, p. 5, in Kohler, 2008, p. 132)

Piaget's theory is reflected by other early years' experts: Craft (2002) writes that teachers of young children should promote the "highest levels of thinking, originality, innovation, resourcefulness, individuality, vision, initiative and self expression, as well as artistry" (p. 11). Creativity is seen by some researchers as having an important role to play in learning and development (Carruthers & Worthington, 2006; Craft, 2002). Children in the early years are at their most creative, playful and imaginative (Craft, 2002). She distinguishes between the type of creativity shown by people such as Einstein and Picasso, and "little c creativity", or the "art of possibility thinking". According to Craft (2002), everyone is capable of this type of thinking and it is not only necessary but also vital to encourage creativity thinking.

The idea of a classroom where children are able to express themselves through visual arts or mark making is promoted by Craft (2002, 2005). Riley (2003) confirms that for creativity to result, there has to be an interaction between people, their ideas and their social-cultural contexts. Research suggests (Worthington, 2005, Worthington, 2008; Brooks, 2009; Anning, 2003 and Craft, 2002; Craft, 2005) that creativity through the use of visual representation or mark making should be used cross-curricularly. This has particular implications for the teaching and learning of space and shape.

A creative classroom should ideally provide opportunities for children to ask questions, generate their own ideas, draw conclusions, collaborate and co-construct (Craft, 2005). Many of these principles have been discussed with regard to pedagogy. Craft (2005) mentions the following teaching strategies for a creative classroom: developing children's motivation to be creative; fostering in-depth studies on topics of interest; stimulating and encouraging language; setting clear routines which also involves children in ideas and structures; letting children go beyond the minimum requirements; allowing children to find relevance in activities; using alternative ideas in teaching and learning; encouraging alternative ways of being and doing; giving children time to incubate ideas; and allowing children to adopt different perspectives.

Moreover, teaching for creativity should be focused on the learner: innovative contributions are valued, questions are encouraged and problems are identified, and opportunities are provided for debating and discussing. Children co-participate in an inclusive, creative learning environment (Craft, 2005). All of the strategies mentioned, bring together conceptual knowledge (or "knowing that") and procedural knowledge (the "how" of learning) (ibid.).

The following section aims to explain how an emergent curriculum provides an appropriate creative teaching and learning environment for a pedagogy of space and shape in Grade R.

3.7.4 Emergent Curriculum

As previously mentioned, the notion of an emergent curriculum is supported by the cognitive learning theories of Piaget, Vygotsky, Bruner and Fleer. Some more recent approaches to early childhood education have incorporated the emergent curriculum approach e.g. Te Whariki (Carr, 2001), Reggio Emilio (Edwards, 2009, and High/Scope (Hyson, 2008; Hohmann & Weikart, 2002). All these approaches have in common the recognition of children's prior learning experiences, the valuing of their cultures and the consideration of their interests when planning the curriculum.

Bruner spoke about "their excellencies", referring to children's own knowledge and understanding (Carruthers & Worthington, 2006, p. 24). Both Piaget and Vygotsky emphasized the importance of taking children's previous learning and interests into account when preparing learning activities. Fleer (2010) also reminds us of the fact that children's learning experiences have to be based within their cultures and previous experiences in order for to them to be meaningful.

Stacey (2009) notes that the following behaviours are visible when a successful emergent curriculum is being practiced:

> ***Children's work is valued:*** It is displayed and accessible to all. Commentaries accompany the work.
>
> ***Children's engagement:*** Busy children are actively involved in learning, talking and discussing. The classroom is "noisy and messy in a purposeful way".
>
> ***The teacher:*** The role of the teacher is one of co-construction, scaffolding learning, discovering and chatting with the children. The teacher makes observations, assists group work and is involved in problem solving activities with the children.

The work: The work on display and incomplete projects reveal the investigations under way in the classroom (p. 12).

> The disposition of the teacher has an enormous influence on what happens in the classroom. Emergent curriculum requires the disposition of genuine curiosity about children and their play. A teacher who is curious, who wonders why children are doing a particular thing in a particular way, will be genuinely interested in finding a meaningful response (Stacey, 2009, p. 16).

Emergent curriculum is a process, but does not necessarily follow a linear path. It may be circular, and constantly evolves and grows (Stacey, 2009, p. 13). In the context of learning about space and shape, an emergent curriculum needs to bring together the ideas of schemas, creativity and visual art. The steps towards an emergent curriculum will be described below.

- ## Observation

Stacey (2009) considers observation as the starting point for an emergent curriculum. In fact Bruner noted that "a chasm exists between research findings and classroom observations" (Athey, 2007, p. 28). Through anecdotal note-taking, writing narratives, collecting or photocopying children's art, and taking photographs, videos or audio-recordings, teachers observe children's behaviour – in their play, interactions with others and their mark making or representations of schemas. Children bring their prior knowledge and experiences to the learning activities, whilst teachers observe from a position of interest and curiosity, bringing their prior knowledge and intuition to the situation (Stacey, 2009, p. 15).

- ## Making meaning and making decisions

Teachers may collaborate, talking about what they have noted. Team meetings involve dialogue and reflection. Supportive relationships amongst the staff are required for this type of collaboration to take place (ibid). Approaches such as High/Scope suggest close collaboration between teachers (Hohmann & Weikart, 2002). Changes to the daily routine may result from these discussions, if it is felt that enough time is not being given to a particular aspect of the school programme.

In relation to learning and teaching about space and shape, in an emergent curriculum environment, children's mark making would be examined and discussed, to see what schemas they are interested in. Carruthers & Worthington (2006) describe how children in the community of a classroom often become interested in the same or similar schemas. Because of the recent adoption of Grade R classes into primary schools, many Grade R teachers have to plan alone and thus cannot collaborate and discuss with other teachers using an emergent curriculum approach. It would be important therefore, for them to collaborate with other Grade R teachers in their communities as well as parents of the children they are teaching.

- **Planning the next steps**

Decisions need to be made regarding how to support children's ideas and interests. Teachers need to collaborate with children so their interests and schema can be extended. Additional equipment and materials may need to be introduced, outings may need to be planned or experts invited in order to enhance learning (ibid). In particular, visual arts activities should be planned to extend the schemas that children are representing.

- **Letting go**

The teacher takes on the role of researcher and observes their behaviour and further development of schemas. She reflects. She asks questions, responds to children's interests and continues to extend their learning (ibid). Stacey (2009) suggests that one of the advantages of an emergent curriculum is that it requires teachers to "become researchers in their own environment" (p. 7). This reflects what Piaget (1965) had to say:

> … child psychology can only be learned by working on research projects and by participating in experiments […] Only thus can teachers become researchers and can rise above the state of merely being transmitters of knowledge. The same is true for experimental pedagogy itself, the actual discipline par excellence of teachers. (pp. 130, in Kohler, 2008, p. 152)

The cycle of action research is therefore vitally important for informing teaching practice and would be a valuable skill to be developed in teachers.

Recently the South African Department of Education produced lesson plans for teachers (http://ecdfoundationphase.250free.com), and although it is made clear that these are only suggestions, many teachers use them without questioning their relevance for their particular contexts. This is a characteristic of what Craft (2002) calls a "technicist view of pedagogy" (p. 125). Many teachers feel that "successful teaching is technical and prescribed by policy makers" (ibid.) and that if "teachers do as they are told, they will produce 'better' learners" (ibid.). The participant teachers clearly regarded the departmental lesson plans as more important than the ideas they had learnt during the MStAC curriculum intervention.

Teachers would therefore need to not only understand the value of an emergent curriculum, but also have the necessary skills and confidence for incorporating it within their contexts. The research intervention would therefore incorporate a professional teacher development agenda, to make this possible.

3.8. Conclusion

Chapter Three has presented the theoretical framework of the research, which is focused on teacher professional development. It has as its goal investigating how Grade R children can be taught about space and shape through visual arts. It has reviewed literature on teacher professional development, learning, space and shape, creativity, schemas, visual representation, and emergent curriculum pertinent to the research intervention. Although these notions are discussed in discrete sections, they constantly interlink.

The first section examined models of professional development. Then, constructivist theories of learning were explored, and theories of how children learn about space and shape were introduced. Pedagogy was discussed, as the art of teaching, because the teaching of space and shape through visual arts requires teachers to have a particular view of the mind, of learning, of learners, and of the notion of knowledge (Moon & Leach, 2008). Emergent curriculum in the framework of a creative classroom has been explored in this chapter. The following chapter will explain how the theories discussed in this chapter are implemented through the methodology of the research.

CHAPTER FOUR
Research Design and Methods

"We cannot understand this case without knowing about other cases." (Stake, 1994, p. 237)

4.1. Introduction

As described in Chapter Two, the impetus for this research came from the findings of the evaluation of the MStAC curriculum intervention. My assumptions had been that the curriculum intervention would achieve the intended learning outcomes set by the programme developers, but this was not the case. The evaluation of the intervention programme thus provided the impetus for this study and for locating it within a teacher education programme.

This chapter describes and justifies the research orientation and case study method adopted in this research. The research design is explained, with the rationale behind Phases I, II and III. The management of the data is described, with a summary of the research process in tabular form. Chapters Five, Six and Seven will then seek to analyse and discuss the data and findings from Phases I, II and III of the research process.

4.2. The Research Orientation

In order to achieve my research goal, namely to investigate how visual arts can be used to teach the mathematical concepts of space and shape in Grade R, it became necessary to examine more closely the teaching practices of my participants. I wanted to gain an understanding of why and how the participating BEd teachers were teaching in their particular ways, as well as design a programme which would strengthen their pedagogies. In addition to this, I wanted to investigate, with a view to understanding, whether and if so, to what extent, a curriculum intervention could support and enhance the teaching of space and shape in Grade R. My goal was to understand and enhance practice. Qualitative research is concerned with different understandings people bring to their experiences and the ways that they choose to respond to them (Newby, 2010, p. 115), and for this reason I realised that a qualitative approach would be the most appropriate.

Qualitative methods involve collecting various types of data and combining them to form rich descriptions of people's experiences and perceptions. Merriam (1998) notes that qualitative research takes place in the participants' natural settings, so that the data obtained is as realistic as possible (p. 7). During the evaluation process which formed the background to the research project (see Chapter Two) I had observed the teachers in their classrooms and collected various forms of data (questionnaires, field notes and photographs). I had not probed deeply enough into the teachers' perceptions though, and I felt that this was needed in my research, in order to work effectively with their pedagogies.

A qualitative researcher should be aware that each participant brings different life experiences and understandings to the research situation (Newby, 2010). Merriam (1998) iterates this when he speaks about "multiple realities" (p. 4). Besides the different realities which are brought to the process by the participants, the researcher's ideas are also highly significant. Cresswell (2007, p. 15) notes that qualitative research begins with assumptions that the researcher brings to the research process. My assumption at the outset of this research, was that Grade R teachers, through a particular research intervention, could learn how to build a curriculum around their children's interests and could thus be able to teach the concepts of space and shape through visual arts experiences.

Cresswell (2007, p. 15) and Guba and Lincoln (1994, p. 108) speak about the ontological, epistemological, axiological, rhetorical and methodological assumptions made during the research. These are philosophical views about the nature of knowledge, the nature of reality, the role of values, the language of the research and the process of the research respectively. Depending on the type of research and worldview of the researcher, these views differ. They will be briefly explored here, before my own worldview is described. Positivism believes that there is only one truth. Research findings are therefore objective and true. The research methodology is mostly quantitative, and hypotheses are tested and proved. Postpositivism is also usually quantitative, but research is often done in natural settings. It recognises that people have differing perspectives. Critical theory believes that reality is shaped by social, political, cultural, economic, ethnic and gender values. Findings are value-laden, with the methodology heavily concerned with the dialogic relationship between the researcher and the researched (Cresswell, 2007; Guba and Lincoln, 1994).

The awareness that everyone brings their own experiences to their constructions of meaning influenced my research methodology. I recognised that the experiences and realities of my research participants would be significant to this research. I was therefore interested in understanding and reconstructing the participants' notions of teaching and of knowledge (Guba and Lincoln, 1994, p. 113). My research would be mainly narrative in nature, thus a constructivist approach was deemed appropriate (Cresswell, 2007; Guba and Lincoln, 1994). Constructivism is concerned with the different constructions of reality that individuals and groups have, and the dialogic relationship between the participants and researcher is significant. Having observed the teachers in their own classrooms during the evaluation of the MStAC curriculum intervention (see Chapter Two), enabled me to better understand the contexts they later wrote about in their assignments.

Because I intended examining the BEd teachers' practices, my research needed to take on an *interpretive* orientation. Merriam (1998) explains that interpretive research is concerned with meanings that individuals bring to experiences and theories that can be generated through the research process (p. 4). The evaluation that I had carried out (described in Chapter Two) had made me realise that a different form of curriculum intervention was required, in order to transform the teachers' practice. The teachers would need to become reflective practitioners and classroom-based action researchers (Hopkins, 1994), given my intention to improve and transform their practice. This is a characteristic of critical research. My research thus took on a *critical* orientation too. This research intervention, while primarily interpretive (in seeking to promote change), also had elements characteristic of the critical paradigm.

4.3. The Research Participants

I have known the participants for at least four years: firstly, during their two years of part-time study towards the National Diploma in Early Childhood Development (ND:ECD); and secondly during the two years that they have been enrolled for the BEd (in-service) FP degree programme. Some of the participants had also completed a previous qualification at the CSD, the Level 4 National Certificate in Early Childhood Development (NC:ECD), which also requires two years of part-time study.

The Level 4 and 5 learning programmes offered by the CSD have received programme approval from the Education, Training and Development Practices Sector Education and Training Authority (ETDP SETA), while the Level 6 BEd FP is accredited by Rhodes University as a Higher Education Institution. The BEd in-service FP is a pilot programme presently offered only by Rhodes University and the CSD, attempting to provide a career path for ECD practitioners who wish to further their qualifications through part-time study. For the teachers who had started with the Level 4 qualification, achieving the BEd FP degree would take seven years. They were thus a highly committed group. The BEd FP course is three years long, and consists of 25 days of contact session days during the year.

My relationship with the twelve participants had therefore grown and developed over several years. As the BEd course co-ordinator, they regarded me as their lecturer and expert in the field of ECD. They were also aware that I had been teaching until four years previously, and they often asked me for practical advice for their classroom practice. The participants ranged in age from 23 to 50 and most had been teaching for at least seven years. They were aware that I was conducting a Masters' research study and seemed to feel solidarity with me, knowing that I was also studying part-time. From this one may infer a high degree of collegiality. All twelve of the Grade R teachers attended the MStAC curriculum intervention and participated in my research.

4.4. The Research Design

The heart of this research intervention centred around a teacher development programme consisting of three contact sessions of one to two days each. Data was generated during the three contact sessions through focus group discussions, individual activities and carefully designed assignment tasks which the teachers completed at home. Each contact session generated rich data in the form of written and visual documents (assignments, photographs and audio-visual recordings). I wanted the rich narrative data to reflect the authentic voices of the participants, thus I did not correct grammar or spelling in the data. The contact sessions took place over three months. Five full days in total were dedicated to the research intervention, with each contact session having a specific research focus.

Table 4.1: The research intervention

SESSION	DATE	RESEARCH INTERVENTION PHASES	RESEARCH FOCUS
BEd contact session 1	30 – 31 January 2010	**Research Intervention Phase I: Awareness and Knowledge Building around Creativity** Creativity Observing children Collecting evidence in the form of art	Children's learning
BEd contact session 2	27 February 2010	**Research Intervention Phase II: Meaning making, decision making and reflecting** Emergent curriculum	Curriculum design
BEd contact session 3	31 March – 1 April 2010	**Research Intervention Phase III: Teaching Space and Shape** Teaching Space and Shape	Pedagogy Space and Shape

A more detailed discussion of the three contact sessions and an analysis of the data they generated can be found in Chapters Five, Six and Seven.

4.5. The Rationale for the Research Process

Craft (2002) speaks about a "technicist view of pedagogy" undermining the "artistry of teaching" (p. 125). She further recommends that early years educators should promote "highest levels of thinking, originality, innovation, resourcefulness, individuality, vision, initiative and self-expression as well as artistry" (p. vii). As Chapter Two revealed, most of the classrooms I observed as part of the evaluation of the MStAC curriculum intervention allowed few opportunities for children to construct their own meanings, show initiative or be resourceful. Craft (2002) confers by saying that regrettably many teachers believe that "successful teaching is technical" and that "if teachers do as they are told, they will produce "better" learners (p. 125).

I realised that the teachers themselves would benefit from guidance with regard to space and shape, the focus of this research. My view is that insight into how children learn, and specifically how Grade R children learn about space and shape are prerequisite for effective teaching. Furthermore, the teachers would need to develop competencies to enable them to develop and

implement relevant pedagogical strategies for teaching Grade R children about space and shape through visual arts activities.

Based on the critical review of the MStAC curriculum intervention described in Chapter Two, and the theoretical framework described in Chapter Three, I designed a number of learning activities which were intended to develop the participant teachers in the "artistry of teaching" so that they could promote "highest levels of thinking" amongst their learners. Moon and Leach (2008) explain that pedagogy is informed by views of the mind, of the learners, of learning and of knowledge and outcomes that are valued. By taking into account their learners' prior experiences and interests, the teachers would be capacitated to develop a pedagogy or "art of teaching". Figure 4.1, adapted from a diagram describing the emergent curriculum process (Stacey, 2009, p. 15) shows the steps towards an emergent curriculum promoting the "highest levels of thinking" in a creative classroom. Whilst the teachers were involved in learning how to design appropriate curricula for the children in their classes, they were also engaged in classroom-based action research processes as described in Chapter Three, Section 3.3. Action research is described by (1994) as involving the steps "Plan – Act – Observe – Review". The process of emergent curriculum is very similar to that of an action research (see Figure 4.1), so I wanted the teachers to become action researchers whilst engaged in learning about the emergent curriculum. The recursive spiral shown in Figure 4.1 demonstrates the process of constantly observing, making meaning, making decisions and reflecting which should be evident in teaching environments where children are encouraged to make meaning. It is shown as spiralling in nature, with each stage dependent on the previous one. Figure 4.1 shows the co-engagement

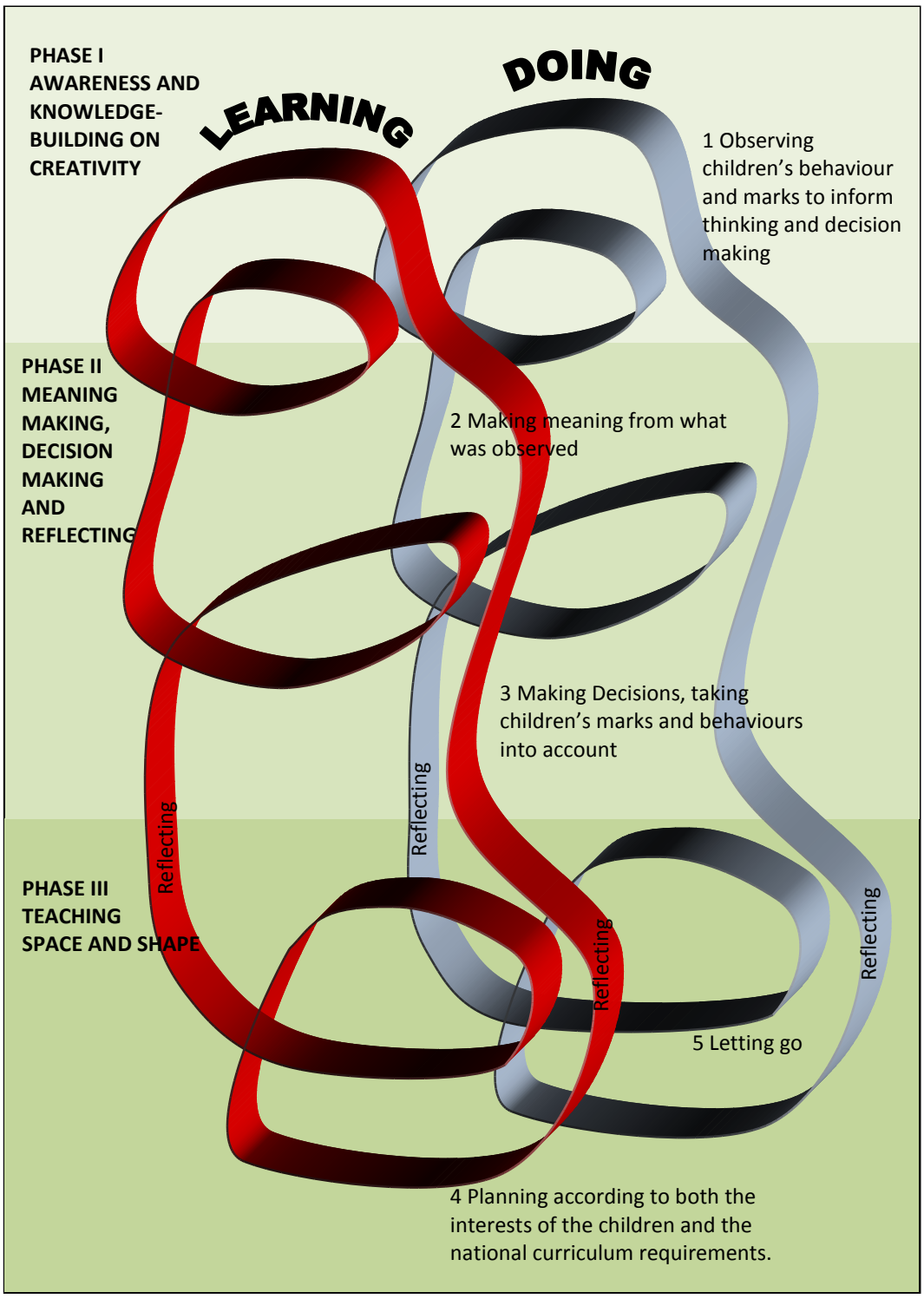

Figure 4.1: Steps towards a creative pedagogy (adapted from Stacey (2009, p. 15)

between the action research of the teachers and the activities they were involved in during the contact sessions.

The red ribbon – "learning" – denotes the teacher professional development that I undertook, and the blue ribbon – "doing" – represents the activities the teachers were engaged in during the action research process. The intersecting loops signify the recursive nature of the teachers' activities and learning, and what was learnt through the contact sessions and assignments. I wanted the teachers to learn about the processes of an emergent curriculum – observing, making meaning, and making decisions, reflecting and planning teaching activities because I believed that these skills would enable them to become critically reflective teachers – a prerequisite for effective teaching and professional development.

Dewey suggests that teachers who do not reflect on their teaching often lose sight of their goals and act as agents of others instead of using reflective practice to develop appropriate curricula. They also forget that problems can be framed and solved in many different ways (Zeichner & Liston, 1996). Each phase therefore consisted of teaching and learning activities, and assignments which the teachers had to complete before the following contact session.

4.6. The Case Study Method

This research focused on a single case which would inform an understanding of why, in spite of a curriculum intervention, the goals were to enable teachers to plan the integration of mathematics and science into arts and culture (CDP, 2009), this did not occur. A case study "is an intensive, holistic description and analysis of a single instance, phenomenon, or social unit" (Merriam, 1998, p. 21). As an "in depth understanding of a situation" (Merriam, 1998, p. 19), the case study's research interest is in process, content and discovery. As a "bounded system" a case study is an "intensive, holistic description of a phenomenon" (Merriam, 1998, p. 27).

A group of Grade R teachers would best be able to inform my study, and as I had built a relationship with the group of BEd teachers (as described in Section 4.3), I selected them and their unique practices as my case. Only the twelve Grade R teachers in the class of 18 teachers teaching Grade R to Grade 3 were used for this research study. Cresswell (2007, p. 125) describes this as "purposeful sampling" because the teachers for my research were selected for the specific purpose expressed in Section 4.4.

Case study research is characterised by particular traits and constraints. These will be described in the following section.

4.7. Issues Pertaining to Case Study Research

I realised that I would need to be cognizant of certain issues when designing my own case study research project. As Newby (2010) suggests, I was aware that by choosing to conduct case study research I wanted to understand a critical issue more deeply, as well as identify what, if any lessons could be learnt that may be useful in other contexts.

Many authors (Cohen et al., 2000) have written about issues which pertain to case studies, some of which are relevant to my own study. During the initial evaluation of the MStAC curriculum intervention which provided the impetus for this research, I had already encountered an unexpected turn of events when the classroom practices that I had expected to find, simply did not exist. My case study was thus forced to "embrace unanticipated events and uncontrolled variables" (ibid.). A critical stance then entered into the research process because my research sought not just to understand, but also to enhance and transform teacher practices.

In conducting my case study research I realised that I would need to be aware of the strengths as well as the weaknesses of case study research. I would have to constantly reflect on my own biases and attitudes whilst conducting this research. A bias which could influence my own perceptions was perhaps my preconceived idea of a western model of a preschool classroom or a particular pedagogical approach.

I would need to be aware of the warnings of certain authors, such as Cohen et al. (2000, p. 184) who caution that case study data can be difficult to analyse and organise. Because a case study is a unique sample of a particular case, the same methods and results may not be able to be applied elsewhere. But the uniqueness of a case study is also a strength, because it can reflect complex social realities and can contribute to knowledge in a particular field. I hoped that my case study research would increase my own competence in teaching student teachers, and also my knowledge of teacher education. I wanted it to be accessible to others involved in similar fields of work and I hoped that insights could be provided that would be valuable in making sense of similar

situations. The trustworthiness of the results would play a role in determining whether my findings were transferable to other similar contexts.

The following section therefore examines issues relating trustworthiness.

4.8. Trustworthiness

"Ensuring validity and reliability in qualitative research involves conducting the investigation in an ethical manner." (Merriam,1998, p. 198) Trustworthiness is dependent on the validity and reliability of the research, and Merriam (ibid.) warns that especially in educational research which is concerned with people's lives, these issues are vital. The conceptualisation and design of the research project therefore needs to take validity, reliability and ethics into account. Qualitative research is characterised by the researcher taking a critical stance in order to ensure that the research is accurate and objective (Merriam, 1998, p. 201) and certain measures can be put in place to ensure validity, reliability and trustworthiness.

With regard to my own research, this involved asking myself whether the findings were really reflecting reality (ibid). I had to be aware that my own interpretation of the data could affect the validity and therefore the reliability of the research project. I chose my research participants because I felt they were representative of Grade R teachers in the Eastern Cape, and were likely to reflect the issues pertaining to other Grade R teachers in the Eastern Cape, albeit that these teachers had almost achieved their BEd degrees at NQF Level 6 and most other Grade R teachers have Level 4 and 5 qualifications. In this way I hoped that my research would resonate with other teachers in similar situations and environments. Merriam (1998) suggests that when the object of the research is familiar to the researcher, as was the case in my research, internal validity is stronger (p.202). The perspectives of the participants need to be understood in order to "present a holistic interpretation" (p. 203). However, to ensure internal validity I would have to engage in processes like triangulation (using multiple methods to cross check findings); member checking (asking participants if interpretations of their meanings are accurate); and I would need to clarify my own biases, assumptions and world views (Merriam, 1998, pp. 204-5).

For the research to be valid for other situations (externally valid) it is important that the internal measures of validity are in place. I would need to use "[r]ich, thick description" (Merriam, 1998, p.213) to show how closely my case resembles others, so that generalisations can be made. Besides this, the typicality of the participants would need to be described. By using purposeful sampling when choosing participants from a wide range of contexts, my research would be able to be applied to a range of other situations.

Reliability in qualitative research is concerned with whether the results are consistent and dependable with the data collected (Merriam, 1998, p. 206). By describing my own assumptions and the background to this study, I wanted to enhance reliability. By using different methods such as interviews, questionnaires, field notes, classroom observations and document analysis during the initial background investigation and during the actual research process, I hoped to strengthen reliability.

My relationship with the participants was highly significant pertaining to the ethics of this research. On one hand familiarity lends validity and reliability, but on the other hand, it is open to abuse. The relationship between the researcher and participants can also affect the dissemination of the research and what is revealed to the participants about the research (Merriam, 1998, p. 213). The teachers I was working with were aware of my research study and of their participation in it. Document analysis may prove less problematic than interviews and observations because it does not necessarily affect people's behaviour. In the case of my research where the teachers' assignments were the documents analysed, I realised that I would need to be sensitive to the participants' privacy.

Merriam (1998) notes:

> The best a researcher can do is to be conscious of the ethical issues that pervade the research process and to examine his or her own philosophical orientation vis-a-vis these issues. (p. 219)

This implies an honesty and accountability in the conducting of a research project, and through a process of reflection and reflexion, being constantly aware of influencing factors; not so that they can be denied or concealed, but in order to enrich and inform the research process more deeply. By ensuring trustworthiness, the results of my research would be affirmed and made more credible.

4.9. Data Generation

Data was generated at each of the three BEd contact sessions (the three phases of the research intervention), where the participant BEd teachers took part in activities during the contact sessions and completed tasks and assignments. All these data generating tasks were designed to produce rich data in the form of reflective reports, completed task sheets, audio-visual recordings and photographs. Phase I, Phase II and Phase III followed the suggested steps in an emergent curriculum process (see Figure 4.9). Based on the research question itself – investigating how children can be taught about space and shape through visual representations – the three phases explored the following notions respectively: awareness and knowledge-building around creativity; meaning making, decision making and planning; and space and shape (see Table 4.1). Table 4.3 in Section 4.12, is more detailed, showing all the activities and tasks related to each phase.
Through the contact sessions and the assignment tasks structured around them, I hoped that the participant teachers would gain a deeper understanding of:

- creativity and how to enhance and extend it;
- emergent curriculum and how to put it into practice;
- making meaning of children's representations;
- how Grade R children learn about space and shape; and
- how space and shape can be taught within a creative pedagogy.

The next section examines the management of the data generated during the research process.

4.10. Data Management

"A good storage and retrieval system is critical for keeping track of what data is available ..." (Huberman & Miles, 1994, p. 428). The data generated for this research consisted of the following:

- Teaching material for the contact sessions;
- Responses from tasks during the contact sessions;
- Resource packs, handed out at the contact sessions, to serve as enrichment and reference material for the teachers;
- Task sheets completed during the contact sessions;
- Assignment tasks;

- Assignments in the form of essays, reflective journal reports, photographs and collections of visual art; and
- Audio-visual recordings of the teachers.

These were divided into Materials Files [MF] consisting of materials designed to generate the data during contact sessions; and Data Files [DF] of the actual data which was generated. I catalogued the data and stored it in separate envelopes in two cardboard boxes named “Materials Files” and “Data Files”. The data which formed the backdrop to this study and which informed the evaluation report, I called Materials Files [MF 1] to [MF 7], because these materials were used to generate data during the research process. They form the shaded area in Table 4.2. The Materials Files [MF 8] to [MF 19] were used during the contact sessions and which generated data in the form of assignments and task sheets. The Materials Files and Data Files are catalogued in Table 4.2.

Table 4.2: Data Management

CATALOGUE OF DATA AND MATERIALS	
Description of data	Catalogue No.
MATERIALS FILES	
Pre-workshop questionnaires and transcriptions	MF1
Post-workshop questionnaires and transcriptions	MF2
Audio-recordings of interviews with the Director of the CDP and the workshop presenter, and transcriptions	MF3
Field notes taken during the three-day "Maths and Science through Arts and Culture" workshop	MF4
Letters to principals asking for permission to observe teachers	MF5
Observations and evaluations of classroom activities	MF6
Evaluation Report	MF7
DVD "Schools kill creativity" by Sir Ken Robinson	MF8
"Creativity" Powerpoint presentation handout	MF9
Readings (Resource pack 1)	MF10
Assignments 1.1, 1.2, 1.3, 1.4 and 1.5	MF11
Powerpoint presentation: Visual Representations, schemas and emergent curriculum	MF12
Videos on scaffolding	MF13
Readings (PSRN manual)	MF14
Assignments 2.1, 2.2 and 2.3	MF15
Powerpoint presentation: Space and shape	MF 16
Group activity describing and translating shape names	MF 17
Readings on Space and shape	MF 18
Assignment task 3	MF 19
DATA FILES	
Responses to "Schools kill creativity"	DF 1
Assignments 1.1 to 1.5	DF 2
Sorting and classification of schema	DF 3
Completion of task sheets	DF 4
Assignments 2.1, 2.2 and 2.3	DF 5
Space and shape activities	DF 6
Assignments 3.1 and 3.2	DF 7

4.11. Data Analysis

The process of data analysis should be an ongoing one, central to the research process (Bryman and Burgess, 1994; Merriam, 1998). Each phase of my research design was dependent upon findings from the previous phases, thus it was vital that analysis took place after each task in which the teachers were involved.

Hopkins (1994) explains that there is no one correct procedure for analysing data in qualitative research. Qualitative research is by its nature, emergent (Merriam, 1998, p. 55). I did not know how the teachers would respond to the tasks, but I expected that their reflective reports and narratives would result in rich, thick descriptions. I wanted to capture some of my participants' notions and thoughts. An inexperienced researcher like me would need to learn how to extract emerging patterns and to make meanings of the data in the context of my research topic. Lincoln and Guba (1985) describe in Merriam (1998) that in order for data to be relevant, it should be heuristic (i.e. it should demonstrate a tenet relevant to the study), and it should be able to be interpreted in the context of the study.

The process of data analysis would involve immersing myself in the data by reading and re-reading the assignments that the teachers had produced; and looking for patterns and themes whilst being sensitive to inconsistencies. Merriam (1998) suggests that the categories or themes for analysis should come either from the investigator, the participants, or outside sources like the literature (pp. 182-3). He warns that the danger with pre-selected themes is one of selecting data to fit in with the themes. I would have to guard against this, as the themes around which I designed the three phases were pre-selected. My research study was informed by literature, but also based on my experiences of observing teachers in practice. The three phases were structured around an emergent curriculum as a framework for teaching space and shape using visual arts, with the teachers developing knowledge about observing, making meaning and teaching space and shape. The data was therefore analysed according to these themes, but sub-categories emerged as analysis was taking place. The sub-categories gave greater insight into how, why and what was taking place with regard to the research question.

Data analysis began with my first reading of the teachers' assignments. I made notes as I read and put markers next to significant comments in the narrative reports. As I analysed the narrative texts, photographs, collections of visual representations and audio-visual-recordings, I grouped them into sub-categories and referred to relevant literature to help explain the findings. Later, threads were drawn together in a synthesis of the study. Conclusions were drawn and recommendations were made.

4.12. The Research Process

Table 4.3 summarises the entire research process, illustrating how the initial evaluation of teachers' practices after the MStAC curriculum intervention (the shaded area) led to the MEd research. Table 4.3 also shows how I used materials to generate data, and the data provided by the teachers prior to the MEd research project became materials on which to base further data generation activities. *Teaching* activities designed by me as the researcher resulted in the *learning* activities which were generated by the teachers. The learning activities in turn generated rich data which I analysed. At each phase, the teaching activities I designed were dependent upon the previous phase's learning activities.

Table 4.3: Tabulated Summary of the Research Process

		TEACHING ACTIVITIES	REF	LEARNING ACTIVITIES	REF
MATHS AND SCIENCE THROUGH ARTS AND CULTURE CURRICULUM INTERVENTION	APRIL 2009	Interviews: Workshop facilitator Director of CDP (audio-recordings and transcriptions)	MF3	Pre-workshop questionnaires	MF1
				Post-workshop questionnaires	MF2
		Participation in 3 day Workshop: "Maths and Science Programmes through Arts and Culture"	MF4	Participation in 3 day Workshop: "Maths and Science Programmes through Arts and Culture"	
	MAY – SEP 2009	Letters to principals	MF5	Teaching practice	
		Observations and evaluations of classroom activities	MF 6		
		Implementation of the programme. Evaluation Report	MF7		
MASTERS RESEARCH STUDY					
RESEARCH INTERVENTION	JAN – FEB 2010 PHASE I: AWARENESS AND KNOWLEDGE BUILDING ON CREATIVITY	**Facilitation of contact session 1 (2 days)**		**Participation in contact session 1:**	
		DVD "Schools kill creativity"	MF8	Responses to DVD "Schools kill creativity"	DF1
		Creativity presentation	MF9	Assignments – 1.1 Observations 1.2 Collections 1.3 Report on rich environment 1.4 Description on scaffolding learning 1.5 Reflective report on observing	DF2
		Readings (Resource pack 1)	MF10		
		Assignments for the session	MF11		
	FEBRUARY 2010 PHASE II:MAKING MEANING, MAKING DECISIONS AND REFLECTING	**Facilitation of contact session 2 (1 day):**		**Participation in contact session 2:**	
		Powerpoint presentation: Visual	MF12	Sorting and classifying schemas (photographs)	DF 3
		Videos on scaffolding	MF13	Completion of task sheets	DF 4
		Readings (PSRN manual)	MF14	Assignments: 2.1 Reflections on meaning making 2.2 Implementation of activities 2.3 Presentation on meaning making and implementation of activities	DF5
		Assignments for the session	MF15		
	APRIL – MAY 2010 PHASE III: SPACE AND SHAPE	**Facilitation of contact session 3 (2 days):**		**Participation in contact session 3:**	
		Powerpoint presentation: Space and Shape	MF16	Group activity translating and describing shape names	DF6
		Readings (Space and Shape)	MF17	Space and shape activities	DF 7
		Assignment for the session	MF18	Assignment 3: Planning, implementing and reflecting on a space and shape lesson	DF8

4.13. Conclusion

Chapter Four has described my research orientation and shown how different paradigms affect one's philosophical assumptions. As qualitative research, my constructivist worldview meant that I was interested in understanding my participants' behaviour and the experiences that influenced

their behaviour. I have also attempted to clarify how and my research focus shifted from being purely interpretive to becoming critical in nature when I realised that I would need to engage with the teachers' practices. Teacher professional development essentially formed an additional layer to my research study. The research participants were described and case study research was elucidated. It was reasoned that this is an appropriate method for my own research. I examined some of the issues which affect case study research, and looked at the strengths and weaknesses of this type of research. An overview of the research process was then given, both in diagrammatic and in tabular form. Data management was described. In relation to the trustworthiness of my research, issues of validity, reliability and ethics were considered.

In the following three chapters, the three Phases that constitute the study are described, the data is analysed and the findings are discussed. After the narrative analysis provided in these sections, a meta-analysis explores the phases as a whole more deeply. Chapter Five contains the analysis and discussion of the findings of Phase I of the study.

CHAPTER FIVE
Analysis and Discussion of the Findings: Phase I

"… creativity is a cognitive or *mental trait* and a *personality trait* as well." (Wright, 2010, p. 3)

5.1. Introduction

Having described and justified the research methodology and given a broad overview of the research process in the previous chapter, Chapter Five now examines Phase I of the research. Here I will describe the rationale behind the teaching and learning activities for contact session 1, and the tasks and assignments which the teachers completed for the following contact session. The teachers' responses generated data which I discuss and analyse later in this chapter. The chapter ends with a summary of what emerged in Phase I.

5.2. The Rationale and Aims for Phase I

The findings of research suggest that "pre-school children do best when they are engaged in activities that make them think deeply" (Worthington, 2009). Carruthers & Worthington (2006) explain how children's representations mediate higher mental processes. Bruner called children's own knowledge and understandings "their excellencies" (Carruthers & Worthington, 2006, p. 21). From my own teaching experiences and the research and readings I had done, I knew that it was important to encourage children's own expressions of meaning.

My classroom observations (described in Chapter Two) revealed that most of the teachers who participated in the Maths and Science through Arts and Culture curriculum intervention were not recognising or paying attention to the children's constructions of meaning. Visual art activities displayed in the teachers' classrooms I visited, and the activities in which I saw the children engaged, showed little evidence of children "making marks to make meaning" (Carruthers & Worthington, 2006).

Craft contends that teachers often have the belief that "successful teaching is technical and prescribed by policy matters" (2002, p. 125). The teachers that I observed were intent on following lessons that were produced by the Eastern Cape Department of Education (Eastern Cape

Department of Education, 2009b) rather than building on the knowledge and understanding that children had brought with them to Grade R. It seemed to me that they believed that published lesson plans had more legitimacy than did their own capabilities to mediate and to teach according to the interests of children.

For Phase I, I therefore aimed to develop the teachers' awareness and understanding of

- alternative ways of thinking about children's learning,
- their role as teachers,
- the concept of creativity, and
- how to observe children's behaviour and visual representations.

Phase I formed the first part of the emergent curriculum process (see Figure 4.1 in Chapter Four). This phase was designed around the findings of the evaluation and critical review of the M StAC curriculum intervention discussed in Chapter Three, and each successive phase was based on the results from the previous phases. I hoped that as effective pedagogues, the participant teachers would develop confidence in their ability to design curricula and structure children's learning activities, and the competencies needed to be curriculum designers and the developers of activities that are appropriate for promoting children's learning.

Research shows that creativity forms a vital part of effective pedagogy (Wright, 2010). Craft describes the "little c creativity" (Craft, Burnard and Grainger, 2005; Craft, 2002; Craft, 2005) which should be evident in all classrooms:

> At its most fundamental, it involves the posing, in multiple ways, of the question 'What if?' – and therefore involves the shift from 'what is this and what does it do?' to 'What can I do with this?' ... (2005, p. 2)

"Little c creativity" is seen as being cross-curricular or multi-modal (Wright, 2010; Craft, 2002, 2005). Qualities of creativity include

> ... a valuing of creativity, originality, independence, risk-taking, the ability to redefine problems, energy, curiosity, attraction to complexity, artistry, open-mindedness, a desire to have some time alone, perceptiveness, concentration, humour, the ability to regress and the possession of childlike qualities. (Wright, 2010, p. 3)

According to Craft (2002, 2005) and Craft et al. (2005), practice which fosters creativity produces resilience, resourcefulness, confidence, intelligence, imagination, self-expression, know-how and self-creation, and is important for basic survival. In order to promote these attributes, it was essential for the BEd teachers to gain an understanding of creativity and the necessity for cultivating an environment conducive to creativity climate in their own classrooms.

In line with Stacey's (2009) writings on emergent curriculum and the readings on schemas, creativity and children's constructions of meaning, I wanted the teachers to learn how to closely observe the children they were teaching. Observing children and recording their behaviour is of paramount importance to being aware of their interests and being able to design an emergent curriculum around those interests. Stacey (2009) lists several methods of observation: anecdotal recordings, narratives, digital photography, videotaping and audiotaping (p. 37). During Phase II, these observations would enable the teachers to design appropriate curricula around the children's interests. The assignment tasks [MF 11] for the first session therefore required the teachers to observe the children they were teaching, write observation journals and reflect on the process of observation. They would collect examples of schemas and visual arts representations from the children in their classes. This aimed to increase the teachers' awareness of children's mark making and the meanings expressed in visual representations.

A creative environment begins with the physical arrangement of resources and the climate of the learning space. The teachers would therefore be required to write an essay on the environment "rich in opportunities for learning" (Department for Children, Schools and Families, 2008) they were providing for the children's expressions of meaning through mark making. Scaffolding or mediating children's learning as described by Vygotsky (1962; 1978), entails working closely with children and using their interests to extend learning. Siraj-Blatchford has called this close collaboration "sustained shared thinking" (2009, p. 156). By requiring them to reflect on their experiences, the final assignment task for Phase I aimed to increase the teachers' understandings of scaffolding and mediating learning with children. The teachers were required to reflect on their experiences of observing children in one of the assignments, as reflection is one of the characteristics of emergent curriculum (Stacey, 2009) as well as a vital skill for developing good teaching practice (Zeichner & Liston, 1996).

Hence, Phase I, as the foundation of the emergent curriculum process, would introduce the notion of creativity as a way of structuring activities in the Grade R classrooms. Figure 5.1 highlights Phase 1.

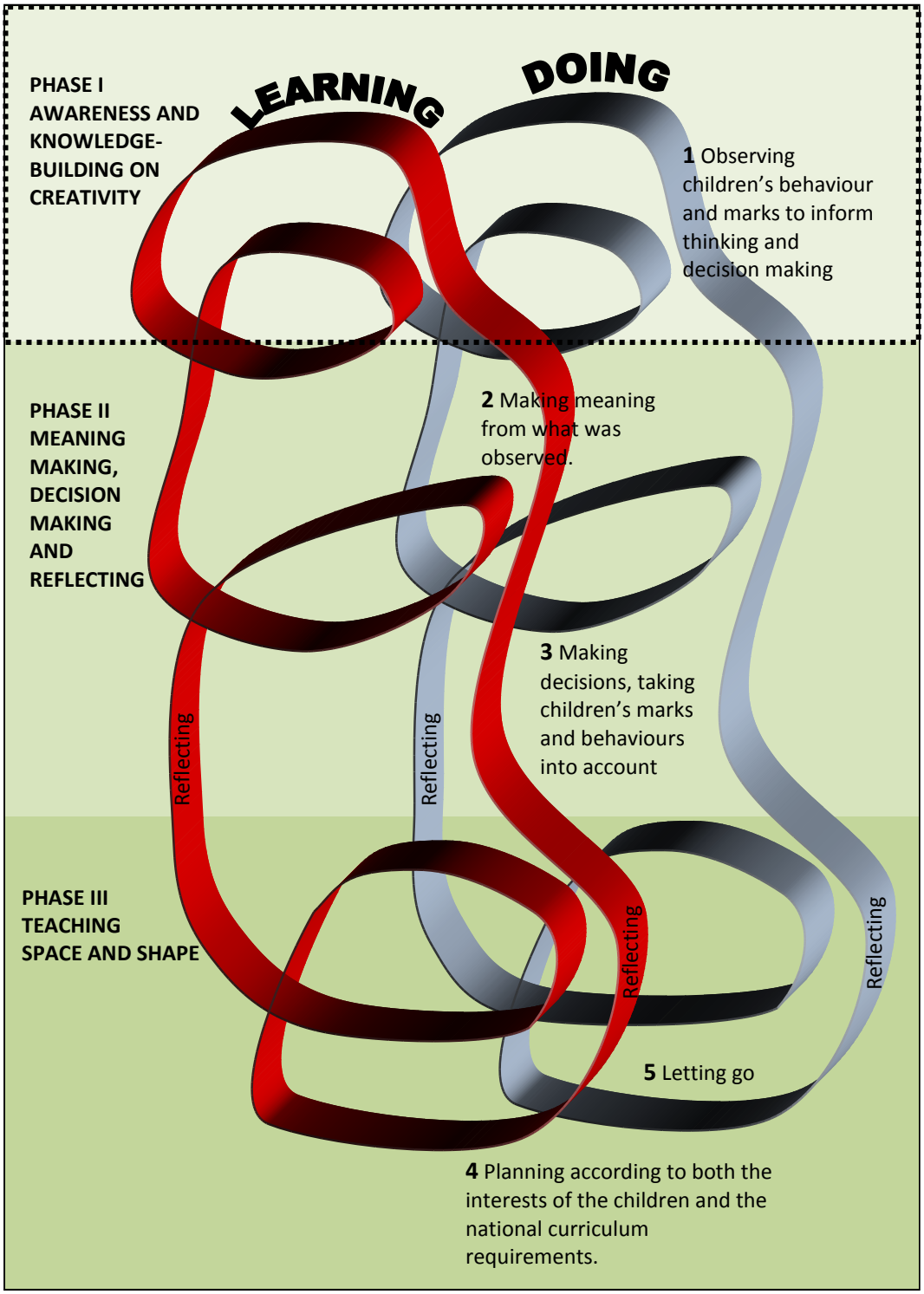

Figure 5.1: Emergent curriculum highlighting Phase I: Awareness and Knowledge building around Creativity

5.3. Phase I: Awareness and Knowledge Building around Creativity

Table 5.1 provides a summary of Phase I. The columns reflect the spiraling ribbons shown in Figure 5.1. The first column "Learning" shows the activities the teachers were involved in during contact session 1, and the second column "Doing" gives an overview of the activities and tasks the

teachers were required to do to put their learning into practice, and to show their learning. "Doing" activities were completed during the contact session and at home. I then used the teachers' responses to design the teaching and learning activities for the subsequent BEd in-service contact sessions 2 and 3.

Table 5.1: Tabulated summary of Phase I

PHASE I: AWARENESS AND KNOWLEDGE BUILDING ON CREATIVITY	
Teaching and Learning Activities during contact session 1 (2 days)	
Learning	**Doing**
DVD "Schools kill creativity"	Responses to DVD "Schools kill creativity"
What is Creativity? Group discussion	
Powerpoint presentation "Creativity"	Assignments (see [MF 11] in Appendix 1): 1.1 Observation journal 1.2 Collections 1.3 Reflective report – "An environment "rich in opportunities for learning." 1.4 Reflective report – Three scaffolding incidents 1.5 Reflective report - Reflections on observing
Resource pack 1: Readings on Creativity (see [MF 10] in Appendix 1): Reading 1: Creativity quotes and poems (Potter, , Picasso, Fuller, Fromm, Nietzche, Piaget) Reading 2: Reflecting on creativity and cognitive challenge: visual representations and mathematics in early childhood – some evidence from research (Worthington, 2009) Reading 3: Mark making matters (DCSF, 2009) Reading 4: Four views of learning (from Carruthers & Worthington, 2006) Reading 5: Research4U - Making your mark (Thompson, 2010) Reading 6: Schemas (from Carruthers & Worthington, 2006; Athey, 2007) Reading 7: Emergent curriculum (from Stacey, 2009)	

The teaching and learning activities for Phase I are presented in Section 5.4 The findings from both the teaching and learning activities and the assignment tasks are then discussed and analysed in Section 5.5. Section 5.6 provides a summary of all the findings from Phase I.

5.4. Phase I: Description of Teaching and Learning Activities

As shown in Table 5.1, the teachers participated in a number of teaching and learning activities. These include a DVD on creativity as well as a creativity Powerpoint presentation and readings.

5.4.1 DVD on Creativity

The notion of creativity was introduced at the first two-day teaching and learning session with the DVD entitled "Schools kill Creativity" (Robinson, 2006) [MF 8]. In the 18 minute recording, Sir Ken Robinson describes how schools can stifle children's creativity by expecting them to conform, and by not recognising the unique talents and potential that each child has. Afterwards the teachers were given time to discuss the DVD in focus groups and to record their comments on coloured response sheets [DF 1] which they hung on the wall. Their responses described in Section 5.5.1 gave me an indication of their understandings of creativity.

5.4.2 Creativity Powerpoint Presentation and Readings

The Readings in Resource Pack I [MF10] (see Appendix 1) were selected to further stimulate the teachers' thinking about creativity. They were read in class, in conjunction with the slides in the Powerpoint presentation.

- The Powerpoint presentation "Creativity" [MF 9] (see Appendix 1) was designed to encourage the teachers to think more deeply about the notion of creativity. In focus groups after viewing the slides they discussed the following notions: *What does creativity look like? What does it sound like? What does it feel like?*
- **Reading 1**: Quotations about creativity - by Erich Fromm, Pablo Picasso, Karl Nietzche, Buckminster Fuller, Beatrix Potter and Jean Piaget were provided in Resource Pack 1 [MF 10], to extend the teachers ideas about creativity (see Appendix 1).
- **Reading 2**: "Reflecting on creativity and cognitive challenge: visual representations and mathematics in early childhood – some evidence from research" (Worthington, 2008) gave research background into the notion of visual representations and mathematics to introduce the notions of challenging children cognitively through creativity, and especially through visual representation. The reading showed how research should inform practice in mathematics teaching.
- **Reading 3**: "Mark Making Matters. Young Children making meaning in all areas of learning and development" (Department for Schools, Children and Families, 2008) was examined, with each group researching one of the following sections in the document: a unique child; positive relationships; enabling environments and learning and development. This reading put forth the idea that opportunities to express themselves and construct meanings through visual arts are vital for the development of young children.

> ... very young children who are given rich opportunities to explore making marks within an encouraging emotional environment will become confident and competent communicators, both orally and on paper, ... (Department for Children, Schools and Families, 2008, p. 2).

The next activity involved the teachers defining "curriculum". They looked up the word in dictionaries and tried to gain an understanding of the concept. The interpretation I provided after the class discussion was the one provided by the Department of Education and Science for England and Wales (1980) in Graham-Jolley (2003).

> The curriculum … comprises all the opportunities for learning provided by a school. It includes the formal programme of lessons in the timetable … and the climate of relationships, attitudes, styles or behaviour and the general quality of life established in the school community as a whole. (p. 4)

The class discussed this interpretation of "curriculum" and surmised that curriculum is the synthesis of ideas about teaching and learning; one's views about children; one's views about family and culture; and views about the role of the teacher.

- **Reading 4**: "Four views of learning" was a tabular summary of four different views of learning adapted from Carruthers & Worthington (2006, p. 21): Behaviourism (Thorndike and Skinner), Constructivism (Piaget), Social Constructivism (Vygotsky) and Socio-culturalism (Bakhtin). The table compared these theorists' views of children as learners and the implications for teachers, the role of the teacher and the role of family and culture. This provoked some interesting discussion amongst the teachers as they reflected on the type of learning experiences they had as children. For instance, the socio-cultural view of learning advocated by theorists such as Vygotsky and Bakhtin, is that children are mediated and scaffolded in rich learning environments and their understandings and meanings are valued. On the other hand, a Piagetian view of learning is more linear and hierarchical, with published lesson plans and activities being used.

The concept "pedagogy" was investigated, using a dictionary activity and discussion. I introduced the notion that "… pedagogy is an art, whereas psychology is a science" (Piaget, 1948, p. 22, in Kohler, 2008, p 153). Moon & Leach (2008) make the following points about pedagogy: it is explicit about vision, values and educational purposes; it takes politics into account; it involves collaboration between teachers and communities; it evolves over time; it regards teachers as intellectuals; theory and practice constantly inform each other; teachers need to be researchers in their settings; it brings out learners' best selves; it acknowledges the relationship between

learning and identity; and it is relevant to ALL contexts. The students discussed how they would be able to apply these ideas in their own contexts.

- **Reading 5**: "Research for you – Making your mark" (Thompson, 2010) was about allowing children to make their own marks to represent their meanings in mathematics lessons. The teachers were required to link what they had learnt about pedagogy with this reading, and discuss how it was relevant in their own contexts.
- **Reading 6**: Schemas provided information on schemas and gave examples of children using schemas in their development. It described eight categories of schemas. These were as follows: dynamic vertical, dynamic back and forth, circular direction and rotation, going over under or on top of, going round a boundary, enveloping and containing, going through a boundary, and thought (internalized action). The question was posed: "How do schemas fit into pedagogy?" in order for the teachers to relate this new knowledge to their own contexts.

  Reading 7: Emergent curriculum - described the process of emergent curriculum, demonstrating that following the pedagogy of emergent curriculum is similar to the "plan-do-review" pattern with which some teachers who use the High/Scope approach are familiar.

5.5. Analysis and Findings from Phase 1

This section records and analyses the teachers' verbal and written responses to the various on-course and take-home assignments completed as part of this phase of the research. Data was generated through the teachers' verbal and written responses to:

- the DVD and readings used in the two-day contact session
- the classroom observations of children they undertook
- the visual representations produced by the Grade R children they teach
- the reflective report on an environment "rich in opportunities for learning"
- the reflective report on three incidents of scaffolding children's learning
- the reflective report on observing children's behaviour and visual representations.

5.5.1 Teaching and Learning Activities

The discussion on the DVD "Schools kill Creativity" (Robinson, 2006) [DF 1] (see Appendix 1), and the quotations about creativity in Resource Pack 1 [MF 10] (see Appendix 1), shed light on the teachers' understandings of creativity. Responses were as follows:

Funny but true!;
We must teach in a way that encourages creativity;
Children should be allowed to explore;
All children are born artists;
Interesting; Create opportunities;
…introspection;
… attitudes and responses;
…emergent;
Provide the opportunity for creativity to be free and individual and expressive and to be yourself.

Focus group responses to the questions "What does Creativity look like?"; "What does Creativity feel like?" and "What does Creativity sound like?" elicited the following responses:

interesting
exciting
colourful
new
different
vibrant
special
busy
nice
contented
active
noisy
quiet

These responses reflected Bolden, Harries and Newton's (2009) research on pre-service teachers' conceptions of creativity in mathematics. In response to teachers' comments on creativity in mathematics, they point out "[h]ere it is clear that 'fun' is paramount in the pre-service teachers' minds" (p. 149). But creativity is not necessarily "fun". This notion will be explored more deeply in later chapters.

Jeffrey & Craft (2004, p. 77) and Craft (2005, p. 140) mention that the National Advisory Committee on Creative and Cultural Education (NACCCE) Report (1999) made a distinction

between “teaching creatively” and “teaching for creativity”. According to Craft (2005, p. 140) “teaching creatively” means using imaginative approaches, making learning more interesting and being effective while “teaching for creativity” involves risk taking and an openness to new experiences. She notes that it is possible for creativity to occur even within a restrictive environment. The “little c creativity” that Craft (2005, p. 39) advocates is a “can do” approach to life and learning, where opportunities are taken. She also calls it “possibility thinking”. Her view is that “little c creativity” promotes resilience, confidence and resourcefulness in children; it is cross-curricular and is found in any domain.

5.5.2 Assignments

By its nature, emergent curriculum requires practitioners to be reflective and reflexive. Teachers have to reflect on previous learning and teaching activities as they plan new activities. The teachers would need to follow all the steps in the emergent curriculum process in order to understand how a curriculum can be planned around children’s needs. The assignments 1.1 to 1.5 listed in Table 5.1 and Data File 2 [DF 2] (see Appendix 1) served the dual purpose of providing evidence of both the children’s representations and the teachers’ observations of their behaviour. By collecting examples of children’s art and displaying it at the contact session, the teachers would also be able to see visual representations of Grade R children other than their own. This was intended as a means to develop their confidence in their own abilities to stimulate visual representations. Phase I therefore formed the basis for starting to plan around an emergent curriculum. The assignments [DF 2] involved:

- An observation journal
- Collections of children’s visual representations
- A reflective report: describing an environment “rich in learning opportunities”
- A reflective report: descriptions of three incidents of scaffolding children’s learning; and
- A reflective report on observing children’s behaviour and visual representations.

- **Classroom Observations of Grade R Children**

I did not give the teachers any prescriptive framework for observing children’s interests (see Appendix 1), because I wanted this first assignment to form a baseline analysis of the teachers’ existing practices. Some teachers observed the children as if they were assessing them according

to a check list. Some teachers only reflected on misbehaviour and wrote about the anxiety, depression, low self-concept, and disruptive and impulsive behaviour in their learners. I regretted not having specified more clearly how observation of children's interests might take place, but I became aware that different approaches to assessment also reflect different pedagogies and theories of learning amongst the teachers.

An analysis of the observation notes made by the teachers as required for assignment 1.1, revealed several styles of observing, which I describe as follows:

i. ***Deficit observations:*** Comments were only made regarding behavioural problems and areas of weakness e.g. "still trying to cut", "always sleepy", "fine motor not well developed" [DF2]. This style of observing is not helpful to constructing an emergent curriculum as it focuses purely on negative aspects of behaviour. Anning (2000) refers to this as the "checklist phenomena", where children are often limited to learning what the adult wants (Carruthers & Worthington, 2006, p. 32).
ii. ***Narrative reports:*** Deficit behaviours were observed, but with the teacher's solution to the problem in italics e.g. "Mandilakhe is struggling to speak English – reason may be because she was at an Afrikaans pre-school. *Need to interact more with Uyathanda and Esona."*[DF2]
iii. ***Anecdotal note-taking:*** The children's words were used, to show their learning and experiences e.g. "no Lihle Alphea and Mandisa's garden are not the same, you are telling two stories in one time."[DF 2]
iv. ***Incident reporting:*** Incidents during the school day were reported on in a factual way e.g. "Today the children did printing again in red and yellow paint using cotton reels, corks and nesting cups, all shaped in [sic] circles children loved the various sizes of the circles and enjoyed finding out what red and yellow make – orange!" [DF2] Here there was no attempt to analyse behaviour.

Some teachers made general observations about all the children in their classes, reporting on the different activities that the children did as a group, some focused on a few, and still others concentrated on one or two children and observed them in detail. The teachers who took anecdotal notes rather than try to analyse actions seemed to be more receptive to children's interests and behaviour. Hohmann & Weikart (2002) confirm this in the pointers they give for effective and accurate observation: observe children throughout the day; briefly note observations and write them up in detail later; and suspend judgement (p. 96-98). Two teachers who worked in

schools with the High/Scope approach articulated the children's interests and explained the children's progress in terms of the High/Scope Key Experiences (Hohmann & Weikart, 2002).

- **Visual Representations**

The collections of children's visual representations were an authentic portrayal of Grade R children's behaviour, development and interests. The children's art displayed a variety of different media, from paintings, to printing and drawing and cutting. Some teachers complained that they had not been able to collect many examples of the children's work as the children wanted to take them home. In these cases, they had taken photographs of the children's work. Although the majority of the artworks showed that children had been allowed to freely express themselves, two teachers brought worksheets as examples of children's expressions of meaning.

During contact session 2 (described in Chapter Six), the teachers displayed all the pictures and photographs they had collected, and additional examples of schemas were shown in a Powerpoint presentation [MF 12] (see Appendix 1), in order to help the teachers to classify, according to various schemas, the visual representations that they had collected.

Although this activity took place during contact session 2, it is described with Phase I as it forms part of the "Awareness and knowledge building around creativity" goal of Phase I. Some teachers found it difficult to categorise their children's art work into schemas, and I helped them to do this by examining the art work, discussing it, and deciding which schemas the art work did *not* represent, in order to classify the schema it did represent. The teachers who had collected examples of worksheets, found that the only schemas they represented were *dynamic vertical* and *dynamic back and forth* because those are the movements required for colouring in. Carruthers & Worthington (2006), Pound (2003) and Bruce (2006) explain that most worksheets are extremely limiting for children because they cannot express their own meanings. The eight different schemas (Athey, 2007) summarised in Reading 6 [MF 10] were represented by a variety of different art techniques. Figure 5.2 shows e*nveloping and containing* schema, which had by far the most examples, showing drawings of people with objects inside them and X-ray views of houses. The weaving shown in Figure 5.3 illustrates how the teacher effectively extended the schema by introducing an extension of the experience of *going through a boundary.* It was evident that some Grade R children were using a variety of schemas in each of their art works. This is described by

Figure 5.2: ***Enveloping and containing*** **schema**

Athey (2007) as "thought (internalized action)". As children mature, their schemas or behaviour patterns become internalized and it is no longer necessary for them to practice them outwardly as in physical movements.

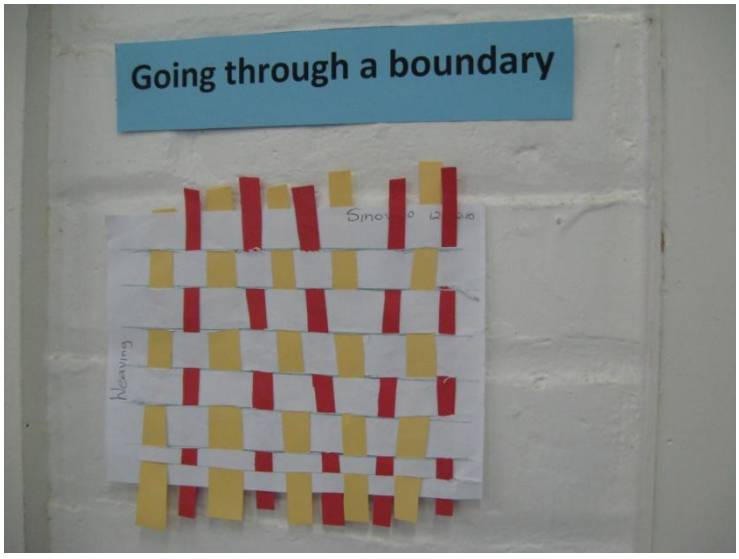

Figure 5.3: Weaving, illustrating an extension of the ***going through a boundary*** **schema**

- **An Environment "rich in opportunities for learning"**

Assignment 1.3 [MF 11] (see Appendix 1) required the teachers to describe how they organize the environment for rich learning experiences to take place. They supported their descriptions with photographs of their learners engaged in activities in their learning environments. Analysis

revealed two focus areas in the teachers' descriptions of an "environment rich in opportunities for learning" (Department for Children, Schools and Families, 2008): exposure to resources, and the teacher's role. This is illustrated by the following:

> *My classroom is a foundation of the early childhood curriculum. Each corner in my class is interesting and accessible and rich in opportunities that motivate children to notice, ask questions and discover things in their world.* [DF 2]

Others were convinced that resources are not that important:

> *A child needs no physical objects in order to create magnificent ideas.* [DF 2]

> *[S]ometimes there are teachers who don't teach children because of lack of resources but there is no such thing where as children can create something* [DF 2]

An awareness of children's prior learning experiences was expressed:

> *Learners come to school with a wealth of knowledge, ideas, opinions and skills which can be developed by the teacher by creating the environment rich in opportunities to learn.* [DF 2]

Fleer (2010) suggests that teachers are inclined to believe that materials and resources do the teaching. She explains that often children are not necessarily learning what teachers intend them to learn when they have organized a particular learning scenario e.g. a shop, restaurant. Gifford (2005) confirms this. It was interesting to note that many participant teachers understood their role as being more active than merely providing a learning environment. Ginsberg, Lee and Stevenson Boyd (2008) suggest that a rich physical environment is not enough. "The crucial factor is not what the environment makes possible, but what the children *do* in it." (p. 7) This is how the teachers described ways in which they extend the children's thinking:

> *Teacher directed activities are in place, but the environment allows for children to express themselves in their own time and at their own pace, basically 'free choice' is catered for. Children have the constant support of the teachers who often extend, encourage or gently direct the learning process.* [DF 2]

> *... I try to provide many opportunities for conversations between teacher and learner as well as the learners among themselves. I make sure that I listen to each and every learner and help them to expand on their language, building their vocabulary and build on their background knowledge.* [DF 2]

> *Each child's needs are endeavoured to be catered for, this is often achieved not through the provision of lots of materials, but rather through the careful and skilful guidance and support of the teachers.* [DF 2]

> *... teachers plays a big role in the learning process of the children. We need to be conscious that drawings can serve various purposes and functions and we must try to understand the young artist's goals and guide him by providing necessary materials, being sensitive and understanding and patient and believe me it isn't always easy but very important... Teachers must be there to guide the learners and not to make them think in a box.* [DF 2]
>
> *It is my responsibility to nurture, guide and facilitate children's development. This is done by providing opportunities, activities, interaction and support for children's active learning, within a learning environment. This stimulates children to play, learn, grow, progress and mature to reach their potential.* [DF 2]

After reflecting on the learning environments they had prepared for learning, I wanted the teachers to examine their own roles in the learning process. This is described in the following section.

- ## Scaffolding

In spite of Vygotsky not using the word "scaffolding" himself, the concept is associated with him (Berk & Winsler 1995, p. 26). The Zone of Proximal Development (ZPD) is described as the distance between the child's actual developmental level and what can result through problem-solving and collaboration. Siraj-Blatchford (2009, p. 156) refers to this as "sustained shared thinking". "Conceptual play" described by Fleer (2010, p. 213), involves the teacher guiding and supporting children's learning. Besides preparing the environment for children to learn, the teacher's role is to direct learning through questioning, and provide extended learning experiences which build on the conceptual learning taking place.

Assignment 1.4 [MF 11] (see Appendix 1) required the teachers to focus on the process of scaffolding because in order for mediation, scaffolding or sustained shared thinking to take place, a teacher has firstly to be aware of what interests the child, and secondly be able to extend that learning to the ZPD. Most of the teachers understood that scaffolding or mediating would enable learning to be extended, and a few hinted that when scaffolding took place, learning was not necessarily linear – what Vygotsky described as "revolutionary" (as opposed to the "evolutionary" development of learning posited by Piaget).

> [T]he development of the child is a dialectical process in which a transition from one state to another is accomplished not along an evolutionary, but along a revolutionary path. (Vygotsky, 1998, p. 193 in Fleer, 2010, p. 165)

Teachers wrote about their understandings of scaffolding:

> *Scaffolding learners is a process of helping them throughout their activities and learning. It is done until such time that a child is able to do the activity by himself.* [DF 2]

> *Noticing where children have problems in learning and devising strategies to help. [DF 2]*
> *Teachers scaffold children's development and learning by providing structures that support them to stretch their understanding beyond the level at which they've been functioning on their own.* [DF 2]

Some teachers described specific incidents where they scaffolded or mediated children's learning:

> *This child started doing a puzzle of 6 pieces and I scaffolded him by sitting next to him and I helped him by asking where the outside and corner pieces are, by showing the corner and straightedges of the puzzle pieces. Then he had to find them and then put them together and then he had to find the inside pieces. He took his time to get it done. I then gave him another 6 piece puzzle which he [completed] by himself and I just observed while he buil(d) the puzzle... His confidence in himself has grown so much and he now is so eager and excited to do puzzles and he has learnt the skill needed to build puzzles.* [DF 2]

Several teachers described *asking open-ended questions* to scaffold learning. They did not describe the specific questions asked, but were aware that questioning was a way of extending children's thinking and assisting them to focus on a particular concept. Others described scaffolding in more general terms, in response to children's behaviour and actions:

> *When I noticed this action (cooking food in the fantasy area) I decided to put the play dough together with the fantasy toys.* [DF 2]

Some teachers clearly understood their role as being more passive:

> *I must encourage children to choose activities of their choice or initiate some activities and not limit their creativity by telling or showing them what to do.* [DF 2]

One teacher described a situation where she and two learners collaborated to solve a problem. When a conflict arose between the two children, she asked them to explain what the problem was. She merely restated the problem in the words the children had used, and asked them what should be done. Eventually they devised a solution to the conflict situation. She explained that the children had learned valuable skills through the process: communication, trust building, observation, listening and problem solving.

• Reflections on Observing Children's Behaviour

Assignment 1.5 [MF 11] (see Appendix 1) required the teachers to write a reflective report on their experiences of observing their Grade R children. In their reflections, many teachers reported that observing had opened up a new world for them and they had become aware of their learners in new ways. Others understood the important role that observations can play:

> *We as teachers play a very important role in the development of our learners. We therefore need to know more about our children's academic, social and emotional development so that we will be able to meet their needs. With the knowledge of this information on how well the learners are progressing we are able to plan our teaching. We will be able to know which tool will be effective for the different activities planned for the learners. I would like it that my learners must feel confident and successful with the experiences you offer them so that they will be able to develop to their full potential. In checking the children's progress we as teachers will be able to identify the learners who need special help or who are facing extra challenges.* [DF 2]

> *I want my learners to feel successful and confident therefore I need an information system that will help me to know how well the learners are progressing will also give me an opportunity to plan my teaching according to the needs of the learners.* [DF 2]

> *Children need an eye to observe and an ear to listen to them and lastly a mouth to talk with and not to them.* [DF 2]

> *Observations [are] necessary to build a picture of the whole child.* [DF 2]

For most of the teachers, observing the children's interests was a new experience. One of the teachers commented:

> *Observing children's behaviour was fascinating as I got to see a different side to the children's behaviour.* [DF 2]

Another teacher described her experience:

> *So I walked around the garden more as I wanted to see what the children were doing, I found it interesting and very sweet and clever in some of the activities that they were doing. ... I at first thought they were just sitting there talking but I got closer and realised they had built something which was the little house of sticks, leaves and a stone. Which I thought was very creative and clever of them and a teacher wouldn't have seen what they had created if I hadn't walked around the garden.* [DF 2]

Only two teachers related their observations to the art work that the children produced. One said:

> *[Children's art] (it) is the expression of his/her feeling and ideas. It is the way in which he communicates all his/her experiences non-verbally.* [DF 2]

The significant role that children's mark-making should play in curriculum planning with regard to mathematics was revealed:

> *An important thing is that teachers must be prepared to listen to children's responses to their mark making and to allow ideas and interests to unfold rather than over-planning. ... I have learnt that mark-making can be seen as the beginning of the process of children understanding the abstract symbolism of mathematics. It is important that, although adults may introduce the activities, children develop them through their own ideas....* [DF 2]

> *How do I know how children are progressing in their mark-making journeys across all six areas of learning and development?* [DF 2]

Most of the teachers enjoyed learning more about the children through observations:

> *The process of observing was very challenging. I enjoyed every moment of it.* [DF 2]

This section has analysed and discussed what emerged in the data generated by the various activities of Phase I. The next section discusses the findings in relation to the goals of Phase I of the research.

5.6. Summary and Discussion of the Findings: Phase I

As listed in Section 5.2 (The Rationale and Aims for Phase I), I aimed to develop the teachers' awareness and understanding of

- alternative ways of thinking about children's learning,
- their role as teachers,
- the concept of creativity, and
- how to observe children's behaviour and visual representations.

This section summarises the findings in terms of the goals for Phase I:

- Their responses to the notion of creativity showed that the teachers did not have a clear idea of how it could be implemented in their own Grade R classrooms. Creativity provoked the idea of fun, and the use of resources rather than a classroom climate of encouragement and openness.
- The observation task showed that the teachers' methods of observation reflected their

pedagogical practices. On the one hand, the deficit models of observation suggested behaviourist classroom practices, and on the other hand, anecdotal note takers seemed to follow social constructivist models.

- Observing the children's behaviours, interests and schemas was a new experience for many
  teachers.
- The majority of schemas represented in the examples of children's art which the teachers had collected, showed the "enveloping and containing" schema. Worksheets were only able to demonstrate one type of schema – "dynamic back and forth". This could be significant in later phases when the teachers would need to make meaning of children's representations.
- Teachers' descriptions of the learning opportunities in their environments reflected two notions: exposure to resources, and the teachers' role. Some teachers seemed to be unsureof the role of the teacher in the environments rich in learning opportunities they described.
- Scaffolding was sometimes described by the teachers as helping a child who had learning problems, rather than engaging with a child and extending and enhancing learning in everyday situations.

5.7. Conclusion

Phase I formed the first part of the emergent curriculum framework. The data which was generated through the tasks and assignments demonstrated the teachers' experiences and knowledge in the areas of observation, the preparation of the learning environment and in the scaffolding of children's learning experiences. Collecting children's visual arts representations helped them to pay attention to the children they taught in a way that some teachers had not experienced before.

In Chapter Five, findings were discussed and a summary of the findings was given. Phase I formed the first part of the emergent curriculum process of awareness and knowledge building around creativity. Phase II would entail making meaning of what the teachers had learnt during Phase I.

CHAPTER SIX
Analysis and Discussion of the Findings: Phase II

"Indeed, art and play are so interconnected in young children's thinking and learning that some preschool children confuse the terms 'draw' and 'write', and use these terms interchangeably." (Wright, 2010, p. 54)

6.1. Introduction

Chapter Six describes Phase II as the next step in the emergent curriculum process. It follows a similar format to Chapter Five with Phase I, and discusses the analysis and findings of Phase II. The rationale behind Phase II is described, with the teaching and learning activities and assignments in which the teachers engaged. These are analysed and emergent patterns noted. The findings from the teaching and learning activities are discussed, and finally a summary is given of the findings according to the aims of Phase II.

6.2. The Rationale and Aims for Phase II

The participant teachers had taken part in Phase I: awareness and knowledge building around creativity, observing the interests of the children, preparing an environment "rich in learning opportunities" (DCSF, 2009) and scaffolding children's learning, form the foundation of an emergent curriculum. Phase II: meaning making, decision making and reflecting, aimed to develop the teachers' understanding and ability to:

- make meaning of children's behaviour and visual representations, using their knowledge about schemas,
- make decisions about activities which would enhance and extend children's learning,
- reflect on the process of meaning making and decision making according to children's interests and behaviour.

The collections of visual arts representations and the teachers' experiences of observing thus formed the foundation and stimulus for making meaning. Stacey (2009) maintains that taking the time to think about what the children are portraying is a vital part of responding to their needs.

The following activities would allow the teachers to develop an understanding of meaning making, decision making and reflecting during Phase II:

- focus group discussions during the contact session would enable the teachers to collaborate,
  whilst making meaning of children's schemas and behaviours.
- three assignments to be completed at home [MF 15] (see Appendix 2):
  - reflecting on the experience of making meaning from observations and collections of schemas (during the class focus group discussions);
  - implementing the activities they had decided on with their focus groups;
  - a presentation on the implementation of the activities.

The rationale for requiring the teachers to do presentations of their work in front of the whole class was so that they could learn from each other's experiences and practice.

6.3. Phase II: Meaning Making, Decision Making and Reflecting

As was the case in Phase I (in contact session 1 of the BEd in service programme), Phase II (in contact session 2) consisted of a number of teaching and learning activities during the contact session and assignment tasks which the teachers had to complete at home. The teaching and learning activities (shown in Table 6.1) consisted of: a Powerpoint presentation (Visual Representations, Schemas and Emergent curriculum [MF 12] (see Appendix 2)); four, one-minute videos of scaffolding scenarios during the early years; and a manual, "Children thinking mathematically: PSRN essential knowledge for Early Years practitioners" by the Department for Children, Schools and Families (www.standards.dcsf.gov.uk) [MF 15] (see Appendix 2). The focus group discussions and task sheets which were completed during contact session 2 are described in this section too.

Table 6.1 shows a tabulated summary of all the activities and tasks which comprised Phase II. The table is divided into two columns: "Learning" and "Doing", reflecting the two ribbons represented in Figure 6.1. "Learning" activities took place during the contact session, whilst "Doing" activities were tasks and assignments which the teachers completed during the contact session and at home. The teaching and learning activities are described in detail in Section 6.3.1, whilst the assignment tasks are elucidated in Section 6.3.2.

6.4. Phase II: Description of Teaching and Learning Activities

In Phase II the teachers learned how to make meaning of their observations and make decisions about the way forward. Reflecting on their own practice formed a significant part of this process. Reflecting with colleagues also involves shared thinking on a deeper and more complex level than reflecting alone (Stacey, 2009), so shared reflection and meaning making would be encompassed in Phase II in the form of focus group discussions.

Table 6.1: Tabulated summary of Phase II

<table>
<tr><th colspan="2">PHASE II: MEANING MAKING, DECISION MAKING AND REFLECTING</th></tr>
<tr><th colspan="2">Teaching and Learning Activities during contact session 2 (1 day)</th></tr>
<tr><td>Learning
Powerpoint presentation – Visual Representations, schemas and emergent curriculum</td><td>Doing
Sorting and classifying schemas (described in Chapter Five) [DF 3]</td></tr>
<tr><td>Four movies of scaffolding and supporting children's learning – [MF 13] in Appendix 2
• Getting ready to go out
• A bed for a giant
• A picture of my family
• Talking about monsters</td><td rowspan="2">Making meaning – group discussions and completion of group task sheets: Making meaning, decision making and planning. ([DF 4] in Appendix 2). Appendix 3 shows the task sheet.
• Children's stories
• Learning and development story
• The teacher's story
• Big ideas
• Activities
• Practicalities
• Resources</td></tr>
<tr><td>Reading: Children thinking mathematically: PSRN essential knowledge for Early Years practitioners (DCSF, 2009) [MF 14] (see Appendix 2)</td></tr>
<tr><td></td><td>Assignments for Phase II:
2.1 Reflect on the process of making meaning of children's behaviour and planning to enhance and extend their learning in these areas.
2.2 Plan and implement activities around children's interests, and reflect.
2.3 Presentations of making meaning, planning and implementation of activities around children's interests.</td></tr>
</table>

6.4.1 Powerpoint Presentation on Visual Representations

The Powerpoint presentation [MF 12] (see Appendix 2) provided a summary of different types of schemas to which the teachers had been introduced during Phase I: dynamic vertical; dynamic horizontal; going through a boundary; circular rotation; going round a boundary; thought (internalized action). It showed examples of each of these so that the teachers would be able to sort and classify the examples of their children's visual arts representations that they had collected for Assignment 1.1 [MF 11] (see Appendix 1). This was described in Chapter Five (Section 5.4.2). With all the art works which the teachers had collected arranged around the room according to the schemas they represented, the teachers sat in focus groups and discussed what schemas are; where we find them; how they can assist teachers; and why they are important. I then showed them the diagram of emergent curriculum with which they had become familiar (Figure 6.1, in which Phase II is highlighted), and explained how they had progressed to the next phase of the emergent curriculum process: meaning making, decision making and reflecting.

A series of four, one-minute videos (Department for Children, Schools and Families, (2010) on scaffolding children's learning [MF 13] (see Appendix 2) were shown to the teachers to increase their understanding of scaffolding children's learning within the context of Grade R. The videos illustrated scaffolding incidents during everyday routines in a Grade R classroom such as comparing sizes of boots, making a bed for a giant, discussing a picture of a family and talking about monsters. In the videos the teacher asks questions which stimulate the children's thinking and responses, and encourages problem-solving and collaboration between groups of children.

6.4.2 Making Meaning and Making Decisions in Focus Groups

Stacey (2009, p. 15) explains how the dispositions of teachers contribute towards generating an emergent curriculum. According to her, dispositions are qualities of mind and tendencies to respond in a certain way. She argues that the dispositions of teachers and children affect each other continuously. Relationships, experiences and prior knowledge are seen as having an effect on dispositions and hence on the way the curriculum develops. She contends that during each stage of the emergent curriculum process, different dispositions need to be brought to the fore.

Figure 6.1 shows the dispositions of the teacher at each stage of the emergent curriculum process, with Phase II highlighted.

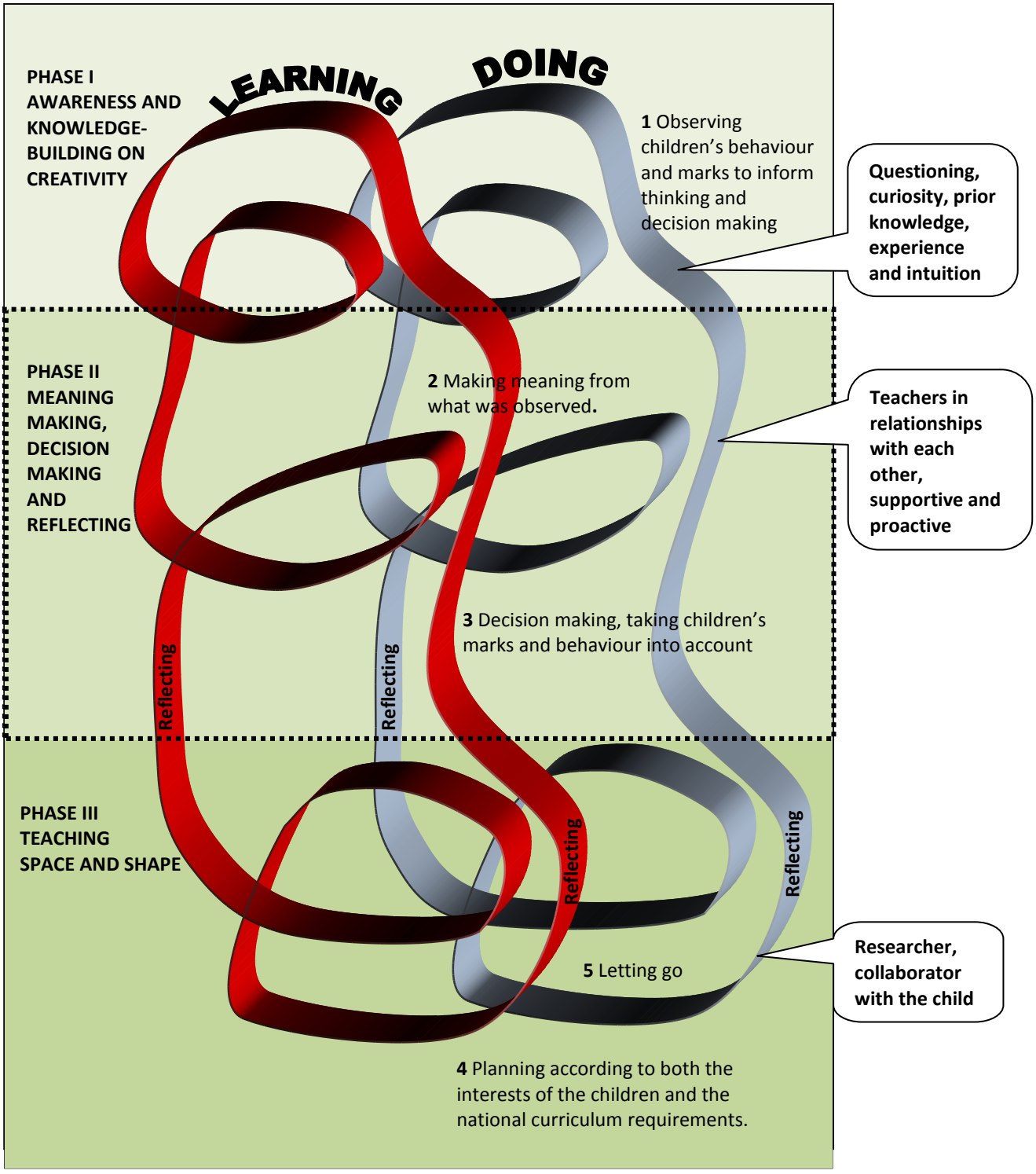

Figure 6.1: Dispositions evident during each phase of the emergent curriculum process, highlighting Phase II (adapted from Stacey, 2009, p. 15)

The teacher starts by being curious about children's behaviour. Her own prior experiences affect her observations of the children. Children display their interests, which are in turn, a response to

their own prior experiences. All this occurred during Phase I. The current stage (Phase II) of the emergent curriculum process involves teachers displaying the dispositions of relating to each other, discussing and making meaning of what they have observed. When decisions have been made regarding children's needs and interests, planning takes place. According to Stacey (2009) the disposition appropriate for this stage is one of collaborating with the child, with the teacher as researcher and the child as protagonist. Phase III explored this more deeply.

To facilitate the process of meaning making taking place in this study, the teachers formed three focus groups (A, B, and C). The rationale was firstly for the teachers to experience making meaning with the support and guidance of colleagues, and thereafter to make decisions about appropriate activities and plan for them. The focus groups discussed what the teachers had seen portrayed in the children's visual representations of schemas, and the behaviours and interests amongst the children they taught. Athey (2007) describes how children's physical movements and drawings are closely related because drawings are symbolic representations of the child's thought processes (p. 115). Through their observations and the readings they had done, the teachers became aware of this close relationship. In focus groups, therefore, they made meaning of their observations and the children's schemas and recorded this information on a task sheet [DF 4] (see Appendices 2 and 3).

The first section of the task sheet is shown in Table 6.2 [DF 4] (Appendix 3 illustrates the entire task sheet) which the teachers completed was divided into three columns and was essentially about making meaning. The groups were required to discuss the children's behaviours and schemas from three different perspectives: the child's, learning theorists', and their own perspectives as teachers.

- The first column, *The Children's Story,* asked the following questions: *What fascinates children? Why do you think this is so? Why do they keep returning to these activities? What are their previous experiences with this scenario?* The teachers wrote about behaviours and schemas they had observed amongst the children they taught – what they felt the children were 'saying' through their behaviour and art.
- In the column *Learning and Development story*, they were expected to apply child development theories to the behaviours and schemas that had been observed. The questions

which provoked their thinking were: *What common factors do the children's activities and drawings have? What does this mean in relation to the children's development?*

- The third column, *The teacher's story,* was where the teachers could write about how they, as teachers should respond to the children's behaviour and schemas. Questions asked were: *What delights or puzzles you about what you are seeing? How can you find out more?*

Table 6.2: Meaning making and decision making task sheet: page 1

THE CHILDREN'S STORY What fascinates the children? Why do you think this is so? Why do they keep returning to these activities? What are their previous experiences with this scenario?	LEARNING AND DEVELOPMENT STORY What common factors do the children's activities and drawings have? What does this mean in relation to the children's development?	THE TEACHER'S STORY What delights or puzzles you about what you are seeing? How can you find out more?
1.		
2.		
3.		

- The next page of the task sheet had a space for writing down what the big ideas were, i.e. the activities in which the children were persistently interested. Here they had to take their interpretations a step further. They were encouraged to ask themselves the questions: *Why do these children keep returning to this play? Why is this particular schema being represented? What fascinates them? What are they saying? How many ways can I provide for them to show what they know?*

Table 6.3: Meaning making and decision making task sheet: page 2

What are the big ideas, repetitive topics and long-lasting interests emerging from the above?

According to Stacey (2009, p. 15), after meaning making the following step in the emergent curriculum process is decision making (see Figure 6.1). The teachers were therefore required to make decisions on several activities they would present to the children in response to what they had learnt about the children's interests. They needed to think about the practicalities of presenting these particular activities, and the resources they would need to find.

- The last page of the task sheet was divided into three columns for the teachers to write down what they would do in response to what they had observed and discussed:
    - Activities (what activities would the teachers provide);
    - Practicalities (how, when, where, what support would be provided); and
    - Resources required (what would be needed and how it would be obtained).

Table 6.4: Meaning making and decision making task sheet: page 3

ACTIVITY What activities will you provide?	PRACTICALITIES How will you provide these? What time of the day? Where? How will you support the children in their learning?	RESOURCES REQUIRED What do you need in order to make these activities available? How will you get/make them?
1.		
2.		
3.		

When the focus groups had finished completing the task sheets, copies were made and handed to each member of the group, to use for their assignments, where they would use the meanings they had made to guide their decision making about activities to extend the children's learning. These they would present to the BEd class during contact session 3.

6.5. Analysis and Findings from Phase II

As Table 6.1 illustrates, data for Phase II was generated through

- the written task sheets which the teachers completed as part of focus groups during the second contact session [DF 4];

- the audio-visual recorded presentations which the teachers prepared for the following contact session [DF 5] (see Appendix 2), and
- the reflective reports they wrote on the process of making meaning and decision making [DF 5] (see Appendix 2).

The presentations would be given at the following contact session (contact session 3) but because they demonstrate the teachers' understandings of meaning making according to the focus group task sheets they completed in class, each group's presentation is analysed in the following section, together with the group's responses to the task sheet. This is followed (in Section 6.4.2) by a narrative discussion of the teachers' reflections on meaning making and decision making.

6.5.1 Task sheets and Presentations

This section is divided into two parts. The first part, *Meaning making and decision making*, analyses each group's response to children's behaviour interests and schemas as stated on the task sheets they had completed in groups. The second part, *Planning and implementation,* analyses the teachers' video-recorded presentations of the activities they implemented in response to the focus group task sheet activity. The three groups (A, B and C) were formed according to the common schemas and behaviour interests of the children they were teaching.

I analysed the data as follows: a table was designed to show how the decision making process was a response to the teachers' observations and meaning making, so for each group the table was divided into two columns (see Tables 6.5, 6.6 and 6.7). The first column (children's behaviour interests) lists the data from "The Children's Story" in the first part of the task sheets that they had completed. The second column, "Decision making", reveals the activities which the focus groups decided on as a response to the schemas and the behaviour interests described in column 1. I could then see how the process of decision making was a response to meaning making. Each group's task sheet and activities is analysed and discussed below.

- **Group A: Meaning Making and Decision Making**

As illustrated in Table 6.5, Group A focused on the schemas *circular direction and rotation* and *enveloping and containing*. They had closely observed the children's behaviour interests and interpreted them in terms of schemas. Group A spent much time discussing the behaviours of their children in their contexts. After a while, they managed to deduce that what they all had in

common was the *circular direction and rotation* and *enveloping and containing* schemas. Unfortunately discussions became so involved that they did not have time to complete the worksheet by making decisions on activities to extend the schemas. However, their presentations (in the following section) revealed several interesting decision making responses.

Table 6.5: Group A: Meaning making and decision making

GROUP A	
SCHEMA: Circular direction and rotation	
CHILDREN'S BEHAVIOUR INTERESTS	**ACTIVITIES (Decision making)**
Driving with steering wheels round the playground	Discuss cars with boys – talk about all things cars – maybe suggest making a track with sticks or making an area just for cars.
Painting circles. They call them 'eggs'	
Create beads from salt dough – roll the beads and then push pencils through to make holes.	
SCHEMA: Enveloping and containing	
Drawing borders or frames around pictures and decorating it with patterns.	Not enough time to complete
In sandpit – using long wide plastic pipe to fill the moat, and use it to pour water deep into the sandpit.	

- **Group A: Planning and Implementing**

During their presentations, most of Group A explained how they had planned activities around the schema *enveloping and containing* and *circular direction and rotation*. One of the group members chose the "Homes" theme to extend the e*nveloping and containing* schema. She brought examples of her children's art work showing homes with the wall cut away so that the furniture in the rooms was visible. Another teacher explained how she developed the theme of Easter. The children made candle holders which illustrated the schema *going on top of*.

One of the teachers demonstrated her own understanding of the emergent curriculum process in diagrammatic form (Figure 6.2). It shows how she used the *enveloping and containing* and *circular direction and rotation* schema to develop activities. During the presentation, she remarked "*You have to spend quality time talking with children so that you can understand their interests*" [DF 5].

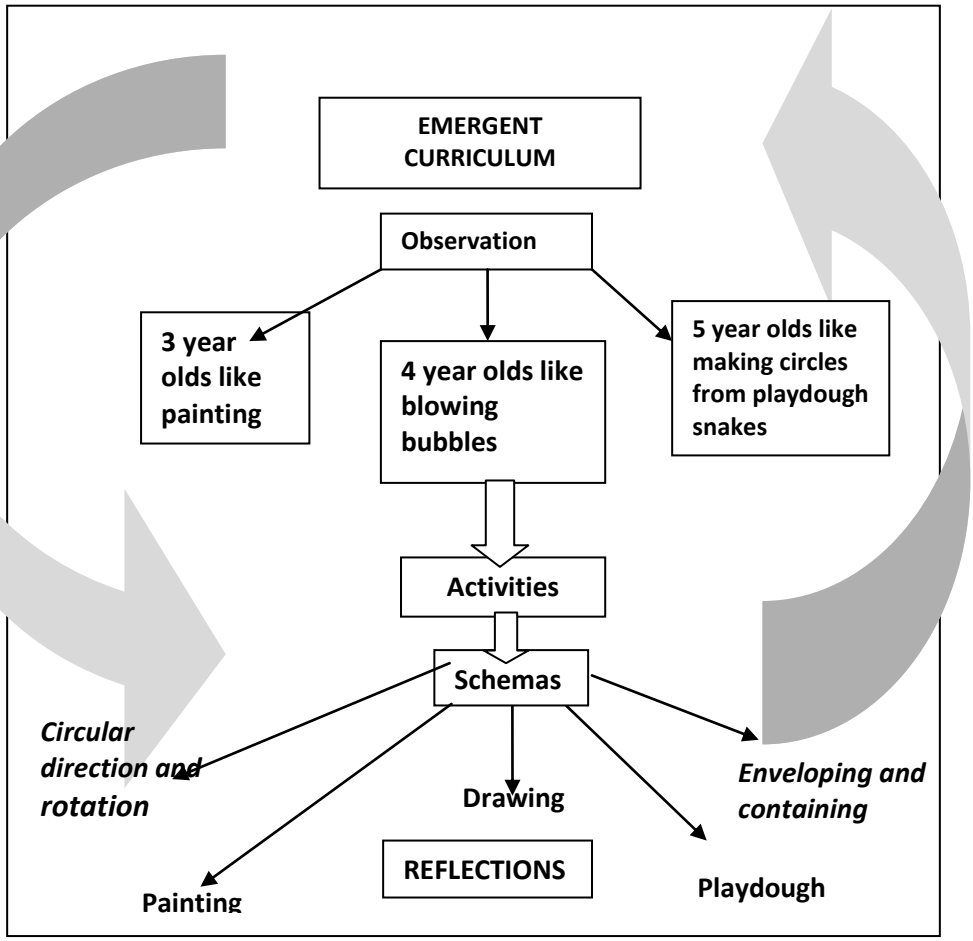

Figure 6.2: One teacher's understanding of the emergent curriculum process

One of the other teachers in Group A noted that there were so many schemas evident in her class that she decided to work with children individually. Through a process of sustained shared

thinking (Siraj-Blatchford, 2009), she collaborated with a child who developed a drawing and story over several

days. This was an example of *thought and internalized action* because many schemas were represented. Another child was fascinated by *going through a boundary* when she threaded all the holes in a peg board. Other children in her class became interested in this activity, so the teacher extended the schema by photocopying the threaded pegboard so that the other children could also thread their pegboards in the same way.

The *enveloping and containing* schema was extended by children blowing coloured bubbles through a straw for printing. This is illustrated in Figure 6.3. When this teacher saw a group of boys building a block tower, she encouraged them to go higher and higher. Later they explored *going through a boundary* when they dropped blocks through the tower from the top (see Figure 6.4).

Figure 6.3: A child enjoying the *enveloping and containing* schema by blowing paint bubbles for printing

Figure 6.4: Boys were encouraged to build their tower higher and higher whilst exploring the d*ynamic vertical schema*

- **Group B: Meaning Making and Decision Making**

Group B chose the *dynamic vertical* schema for their meaning making task as this seemed to be most in evidence amongst the pictures they had collected. Group B had closely observed the

Figure 6.5: Children playing "train" in a *dynamic vertical* schema

physical activities of the children they taught. As shown in Table 6.4, column 1, they had observed the

children positioning the chairs in lines, rolling tyres, printing with wheels and skipping with stockings and rope. All of these, they felt, were examples of *dynamic vertical schema.* Figure 6.5 illustrates the *dynamic vertical schema* which the teacher extended by skipping with stockings and rope. All of these, they felt, were examples of *dynamic vertical schema.* Figure 6.5 illustrates the *dynamic vertical schema* which the teacher extended by helping the children arrange the chairs one behind the other so that they could experience the feeling of sitting behind one another as on a train.

- **Group B: Planning and implementing**

Group B's presentations were all around the *dynamic vertical* schema, with some of the teachers planning the same activities that had been decided on during the focus group discussions, and others planning some different ones, e.g. the train activity illustrated above. Figure 6.6 shows some examples of *dynamic vertical* schemas. The teachers had designed activities that took place indoors and outdoors and some teachers mentioned free drawing as an important daily activity. This illustrates how the participant teachers attached significance to children constructing their own understandings through drawing.

One teacher described the children drawing trees with apples falling as a *dynamic vertical* schema. However, the photographs taken by the teacher to illustrate this, revealed that the children were merely colouring in pre-drawn trees on a published worksheet. A worksheet like this does not allow children to express their own understandings or thinking by expressing their marks (Carruthers & Worthington, 2006, p. 196).

Table 6.6: Group B: Meaning making and decision making

GROUP B	
SCHEMA: Dynamic, vertical	
CHILDREN'S BEHAVIOUR INTERESTS	**ACTIVITIES (Decision making)**
Position chairs in a vertical line such as a train/car. Wheels and prints/patterns they make on the paper Rolling tyres up and down in a vertical line Using stockings/skipping rope to play games Threading using large beads. Making a sequence using various colours	• Drawing – throughout the day. Paper and various media and writing tools available. Scaffold their learning by asking open-ended questions. • Stories – involving children in the story by asking questions and retelling the story • Painting – Using rollers up and down • Movement – Beanbag passing in a vertical line. Frog jumping in a straight line. Balancing on a straight line • Cutting – Cut out squares and rectangles and make pictures out of the shapes.

Figure 6.6: Some examples of *dynamic vertical* schemas

- **Group C: Meaning Making and Decision Making**

Table 6.7 illustrates Group C's meaning and decision making according to children's behaviours and interests. In spite of not mentioning schemas during their focus group task sheet activity, the activities they listed on the task sheet in column 2 (Decision making) were directly related to their observations of children's behaviour interests in column 1. They had observed children's behaviour interests, but when I analysed the task sheets it appeared that they seemed not to have taken note of the children's physical movements as the other groups had. This therefore had a direct impact on the activities they suggested in column 2 – they consequently did not take physical movements like schemas into account and suggested activities like mixing paint, measuring and fantasy. Perhaps this was because I had not made this clear enough on the task sheet instructions.

Table 6.7: Group C: Meaning making and decision making

GROUP C	
SCHEMA: none	
CHILDREN'S BEHAVIOUR INTERESTS	**ACTIVITIES (Decision making)**
Imaginary stories – (animals that can speak). They like to play their characters – dress up.	Fantasy play – by providing different resources: play house, hospital, doctor.
Constructions with building blocks – building a tower of a big giant.	Construction, measurement, counting, colours, sizes and shapes.
Play in sandpit – put damp sand in a bucket and pretend to build a house.	Measurement/estimation. Moulding shapes, writing in sandpit.

Measuring water with small buckets and cups.	Plan interesting theme about water. Give instructions and challenge with open-ended questions.
Mixing different colours of paint.	Mixing colours.

- **Group C: Planning and Implementing**

Group C did not mention any schemas during the task sheet activity, but their presentations showed that they understood the notion of schemas. During their presentations, I noticed that members of Group C spoke of schemas in relation to activities that they had planned, rather than the activities being a response to the schemas.

Schemas mentioned were *circular direction and rotation*, *enveloping and containing*, and *going around a boundary*. One teacher planned a Maypole dance for the *circular direction and rotation* schema, with the children holding ribbons and moving round a pole whilst weaving the ribbons in and out of each other. She used a jigsaw puzzle to extend the experience of *enveloping and containing*, and bead threading and jungle gym climbing for *going around a boundary*. Another student planned an activity which involved crayon rubbing over templates of fruit. She did not mention what schema was involved in this activity, or in the game "Cat and mouse" which she planned.

The fact that Group C did not implement the activities they had decided on during their focus group discussion, led me to believe that they saw each of the steps that had been building towards understanding of an emergent curriculum process as discrete. They were starting to plan activities that extended children's areas of interest, as in Table 6.7 – columns 1 and 2, but when they reached their classrooms they had carried out different activities unrelated to what they had previously observed in "The Children's Story" of the task sheet.

6.5.2 Reflections on Meaning Making

The third assignment for Phase II [DF 5] (see Appendix 2) required the teachers to reflect on the meaning making process that had informed their decision making and planning. This activity was intended as a means to gauge their understanding of the emergent curriculum process. I wanted to understand what motivated the teachers to respond as they did to the behaviours they had observed. Although it was interesting to note which schema were being displayed most often

amongst the children they taught, for research purposes I wanted to discover if this would be the process which would guide the teachers towards planning with the children's interests in mind. It was also more important that the teachers gain confidence in being able to classify schemas even if the classification of schemas was not entirely correct. Following Zeichner & Liston (1996) who argue for reflection and collaboration as prerequisite for teacher professional development, I tasked the teachers with writing a reflective report on the meaning making process. This, I contend, would enable the teachers to acquire the reflective skills needed for implementing an emergent curriculum.

An analysis of the teachers' reflective reports revealed the dispositions which Stacey (2009, p. 15) described. The findings which emerged during analysis of the teachers' reflective reports echoed these dispositions in many ways, as shown below in the teachers' own narratives. The following themes were identified:

Mark making can influence planning:

> *Mark making is when children are constantly striving to make sense of the world around them. Then it is no wonder that teachers are interested in investigating the meaning children make as they explore their own world in a range of home and school context... I am aware that mark is about complexity of children's thinking and what I always do now I provide them with relevant and a variety of resources, and have produced matrix to help them develop the necessary skills.* [DF 5]

> *I need to listen to children's voices and to recognise, value and support children's thinking and visual representation in Mathematics. Failure to do so will mean that opportunities for creative thinking will continue to be limited.* [DF 5]

Increased awareness of children's behaviour interests and drawings:

> *The reading helped me a lot because I wanted my learners to draw what I can see not what they want to draw, e.g. this little boy in my classroom draws something that appeared to be scribbling to me and I did not even bother to ask what he had drawn, with the help of the reading the scribbling as I called it got the meaning to this little boy*. [DF 5]

> *For example, I had seen children folding up their paintings until they couldn't fold them anymore. I used to stop the children from doing this, as I felt they were wasting their paintings ... little did I know they were actually enveloping and containing – an essential part of their growth and progress. After learning about different schemas, I stopped restricting this activity.* [DF 5]

> *Understanding schemas are useful for helping to understand a child's motivation for doing something. From there, we can extend their learning by matching curriculum content based on individual interests.* [DF 5]
>
> *What is new to me that those schemas have meanings* [DF 5]

The role of the teacher:

> *Adults also need to spend quality time critically and creatively emphasize these representations. Adults will never be able to understand children's representations unless they are focusing on the process not the product. Adults['] plannings should be influenced by their observations. Adults need to always remember that they are there as supporters and facilitators.* [DF 5]
>
> *The teacher must value and celebrate mark making. Develop children's awareness of language and writing systems of their language and other communication systems. Teachers are fascinated by children's thinking and are committed to supporting them.* [DF 5]

An awareness of guided (scaffolded) activities:

> *If I saw a child writing, I'd jump in and sit with them, for at least five minutes, giving them encouragement, finding additional resources for them, and subtly giving them ideas and extending the activity. I discovered this was an excellent way of scaffolding their learning. The immediacy of the process was also exciting to watch – instant gratification and results!* [DF 5]
>
> *I facilitate learning by setting up environments to enable access to resources and space to work independently, providing exciting starting points, resources and ideas, modeling creativity and being willing to find things out alongside the children, helping them to think carefully about decisions, inviting children to solve problems and extending children's ideas by setting challenges, being active listeners and observers.* [DF 5]

There is evidence from the teachers' responses which suggests that they were developing an understanding of the emergent curriculum process and how planning in this way could help them to become more effective teachers. The dispositions identified by Stacey (2009, p. 15), namely "teachers in relationship with the child, parents and community", "collaboration with the child" and "teacher as researcher, child as protagonist" were apparent in the teachers' reflections. One teacher's understanding of mark making is revealed here:

> *Mark making is the child's way of formulating ideas, expressing themselves and processing their perceptions of their worlds. By making marks, they can create evidence of their thoughts.*[DF 5]

Section 6.5 has analysed and discussed what emerged from the data generated from the activities in Phase II – written focus group task sheets, audio-visual recordings of presentations and written reflective reports on the teachers' experiences of making meaning. Section 6.6 discusses the findings in relation to the goals of Phase II of the research.

6.6. Summary and Discussion of the Findings: Phase II

Phase II – meaning making, decision making and reflecting – had the following goals: for the teachers

- to make meaning of children's behaviour and visual representations using their knowledge about schemas,
- to make decisions about activities which would enhance and extend children's learning, and
- to reflect on the process of meaning making and decision making according to children's interests and behaviour.

What emerged during Phase II was as follows:

- It was significant that none of the focus groups listed visual arts representations under "The Children's Story" of the task sheets. This could be because I had not explicitly suggested drawings and art as an expression of behaviour interests.
- Many of the activities planned and implemented by the teachers were a direct response to the behaviour interests and schema that they had observed. Some teachers, however seemed to view each step in the emergent curriculum process as discrete.
- It was not always obvious to the teachers which schemas were being displayed. Perhaps this was because they needed to observe the children in a specific way i.e. according to physical movements, whether in art or play.
- Although some of the teachers mentioned mark making in relation to mathematics, none of the activities were directly related to mathematics.
- There was an increased awareness of children's behaviour interests and drawings, and teachers remarked how being aware of children's mark making can enhance planning.
- Reflections had prompted the teachers to think more deeply about the role of the teacher and how to effectively mediate learning.

- Some of the activities which were planned were not a response to any observations.
- Some activities did not allow children to express their own meanings and understandings e.g worksheets.
- The teachers were starting to reflect deeply on their practice.
- The dispositions mentioned by Stacey (2009, p. 15) were evident in many of the teachers' reflections and presentations.

6.7. Conclusions

Chapter Six examined Phase II of the emergent curriculum process: meaning making, decision making and reflecting. The teaching and learning activities for contact session 2 involved a Powerpoint presentation on visual representations, and afterwards, the teachers' collections of visual art were classified according to the schema represented therein. Focus groups then completed task sheets, which the teachers used for their assignments on implementing the activities appropriate to the schema they had observed. The data generated from the task sheets and presentations by the teachers was analysed. The final reflective assignment for Phase II was analysed and emergent themes were highlighted.

In the following chapter, Phase III of the emergent curriculum process is described and analysed, and the findings in terms of the activities and the goals for Phase III are discussed and summarised.

CHAPTER SEVEN
Analysis and Discussion of the Findings: Phase III

"One of the functions of mathematics education is to help children to advance beyond their informal, intuitive mathematics – what Vygotsky called 'everyday knowledge'. In Vygotsky's view, the goal is to help children develop, over a period of years, a powerful and organized 'scientific' knowledge – in this case the formal concepts, procedures, and symbolism of mathematics." (Ginsburg et al., 2008, p. 6)

7.1. Introduction

Phase III, the final phase of the emergent curriculum process took place during a two day contact session. This chapter starts by examining the rationale and aims for Phase III. The teaching and learning activities are described and the assignment tasks are explained in the section thereafter. Data generated in Phase III is then analysed and discussed. The findings in terms of the goals for Phase III are summarized and discussed at the end of the chapter.

7.2. The Rationale and Aims for Phase III

By the time young children enter Grade R, they have already developed many mathematical understandings (Ginsburg et al., 2008). Teachers need to build on what young children already know, even though it might not correspond with the ways that young children are expected to represent their learning at school. (Carruthers & Worthington, 2006; Ginsburg et al., 2008; Pound, 2003; and Gifford, 2005) explain that young children should be allowed and enabled to learn by expressing their understandings through, for example, mark making or mathematical graphics. Young children's interest in mathematics is spontaneous and natural. It is often quite complex and sophisticated (Ginsburg et al., 2008).

Phase I and Phase II enabled the participant teachers to observe the children's behaviour and appreciate the knowledge and understandings that the children already have. Phase III was thus purposively designed to provide an opportunity for the teachers to apply what they had learnt about children's prior knowledge, and extend it through their teaching. In Phase III an emergent curriculum approach was used to enhance the teaching of mathematical concepts, specifically space and shape.

Subject matter knowledge is recognized as an essential aspect of teaching (Silverman and Thompson, 2008; Borko &Putnam, 1995). With this in mind, Phase III involved the teachers learning more about space and shape, and how to teach it in their Grade R classes. Space and shape knowledge was thus introduced to the teachers who had been learning how to collaborate, make meaning, make decisions and reflect. The purpose of Phase III was therefore to bring together the skills and strategies from Phases I and II in order to teach space and shape. Having learnt about the importance of allowing children to express themselves visually, the teachers would use visual arts in particular to teach the concepts of space and shape. The knowledge and skills that the teachers had learnt in Phases I and II was further developed in Phase III, when the teachers applied what they had learnt about creativity, curriculum, observation, meaning making and decision making, to actual mathematics teaching about the concepts of space and shape.

7.3. Phase III: Teaching Space and Shape

The teaching and learning of mathematical knowledge demands the interrelationship of several features. Ginsburg et al. (2008) emphasise that for Early Childhood Mathematics Education (ECME) to be effective, teachers should have a good understanding of subject matter, i.e. the concepts that are being taught; mathematical thinking and metacognitive processes in children; and the components of effective mathematics teaching. Ginsberg et al. (2008) include the environment, an understanding of play, teachable moments, explorations grounded in real life situations, the curriculum, and intentional teaching as desirable components for effective mathematics teaching.

Phases I and II introduced the participant teachers to a creative pedagogy in the form of an emergent curriculum. Moon and Leach (2008) explain that effective pedagogy is relevant to all contexts, and is a collaborative process between colleagues. They remind us that teachers should be researchers in their own settings, doing the best they can for the children they teach (pp. 28 – 29). I understand this to mean that pedagogy should be appropriate, by taking children's prior knowledge and understandings into account, and that it should not have to rely on expensive resources. The skills and knowledge relating to the emergent curriculum process learned in Phases I and II would complement the mathematical knowledge learned in Phase III, in order for the participant teachers to teach space and shape through visual arts activities.

Contact session 3 began with the teachers giving the presentations which were analysed as part of Phase II (see Chapter Six, Section 6.4.1) These presentations were video-recorded for later analysis. Phase III consisted of teaching and learning activities, and an assignment task which required the teachers to implement what they had learned during the contact session. The assignment task [MF 19] (see Appendix 4) for Phase III required the teachers to plan a lesson on an aspect of space and shape, using particular strategies (see Appendix 4). Visual arts activities were to be used during the lesson which the teachers implemented, and they were to reflect on the process.

Figure 7.1 illustrates how Phase I and Phase II culminated in Phase III, the teaching of space and shape. Phase III is highlighted.

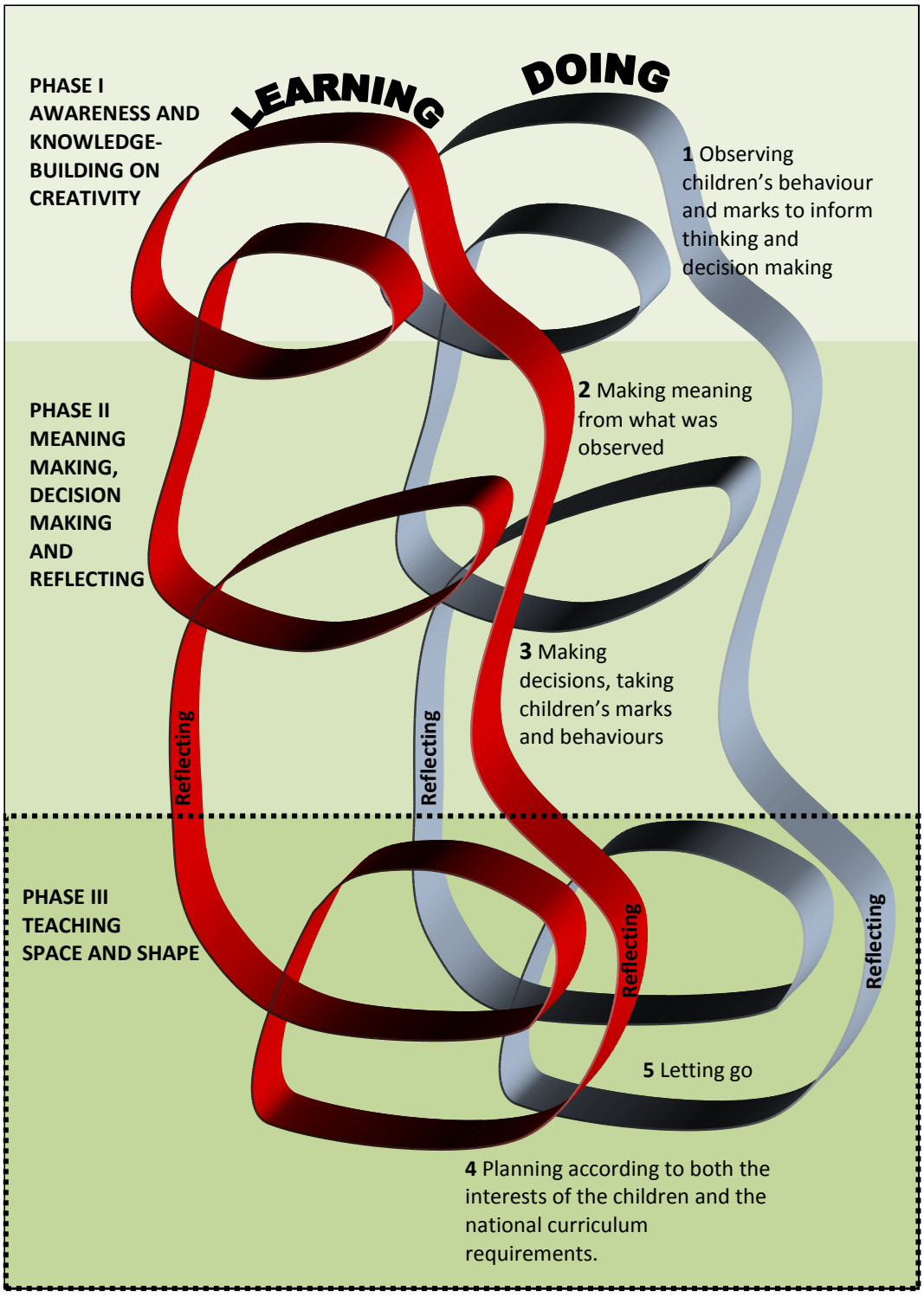

Figure 7.1: Emergent curriculum highlighting Phase III: Teaching Space and Shape

7.4. Phase III: Teaching and Learning Activities

The teaching and learning activities for Phase III involved a Powerpoint presentation on Shape and Space, a number of readings, a group activity translating shape names, and space and shape games which the participant teachers engaged in, as shown in Table 7.1. The activities are explained below. As with Phases I and II, the table shows the "Learning" and "Doing" activities in which the teachers were engaged.

Table 7.1: Tabulated summary of Phase III

<table>
<tr><th colspan="2">PHASE III: TEACHING SPACE AND SHAPE</th></tr>
<tr><th colspan="2">Teaching and Learning Activities during contact session 3 (2 days)</th></tr>
<tr><td>Learning
Facilitation of Contact session 3:
Powerpoint presentation: Space and Shape [MF 16] (see Appendix 4)</td><td>Doing
Participation in Contact session 3:
Group activity translating and describing shape names [MF 17] (see Appendix 4)</td></tr>
<tr><td rowspan="2">Mathematics Resource Pack I [MF 18] (see Appendix 4)
• Reading 1: Ginsburg, H.P. & Amit, M. (2008) "What is teaching mathematics to young children? A theoretical perspective and case study".
• Reading 2: Gauteng Department of Education (2009) "Guidelines for teaching Numeracy". Johannesburg: Gauteng Department of Education.
• Reading 3: Dept of Basic Education, SA. (2010) "Numeracy Handbook for Foundation Phase Teachers".
• Reading 4: Carruthers, E.& Worthington, M. (2006) "Developing children's written symbols".
• Reading 5: Carruthers, E.& Worthington, M. (2006) "Challenges young children experience with written mathematics".</td><td>Space and shape activities [MF 19] (see Appendix 4):
• Jigsaw puzzle
• Tangram
• Symmetry
• Drawing from different perspectives
• Logi-shapes
• Shape buckets
• Grape box construction
• Map drawing</td></tr>
<tr><td>Assignment 3: Planning, implementing and reflecting on a space and shape lesson</td></tr>
</table>

7.4.1 Powerpoint Presentation on Space and Shape

The questions on the first slide of the Powerpoint presentation [MF 16] (see Appendix 4) which the teachers engaged with during the course of Phase III were: *Space and Shape: What are they? How does spatial reasoning develop? What do we need to know about Space and Shape in Grade R? How will we teach Space and Shape?*

The teachers gave their own interpretations first of "space" and then of "shape", and the class briefly discussed the concepts. The class thought of all the shape names that they knew in their

own languages, and discovered that there were many shapes for which they did not know the names. Some isiXhosa speakers realized that they were not familiar with the names of certain shapes in their mother-tongue e.g. different types of triangles – equilateral, isosceles, scalene; and quadrilateral – square, rectangle, rhombus, parallelogram. The teachers formed groups according to the language in which they taught, and researched shape names in isiXhosa and Afrikaans, using the multi-lingual book "Understanding concepts in Mathematics and Science" by Young et al. They filled these in on a worksheet [MF 17] (Appendix 5).

The next slide of the Powerpoint presentation described the van Hiele levels of spatial thought (Ryan and Williams, 2007): visualization, abstraction, analysis, deduction and rigour (see Chapter Three). Only the first two levels would apply to the children the participant teachers were teaching. The class discussed how van Hiele's "phases of learning" (ibid.) could practically take place, through free play, focused play and explicitation (Department of Basic Education, 2010). Most of the teachers listed many examples of free play activities concerning shape and space, like block play and construction toys. They suggested that focused play was more structured, for example, a particular role play scenario such as a shop or farmyard could be arranged in the classroom for learning mathematics concepts. Explicitation and the teaching of the vocabulary for properties of shapes could be developed through scaffolding children's learning, and asking relevant questions which would extend their thinking. It is important to teach children that not all triangles are equilateral (Gifford, 2005, Pound, 2003; Ryan and Willams, 2007), and by learning about the properties of shapes children can learn how to classify shapes more efficiently. They should be given many different examples of shapes to play with and manipulate. The notions of free play, focused play and explicitation were discussed until the teachers felt they understood them more fully.

7.4.2 Space and Shape Activities

I selected specific space and shape activities so that by doing the activities themselves, the teachers could understand more fully how children actually engage with shape and space, the difficulties they encounter, and how space and shape perception occurs. The activities could also be used in their own classrooms with their learners. Eight shape and space activities and games were arranged on tables in the room, and the teachers were given task sheets [DF 6] (see

Appendix 4) to complete (Appendix 6). They then moved freely around the room, tackling each task. The activities and games were:

- Jigsaw puzzle
- Tangram
- Symmetry
- Drawing from a different perspective
- Logi-shapes
- Shape buckets
- Drawing a map

Below, the rationale for each of the activities is given, the instructions for the activity are described, and the findings are analysed and discussed:

- ***Activity 1: Jigsaw puzzle***

Build a puzzle with a partner, helping each other. Describe how you went about it.

In pairs, the participants were required to complete a 40-piece jigsaw puzzle. The rationale for choosing this activity was because putting a jigsaw puzzle together involves looking carefully at the shapes of the puzzle pieces as well as cues like the picture on the pieces, to see how they fit together. By working in pairs, they would be participating in sustained shared thinking, as Siraj-Blatchford (2009) suggests. The teachers would encounter the problems that children have when constructing jigsaw puzzles and also appreciate the value of co-constructed learning.

The teachers commented:

I've started with corners it's how I will teach my learners.

It was difficult at first but we finish[ed] it.

Fast. Started with frame, worked well in a team!

Doing puzzles is very interest[ing]. It was the last activity for me to do it and I couldn't go before I finished. I liked and enjoy this activity.

We put all the outside pieces together and built it first and then added in the inside pieces.

As the comments show, most of the teachers had clearly developed a system for putting jigsaw puzzles together: first making the frame around the edge and then inserting the inside pieces. Some of them admitted that although they gave puzzles to their children to do, they had not done them themselves. Figure 7.2 shows two of the teachers working on the jigsaw puzzle.

Figure 7.2: A pair of participant teachers working together on a jigsaw puzzle

- ***Activity 2: Tangram***

The tangram is an ancient Chinese puzzle that involves geometrical shapes called tans. The aim of the puzzle is to create as many shapes as possible using all seven pieces. Cards illustrating possible forms are provided, with one side of the cards showing the forms as a solid black shape while the other side shows the form broken up into the geometrical tangram shapes. If all seven tangram pieces are placed strategically, they can form a perfect square.

Use the tangram shapes to make the pictures.
Would you use this activity with your own learners? Why/why not?

My rationale for giving the teachers this task was so that they could become familiar with a tangram. My experience (e.g. at SciKidz events) was that not many teachers used it and hence did not introduce children to it either. Using large wooden shapes to construct a recognizable form requires being able to visualize the shape as a part of the completed form.

While two teachers said that they already use tangrams in their classes, most of the teachers felt that they would like to introduce their children to the game. They themselves found the activity quite difficult, but could appreciate how it could benefit children's understanding of shape and space. Below are some of the answers.

> *It encourages them to think about the space, shapes and think problem-solving.*
>
> *It will encourage them to be 'creatical' thinkers.*
>
> *Yes although it's difficult they will put shapes together to initiate what they like before I gave them the cards.*
>
> *It helps with spatial orientation, processing visual information (copying) and with shape recognition and problem-solving.*

Figure 7.3: A teacher using tangram shapes to make the illustrated forms

A new word coined by one of the participant teachers (see above), "creatical", expressed the notions of "creativity" and "critical" for her. She had clearly felt that the tangram activity entailed skills of critical analysis as well as creativity. Figure 7.3 illustrates the tangram activity, showing the large tangram pieces and small cards displaying the black forms.

- ***Activity 3: Symmetry***

Fold a piece of paper into four and use scissors to cut shapes out of it to make a symmetrical doily.
What's the most important piece of advice you would give someone doing this activity?

This activity involved folding a piece of A4 paper into four; and cutting pieces from it in order to make a doily. The rationale for this activity was for the teachers to understand and experience symmetry, and how to present the activity to their Grade R classes. It is interesting because instead of using solid shapes as in the other activities, negative shapes are created by the empty holes left behind after cutting. This would be a different way of experiencing shapes. In order to make a successful doily, one needs to have an understanding of how symmetry results from the cutting of the folded paper. The shapes that one cuts should not be too big, or the doily will fall apart.

I wanted the teachers to try to express the key element of this activity so that they would understand it and be able to teach it successfully. Some of the teachers found that they cut the folds away and their folded papers fell into four pieces. Other participants demonstrated doily cutting and the teachers who had not experienced it before, were fascinated. Figure 7.4 illustrates one of the teachers cutting a doily. Once they had managed to successfully cut a doily, they were able to advise:

Figure 7.4: Cutting a doily

Have a middle corner not cutted so that you do not cut the paper into two pieces.

Fold the paper four times and cut to each corner and fold it once and cut each corner again.

Do not cut each side completely off, must leave gaps between your cutting.

Interestingly, teachers who knew how to do this activity expressed their enjoyment of it without describing how to do it. This is how they expressed themselves:

Don't worry about the end result – just enjoy the free cutting! Everything looks good, as long as it's a lot of it.

Try to be as simple and natural as you can.

One teacher enjoyed using "shape words", but did not describe the process:

The paper came out vertical symmetrical doily.

Figure 7.5 below shows a skillfully cut symmetrical doily, while Figure 7.6 illustrates a more simple doily cut by a teacher who had not done this activity before.

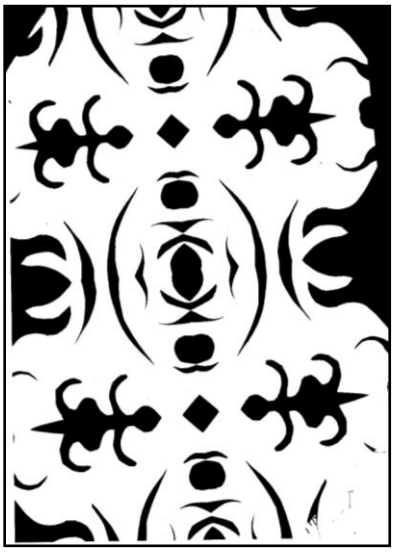

Figure 7.5: An intricately cut doily

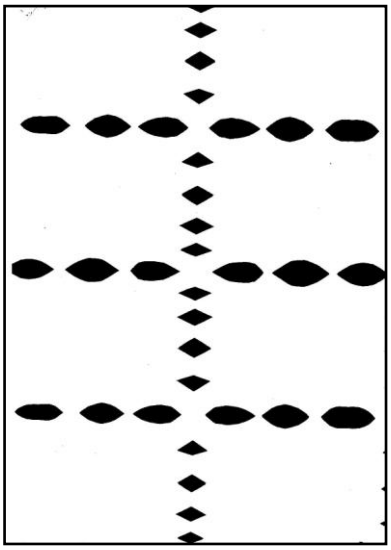

Figure 7.6: A doily cut by a teacher doing this activity for the first time

- ***Activity 4: Drawing from a different perspective***

> **Draw the arrangement on the table as if you are sitting on the opposite side of the table.**
> **Draw the arrangement from the top.**
> **Describe how you went about doing this activity.**

The teachers were required to imagine what a still life, consisting of a bowl containing apples and two matruschka dolls looked like from the other side and from the top. They then drew it from these two different perspectives.

The rationale for giving this activity to the teachers was twofold. Firstly, in encouraging children to express their understandings through visual arts activities I felt that the participating teachers should experience the process of visual arts expression themselves. Bruner showed that enactive learning leads to iconic representation where what is seen and experienced is represented. Later symbolic representation like language and writing are used (Hayward and Fraser, 2003). The teachers would thus represent their understanding of the still life through iconic representation.

Secondly, I wanted them to use their imaginations to imagine what the scene would look like from different perspectives. In Piaget's view, young children find it difficult to imagine what a scene looks like from another perspective (Kohler, 2008). According to Piaget, during the pre-operational stage children start to represent objects through signs and symbols. Intuitive thought develops when they start to think about different possibilities, as in what a scene would look like from a different perspective. This activity would not be suitable to present to Grade R's but I wanted the teachers to appreciate its difficulties. Figure 7.7 illustrates the still life I set up on a table for the teachers to draw.

Most of the teachers did not comment on this activity and some avoided it completely. I realized

Figure 7.7: The still life arrangement which had to be drawn from different perspectives

that expecting them to draw the arrangement from the top and the other side was too demanding, and some of the participants had had little or no experience in drawing from real life. Figures 7.8, 7.9, 7.10 and 7.11 illustrate the still life drawings which the participating teachers executed. These were their comments:

> *I tried to picture it from what it looked like at the top (frontal view) and then also from the other side.*

> *First had to look at the objects, then 'flipped' them in my mind – imagined myself sitting opposite side, therefore left = right and vice-versa. From top – stood up and looked from top.*

> *Imagining looking from back. Looking from top looking at shape.*

> *It was very difficult for me especially to draw from the top.*

> *It was very difficult.*

The illustrations below show the teachers' depictions of the still life.

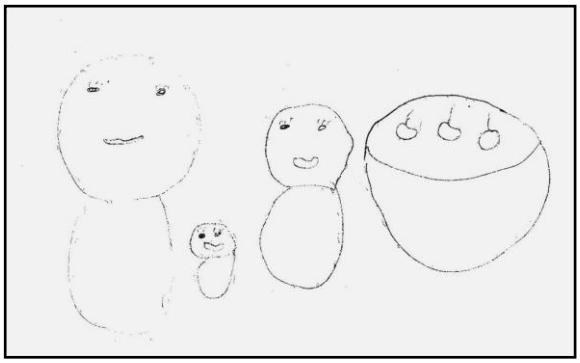

Figure 7.8: Still life drawing by one of the teachers

Figure 7.8 is one of the teacher's interpretations of drawing from the opposite side. The figures

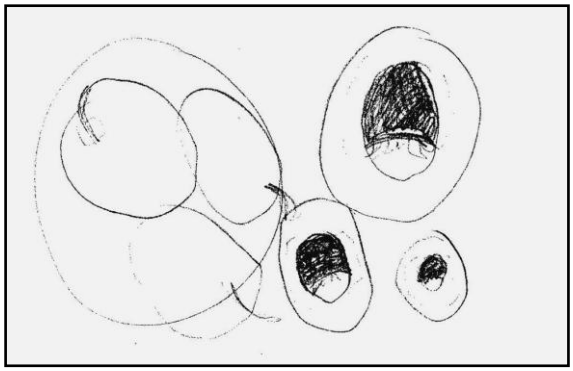

Figure 7.9: Still life drawing from above

and apples are symbols rather than images of the objects themselves. They are not drawn from the opposite side as the fronts of the figures are shown.

Figure 7.9. shows the still life shown from the top. The objects are drawn more realistically. Below, Figure 7.10 illustrates the still life from the opposite side. Again, symbols for the apples and matruschkas are used, with smiling faces being used to symbolize the matruschkas.

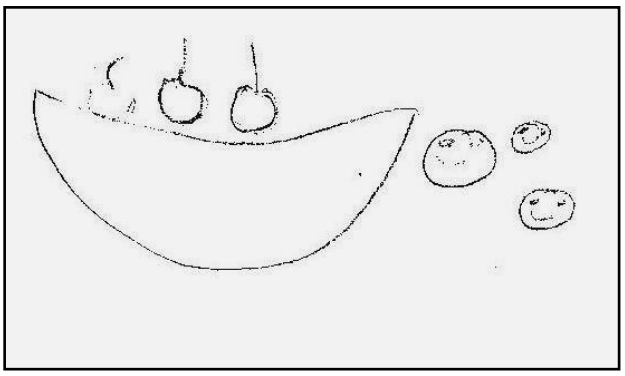

Figure 7.10: Still life drawing from the side

Figure 7.11 shows the most realistic rendition of the still life as seen from the opposite side.

Figure 7.11: Still life from the side

- ***Activity 5: Logi-shapes***

> **Place the correct shapes into the outlines.**
> **Try to create your own shapes. Is this activity easy or difficult? Why?**

This activity involved placing 3-D coloured plastic solids onto cards showing outlines of pictures. I presented this activity because it requires matching the concrete 3-D plastic shape with the more abstract 2-D shape. It is one of the activities which should be available to Grade R children as they progress from the first level of visualization and recognition to the second level of analysis, according to the van Hiele model of conceptual development in geometry (Ryan & Williams, 2007; Clements & Battista, 1992; Clements et al., 1999).

Figure 7.12: Logi-shapes being placed onto cards

Figure 7.12 shows one of the participants using Logi-shapes. The abilities of the participants varied greatly with this activity, with some finding it easy whilst others struggled. They wrote:

Easy to create own shapes but difficult to work on already laid shapes.

It was easy as the shapes were there and predictable.

Easy to see the shapes within the pictures – square edges etc. Simple pictures.

The activity is easy because the outline already shows the shapes.

Difficult because some shapes I did not know.

It's complicated the shapes does not fit. I'm suppose to put them together trying them to fit in.

- ***Activity 6: Shape buckets***

Plastic buckets with lids containing geometrically-shaped holes, and a collection of shapes to fit through the holes were provided. Specific 3-D shapes had to be inserted into their matching negative holes.

The purpose of this activity was firstly to match positive with negative shapes. Secondly, by timing themselves, the participants could experience how practicing a skill improves one's performance. In Figure 7.13 a teacher is using Logi-shapes.

Post the shapes into the correct holes in the bucket lid.
Time yourself.
Take them out again and see if you can do it faster this time.
Write down your time:
_____ minutes, _____ seconds
_____ minutes, _____ seconds
How would you be able to do it even faster? Would this work

Figure 7.13: A participant doing the shape bucket activity

It was interesting to note how the teachers improved with practice. Everyone managed to insert all the shapes far more quickly the second time. Some people worked out a strategy for doing the activity even faster. These were their comments:

> *Yes. They will love it.*
> *I would put the same shapes together and put that shape in at the same time. It would work with my learners.*

- ***Activity 7: Making boxes***

A number of grape boxes were undone and flattened. The activity entailed folding them back together to form boxes. The teachers timed themselves to see how long they took to fold the box. The aim of presenting this activity was for the teachers to visualize the end result and then construct the 3-D shape using the net. They would also experience how practicing improved their performance.

Fold a box from this template whilst timing yourself
Take it undone and do it again, timing yourself.
Write down your fastest time: _____ minutes
_____ seconds

Figure 7.14: A box is folded together

I did not provide space to comment on the box folding activity, but the participant teachers enjoyed the satisfaction of easily forming a box shape. Some took the flattened boxes home with them as they saw the potential of using it with their own Grade R children. Figure 7.14 demonstrates a box being folded together by one of the teachers.

- ***Activity 8: Map drawing***

Draw a map of the route you take to get from your home to your school. Describe how you feel about this activity.

The final activity entailed drawing a map of the route that the teachers took to get from home to school.

I presented this activity because drawing a map from a bird's eye view requires a certain degree of spatial conceptualization. One needs to take perspective and scale into account as well as the landmarks that the map is required to show.

Figure 7.15 illustrates a map showing both the side and top views of landmarks and Figure 7.16 illustrates a map using symbols to show landmarks.

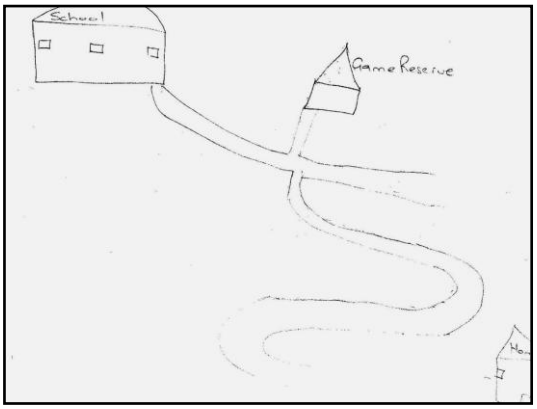

Figure 7.15: A map showing view from the side as well as the top

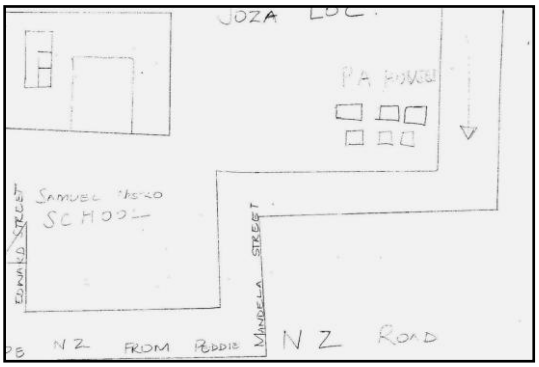

Figure 7.16: A map using symbols for landmarks

Some teachers managed the task easily, but others found it difficult. They described what they felt about doing this task:

Don't like drawing maps as I can never get the distances to scale – proportions not right. Perfectionist=frustration.

I thought it was fine. Easy enough to draw as I live close to school.

Confident because it's something I do daily.

Good, because I know where to go. I go there everyday.

I found it very difficult.

I felt very uncomfortable with this activity because I hate drawing maps.

When the teachers had completed all the space and shape activities, the Powerpoint presentation [MF 16] (Appendix 4) continued.

- **Continuation of the Powerpoint presentation – Unpacking Space and Shape**

The Powerpoint presentation proceeded to examine the requirements of what children in the Foundation Phase Grade R – Grade 3) are required to learn about space and shape. Each slide demonstrated the skills that should be developed at this age (described in Chapter Three) and the class discussed these, giving examples of what they could do in their own classrooms to develop the skills and knowledge:

- Recognising, identifying, naming 2-D and 3-D shapes of all kinds – teaching the children the vocabulary to describe aspects of shape and space.
- Building, observing, creating – 3-D objects, 2-D shapes, construction sets, building blocks, cut-out shapes, clay, straws and more.
- Transformations – including translations (sliding), reflecting, rotating, similarity, family likeness, perspective and topological transformations. This would involve organizing print-making activities with shapes, and allowing children to play with and experience many different shapes and sizes of shapes.
- Position – describing shapes in relation to each other and to other objects – playing games using vocabulary describing position and directionality.

The last slide of the Powerpoint presentation listed the components of emergent curriculum – observation, meaning making, decision making and reflecting, and the teachers were required to

identify each of these in the Ginsburg & Amit (2008) reading described below. The Resource Pack for Phase III [MF 18] consisted of the following readings:

- **Reading 1**: "What is teaching mathematics to young children? A theoretical perspective and case study" by H.P. Ginsburg & M. Amit (see Appendix 4) describes a teacher giving a lesson to four year olds on mapping. I chose the reading because it demonstrates a mathematics lesson for young children and it involves an activity which many teachers find difficult themselves – mapping. The purpose of giving the teachers this reading was to demonstrate how space and shape could be taught using an emergent curriculum approach, by taking the children's interests into account, and also considering the formal curriculum. The classroom observations I had undertaken (see Chapter Two) revealed that little direct mathematics teaching was being done, particularly in Grade R classes. In order to teach mathematics concepts effectively, it is not enough to create rich environments for play and leave learning to chance. The teacher has a specific role to play in the teaching of mathematics concepts, and Ginsburg & Amit (2008) describe the teacher's role in one specific lesson, in detail. They ask the questions:

  > What does it mean to *teach* mathematics to young children in a developmentally appropriate way? What does it mean to introduce mathematical ideas in *depth* to children who are commonly thought to be *concrete* thinkers? What does it mean to implement a *curriculum* for young children? (p. 275)

They describe the lesson, and then mention the teaching strategies which were successfully used. They include "engaged in careful planning", "presented learning as an exciting adventure", "lectured', "used humour to engage children and keep them on their intellectual toes" (ibid.) as well as strategies which refer to the processes of an emergent curriculum: "responded to the children's interests", "showed flexibility, modifying her original plan", and "created a classroom culture of learning" (ibid.).

- **Reading 2:** "Guidelines for teaching Numeracy" by the Gauteng Department of Education is a teachers' manual giving theoretical and practical knowledge on teaching numeracy.
- **Reading 3:** "Numeracy Handbook for Foundation Phase Teachers" by the Department of Basic Education, South Africa, 2010 also provides ideas for teaching numeracy in the Foundation Phase.
- **Reading 4:** "Developing Children's Written Symbols" a chapter from the book "Children's Mathematics: Making marks, making meanings" – "Developing children's written symbols" by

Carruthers & Worthington (2006) (see Appendix 4) was chosen to give the teachers greater insight into why children need to use their own symbols for learning about space and shape, and ideas on how to assess these representations of learning.

- **Reading 5:** "Challenges young children experience with written mathematics" by Carruthers & Worthington (2006) describes how introducing children to formal written mathematics symbols too early can be detrimental to their development. Carruthers & Worthington (2006) iterate:

> Good teaching attempts to foster connections between the child's informal knowledge and the abstract symbol of written mathematics. (p. 1)

7.5. Analysis and Findings from Phase III

Assignment 3 [MF 19] (see Appendix 4) was analysed according to how the teachers were able to assimilate what they had learnt about emergent curriculum (i.e. observation, meaning making, decision making, reflecting and planning) and apply it in the context of the formal curriculum provided by their schools or by the Department of Education. I wanted to see whether they would be able to use what they had learnt about schemas to implement visual arts activities. The following section will analyse the space and shape lessons which were first planned, then implemented and reflected upon by the teachers.

7.5.1 Space and Shape Lessons

I read the assignments a number of times in order to identify emergent themes and patterns. I then decided to focus on the following aspects of the essays the teachers had written:

- Planning according to observed behaviours and interests
- Teaching of space and shape
- Use of visual arts activities during the lesson
- Role of the teacher
- Teachers' reflections on the lesson

Each of these focus areas will be analysed.

Planning according to observed behaviours and interests: All of the teachers described the behaviour and schemas that their children were exhibiting and proceeded to show how the lessons they had planned extended the behaviours and schemas they had observed. The teachers

from state schools planned their lessons in terms of the NCS, whilst those who did not follow the NCS used other guiding principles in the planning of the lesson e.g. High/Scope's key experiences. One of the teachers explained

> *I will look at their behaviours and schemas they develop while doing the activities making a point that the activities are at their interest and level. [DF 7]*
> *I also chose this schema, as at this age that I teach, the children are all interested in many things and are interested in learning and working with different objects and creating their own art work.* [DF 7]

One teacher described her children's fascination with circles and went on to plan her lesson around circles, while another teacher chose to work with boxes:

> *… the obvious fascination children hold with boxes – they are always interested in the mechanisms of boxes, they enjoy exploring the insides and outsides of boxes and are always interested in gluing boxes together to make different things.* [DF 7]

Directionality was introduced by a participant teacher when she noticed through her observations that children could not always adequately explain positions of objects in space.

Teaching of space and shape: In all cases, the space and shape lesson was introduced during the morning ring. It is usual during Grade R to introduce new concepts at this time, and it is also practical because creative activities usually take place after morning ring. It would thus be ideal to move from the formal introduction of a concept during the morning ring to the practical implementation of it during the time when visual arts activities are done. In one of the lessons a pile of boxes was introduced during the morning ring. The teacher introduced the children to their names, sizes and shapes. Another teacher introduced a "feely bag" of shapes which the children had to identify by feeling and not looking, and then match the shape with another one in the classroom.

> *My children know the names of simple shapes, like circle, square and triangle, and they can see the difference between them. The really difficult thing for them is to recognize shape[s] when they are made slightly lop-sided or made longer. After I made this the children couldn't tell me what shape it was. And what I had to teach them was to analyse these shapes. It is easy to see the shape, then they name them and they analyse and really realize that a triangle has three sides and the sides don't need to be the same.* [DF 7]

Another teacher introduced shapes by using a feely box activity. The box with a hole for putting in hands contained interesting items and textures like corks, carpet pieces, and cotton wool. By putting their hands inside rather than outside the box, the children were exploring the shape of a

box in a different way. The teacher introduced the lesson by discussing shape vocabulary around boxes: *square, rectangle, equal/unequal sides, parallel, polyhedron, cube, cylinder, plane, face, vertex* and *edge*. Another activity which explored the insides of boxes included matchboxes filled with different objects. The children had to shake them and listen to see which one sounded the same, and then put them in pairs according to the same sound.

In another classroom, the children were divided into three groups. They were given the tasks of finding objects that can roll, those that cannot roll and explaining why the objects could and could not roll. The teacher who wanted to teach the children more about position in space, introduced the lesson by means of flashcards showing a rabbit behind a box, under a box and on top of a box. The children then had to get into the same positions themselves and describe the positions. Teachers extended what the children already knew about shapes:

> *I had already taught them about circles, triangles, squares and rectangles so I tried to introduce cylinder for toilet tubes, cuboid for rectangle and sphere for circle, I tried to show the different shapes.* [DF 7]

Use of visual arts activities during the lesson: One teacher focused on cylinders and made binoculars from toilet roll inner tubes as their visual arts activity. Although the making of binoculars is not a visual arts activity, the teacher explained that she was extending schema she had identified – g*oing through a boundary*. The children had to thread string through the 'binoculars' to hang them around their necks.

Another teacher prepared pre-cut coloured shapes to form a collage, and shapes to print to form a pattern. Children had to cut their own shapes and glue them to form a rocket. All the rockets were different even though the teacher had specified what the children should make with the shapes. Another activity where the children had to cut was doily cutting, as the teachers had done at the contact session.

> *The activity was difficult for other learners because they were struggling to hold a scissor so for that reason they were unable to cut so I have to hold their hands while they are cutting. The ones who were able to cut were so interested even those who were unable were interested I saw them they wanted to learn to cut so their behaviour was good towards that activity.* [DF 7]

One group of Grade R's cut a foam ball in half and glued the halves to either side of a circle. They then decorated them with glitter and coloured paper to form Saturn planets which they hung around the classroom.

Box construction was used by two teachers, where the children built freely with waste material – boxes of all shapes and sizes, toilet roll inner tubes, corks, cotton reels, string, sellotape and coloured paper. In one school, the teacher had glued a box to a piece of card for each child. Using felt-tip pens, the children creatively turned the boxes into people, trucks, cars, fish and houses. A similar activity was done in another school using circles which the children cut out and stuck to paper, then drew on the paper, turning the circles into faces, people, trees and balls.

Role of the teacher: Almost all the teachers spoke about using open-ended questions. However, they did not describe the questions they asked so it is difficult to know whether the questions were in fact, open-ended. Most teachers spoke about scaffolding the children. Again, it was not always clear how scaffolding was done, because in their descriptions they were not specific.

> *How I assessed them was by observing the children, how they thought about the process, how they answered my planned questions, how they interacted and then how they analysed the process and developed their thinking.* [DF 7]

> *I've observed that other learners learn best when I'm not there to guide or give support they learn best when they are helping each other without my interference.* [DF 7]

Teachers' reflections on the lesson: Almost all teachers reflected on their planning and implementation of the lesson. This demonstrated that they were starting to implement the processes of emergent curriculum.

> *The only thing that was difficult was that the teachable moment where the child says something and the teacher pounces on them and says "Oh, wow, that's very interesting!" This is very difficult when you have 32 children in the class and can't do it all the time with all the children …* [DF 7]

> *Learners were very much engaged in the schemas they have done, what I've observed is although they were not doing exactly what I expected they enjoy the activities and they were confident to talk about their activities.* [DF 7]

> *I group learners according to their abilities and that did not work well in some groups especially the slow group. It was fine with fast learners as they compete*

with each other. The slow group struggled with most of the activities as they had no one to copy from. [DF 7]

This theme was a lot of fun to do, and really caught the children's interests. It was something they could all understand and could all relate to as boxes are all around us. It helped to heighten the children's awareness not only of boxes but also of the sizes and shapes and uses of different things in our environment. [DF 7]

This section has analysed the rich data which was generated from Assignment 3, on the teaching of space and shape. The following section discusses the findings in relations to the goals of Phase III.

7.6. Summary and Discussion of the Findings: Phase III

Phase III set out to bring together the first two phases in an experience of teaching a lesson. The teachers were required to use the knowledge and skills gained from Phase I and II in order to implement the lesson on space and shape, using visual arts. This section summarises the findings of Phase III, and discusses the findings in terms of the goal for Phase III: for the teachers to apply what they had learnt about creativity, curriculum, observation, meaning making and decision making, to actual mathematics teaching about the concepts of space and shape. What emerged in Phase III was as follows:

- Many teachers did not know the range of shape vocabulary that should be taught to Grade R children.
- The isiXhosa speaking teachers did not know many of the shape names in their own language even though they are supposed to be teaching in isiXhosa and introducing the First Additional Language – English – in Grade R.
- It was obvious that some of the teachers had had little experience in doing space and shape activities and games. Some commented that they used the activities in their classes but did not make use of them, themselves.
- Even though they said that they did not do jigsaw puzzles, most of the teachers had developed a strategy of putting the frame together first, which they taught to the children.

- The large tangram pieces were extremely difficult for some teachers to put together. When they used the cards showing how the pieces formed the shape, they found it easier.
- The symmetry exercise which involved cutting an A4 page into a doily revealed that some teachers had not done it before. When they had to describe how to go about the activity, they were more skilled at explaining how it should be done. Participants who cut intricate patterns and designs had had more experience, but did not explain accurately how to cut patterns without cutting the paper in half.
- Drawing a still life from a different perspective proved to be an intimidating exercise, and some participants did not do it. Most of the drawings showed no resemblance to the objects displayed. They drew symbols rather than the objects themselves (see Figures 7.5 – 7.11). This could be because the teachers had not drawn objects from real life before. I expected too much by expecting them to draw them from a different perspective when they had had so little experience drawing objects from life.
- The map drawing activity was difficult for all teachers. Some were not used to drawing from a bird's eye view and consequently some objects were drawn from the side and others from above; and others who had drawn maps before complained about perspective difficulties.
- All the teachers described the behaviour and interests of their children and showed how the lessons they planned extended the children's interests and learning.
- Most participant teachers planned interesting lessons on shape and space, using different resources e.g. feely bag.
- Many teachers planned an entire theme around an aspect of shape e.g. boxes, circles, with many different activities taking place over the period of a week.
- Some visual arts activities were not creative, in that the children were not free to make what they wanted to make e.g. binoculars.
- Certain visual arts activities could have been more creative by allowing the children more choices e.g. using pre-cut shapes to form a particular picture instead of allowing children to create their own meanings and expressions of understanding.

- By giving the children a shape such as a box stuck to card and allowing them to use their imaginations to turn the shape into something, the teachers were effectively helping the children to move from the concrete to the abstract.
- Almost all teachers spoke about using open-ended questions. No one actually wrote down some of the questions used.
- They also wrote about scaffolding, but did not explain in detail how they went about this. From this I deduced that while they know that they should ask open-ended questions while mediating learning, they do not necessarily use the strategy as effectively as is possible.
- Their reflections on their space and shape lessons showed that the teachers were becoming skilled at using an emergent curriculum process, recognizing children's interests and allowing them to make their own meanings.

7.7. Conclusions

This chapter has described and analysed Phase III of the study. Chapter Seven was the final chapter in the emergent curriculum process covering Phases I, II and III. This chapter described the implementation of Phase III of the emergent curriculum process. The rationale for Phase III was described, and the teaching and learning activities were reported on. At the contact session, the teachers engaged in a number of space and shape activities to increase their own understandings of the process of learning these concepts. They also learnt more about the vocabulary attached to shape and space. The assignment tasks were analysed and emergent themes noted. These have subsequently been analysed.

Chapter Eight will attempt to draw together and discuss the threads from the data analysis and findings from all three phases.

CHAPTER EIGHT
Conclusions

"Undertaking a programme of research affects everyone who does it." (Newby, 2010, p. 639)

8.1. Introduction

Chapter Eight synthesizes and discusses the findings from each phase of the study. In weaving together the themes and critical insights which have emerged, the lessons to be learnt from the study are identified. The chapter is structured as follows: first, a review of the questions which were formed at the start of the research intervention is given. Secondly, a description of the themes which emerged during the implementation of Phases I, II and III is given. Thirdly, the findings are evaluated in relation to the research questions, and the lessons learnt from this research intervention are suggested. Fourthly, the limitations of the study are discussed and suggestions are made for further research. The final section concludes with a critical reflection.

This research intervention began with the following questions (stated in Chapter One):
How can a curriculum intervention in a BEd in-service teacher education programme, which adopts and models an emergent curriculum approach, develop teachers' understandings of:

i. how to make meaning of children's behaviour interests;
ii. how to plan their curricula around those interests;
iii. how to use visual arts to enable and enhance children's learning about space and shape; and
iv. how action research processes can promote their development as reflective and reflexive practictioners?

The following sections explain how these questions and resulting data shaped the emergent themes and findings from the research intervention.

8.2. Emergent Themes

My research investigated how visual arts can be used to teach space and shape in Grade R. It brought several notions together: space and shape, visual arts and pedagogy. In addition, the notions of emergent curriculum and creativity formed threads running throughout the research process. Teacher professional development informed the three phases of the research study, and this theme is embedded throughout the study.

The findings from Phase I (described in Chapter Five), Phase II (described in Chapter Six) and Phase III (described in Chapter Seven) have been discussed in relation to the goals for each phase. Table 8.1 below summarises the findings from the three phases. By presenting the findings from the three phases alongside each other and examining them together, I wanted to gain an understanding of patterns and themes which linked the phases. I therefore used different colours to highlight the main themes which ran throughout the research study, to see how the themes repeated themselves throughout the three phases, and to enable a synthesis of the study to take place.

Table 8.1: Summary of the findings from Phases I, II and III

PHASE I AWARENESS AND KNOWLEDGE BUILDING ON CREATIVITY	PHASE II MAKING MEANING AND MAKING DECISIONS	PHASE III TEACHING SPACE AND SHAPE
• Teachers did not have a clear idea of how it could be implemented in their own Grade R classrooms. Creativity provoked the idea of fun, and the use of resources rather than a classroom climate of encouragement and openness. • Teachers' methods of observation reflected their pedagogical practices. On the one hand, the deficit models of observation suggested behaviourist classroom practices, and on the other hand, anecdotal note takers seemed to follow social constructivist models. • Observing the children's behaviours, interests and schemas was a new experience for many teachers.	• None of the focus groups listed visual arts representations under "The Children's Story" of the task sheets. • Many of the activities planned and implemented by the teachers were a direct response to the behaviour interests and schema that they had observed. Some teachers, however seemed to view each step in the emergent curriculum process as discrete. • It was not always obvious to the teachers which schemas were being displayed. • Although some of the teachers mentioned mark-making in relation to mathematics, none of the activities were directly related to mathematics. • There was an increased	• Many teachers did not know the range of shape vocabulary that should be taught to Grade R children. • The isiXhosa speaking teachers did not know many of the shape names in their own language. • Some teachers had had little experience in playing space and shape activities and games. • Even though they said that they did not do jigsaw puzzles, most of the teachers had developed a strategy of putting the frame together first, which they taught to the children. • The large tangram pieces were extremely difficult for some teachers to put together. When they used the cards showing how the pieces formed the shape, they found it easier.

• The majority of schemas represented in the examples of children's art which the teachers had collected, showed the *enveloping and containing* schema. Worksheets were only able to demonstrate one type of schema – *dynamic back and forth*. • Teachers' descriptions of the learning opportunities in their environments reflected two notions: exposure to resources, and the teachers' role. • Scaffolding was interpreted differently by the teachers - sometimes as helping a child who had learning problems, rather than engaging with a child and extending and enhancing learning in everyday situations.	awareness of children's behaviour interests and drawings, and teachers remarked how being aware of children's mark-making can enhance planning. • Reflections prompted the teachers to think more deeply about the role of the teacher and how to effectively mediate learning. • Some of the activities which were planned were not a response to any observations. • Some activities did not allow children to express their own meanings and understandings e.g. worksheets. • The teachers were starting to reflect deeply on their practice. • The dispositions mentioned by Stacey (2009, p. 15) were evident in many of the teachers' reflections and presentations.	• The symmetry exercise which involved cutting an A4 page into a doily revealed that some teachers had not done it before. Participants who had not made doillies before were better able to explain how to do it. • Drawing a still life from a different perspective proved to be an intimidating exercise, and some participants did not do it. • The map drawing activity was difficult for all teachers. • All the teachers described the behaviour and interests of their children and showed how the lessons they planned extended the children's interests and learning. • Most participant teachers planned interesting lessons on shape and space, using different resources e.g. feely bag. • Many teachers planned an entire theme around an aspect of shape. • Some visual arts activities were not creative, in that the children were not free to choose what they wanted to make, and others could have been more creative by allowing the children more choices. • By giving the children a shape such as a box stuck to card and allowing them to use their imaginations to turn the shape into something, the teachers were effectively helping the children to move from the concrete to the abstract. • Almost all teachers spoke about using open-ended questions. No one described the questions used. • They also wrote about scaffolding, but did not explain in detail how they went about this. • Their reflections on their space and shape lessons showed that the teachers were becoming skilled at using an emergent curriculum process, recognizing children's interests and allowing them to make their own meanings.

Each of the themes can be imagined as fibres forming a dense mat. This chapter aims to bring together the findings from each phase, in order to show how each theme played a significant role in the development of a strategy for Grade R teachers implementing space and shape through visual arts activities.

Just as fibres which are woven together form a mat which is difficult to unravel, so it is with the themes of this study which constantly overlap, repeat and intertwine. Thus, whilst attempting to discuss the findings in each strand or theme discretely, the act of synthesis denotes combining the themes into a whole. Interwoven strands also form a pattern, and this chapter will examine the emergent patterns of the research process. Figure 8.1 shows the interwoven warp and weft fibres of the metaphysical mat, with each representing a theme of the study. The vertical warp strands represent the elements of the emergent curriculum process which were developed during Phases I, II and III. The themes which ran through the entire study are represented by the horizontal weft strands. Each of these will be examined in the following sections.

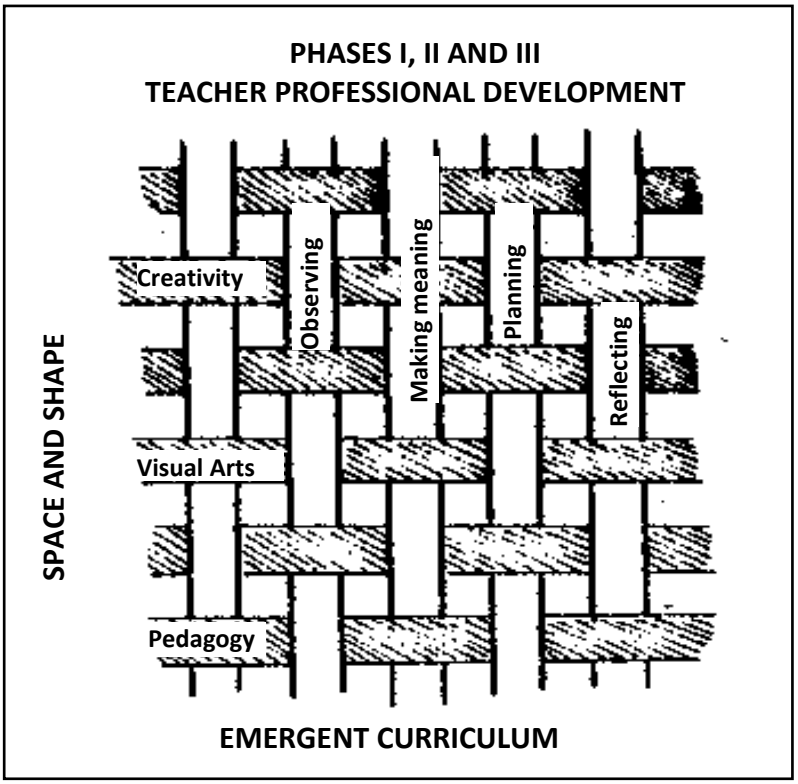

Figure 8.1: The themes which emerged during Phases I, II and III

8.2.1 Creativity

The findings of Phase I discussed in Chapter Five, noted that the participant teachers did not have a definite and clear idea of how creativity could be implemented in teaching mathematical concepts. However, a creative environment is essential for children to be able to express their learning through mark-making (Carruthers & Worthington, 2006). The teachers described creativity as "fun" (see Chapter Two and Chapter Five). However, while making learning fun is an effective teaching strategy, fun is not necessarily always creative. Craft (2002, 2005) suggests that creativity involves more than fun and enjoyment and emphasizes that the role that teachers play is vital. In a creative environment, the teacher has a specific role to play. Far more than merely providing resources and activities which make learning fun, teachers should set clear goals for learning; have the ability to balance freedom and constraint; expect the unexpected, and use language to stimulate creativity (ibid.).

8.2.2 Visual Arts

Schemas are an expression of children's behaviour and interests through mark making (Athey, 2006; Arnold, 2010; Carruthers & Worthington, 2006). It was my view that schemas could be used as other researchers had done (ibid.) to firstly make meaning of the children's interests, and secondly, to extend learning through visual arts activities. In Phase I, the participant teachers learned how schemas reflect children's current interests, and in Phase II they experienced making meaning of the schemas for planning curricula. Generally, the lessons and activities planned and implemented by the teachers were a direct response to the behaviour interests and schemas that they had observed. In my view, this showed that the participating teachers were becoming more confident in themselves as pedagogues who could design learning programmes consistent with the interests of the children they teach.

However, when required to use visual arts activities in their mathematics lessons in Phase III, some of the visual arts activities which the teachers chose did not allow the children to express their own understandings. Some teachers mentioned that visual arts activities strengthened fine motor co-ordination, and hence the activities they presented had the goal of developing fine muscle control, rather than allowing for children's meaning making. It seemed to me that for some teachers, visual arts activities were seen in terms of resources, such as crayons, paper and paint instead of the opportunities they are for meaning making. Einarsdottir et al.(2009) explain that children's drawings convey their understandings and thus it is vital that young children have access to a range of materials and resources as well as an appropriate ambiance for meaning making. Einarsdottir et al. (2009) also recommend that children's graphics should be seen as intentional, purposeful meaning making. Thus, when art media are used in prescriptive activities, children do not have the opportunity to make their own meanings.

The worksheets that some teachers used as examples of visual arts activities did not show the children's expressions of understanding because colouring in only uses the *dynamic vertical* or *dynamic back and forth* schemas. Hence, the worksheets were not effective in allowing children to translate their understandings by making marks, or for the teachers to make meaning of the children's understandings. Carruthers & Worthington (2006) suggest that worksheets hamper children's drawing and writing and on worksheets they often work below their ability. Because of

their confining nature, worksheets do not show what a child thinks and knows, and are more likely to show what children cannot do than what they can do.

8.2.3 Pedagogy

Moon and Leach (2008) talk about teachers and children negotiating an "authentic curriculum" (p. 17). This requires a close relationship between teachers, children and families. Teachers should be aware of children's interests and this awareness results from observing them closely. Many of the participating teachers admitted that they had not closely observed children before. Consequently, they mostly observed their children as for assessing their performance in particular tasks. Often the comments related more to what the child could not do rather than what the child could do. In my view, this form of observation seemed to be characteristic of a behaviourist approach; whereas the teachers who took continuous anecdotal notes were more curious about the children's interests and behaviour, and paid attention to their drawings and speech. This type of observation was consistent with a social constructivist approach.

It became apparent that most of the participating teachers did not have a clear idea of their role as teachers. In Phase I, most of the teachers described the environments they had created "rich in learning opportunities" (Department for Children, Schools and Families, 2008) in terms of resources they had provided, and did not speak about their role other than exposing children to resources. During Phase II and Phase III, they spoke of using "open-ended" questions, but they did not describe the context in which the questions took place, or the particular questions they used. They also had different conceptions of scaffolding learning. Some teachers understood their role as assisting children as they tried to achieve tasks in the formal curriculum requirements, whilst others entered into a relationship of "sustained shared thinking" as suggested by Siraj-Blatchford (2009) with children. Again, the difference seemed to lie in a more technical approach and a social constructivist one.

8.2.4 Curriculum

Craft (2002, 2005) explains how teachers often think that if they implement policies and curricula designed by officials their teaching will be more successful, and they will produce better learners. Frame (2003) describes this as a technical paradigm with the state playing a prescriptive role.

Jansen (2003) also alludes to this when he speaks of a "top down" approach with teachers following curricula formulated by officials. Generally, the teachers participating in my research study seemed to see themselves as purveyors of the national curriculum and did not regard themselves as having the power to change it according to their needs. Jansen goes on to say that teachers need to be empowered to instigate appropriate curricula for their own contexts.

This research study has examined emergent curriculum as a possible agent for the implementation of a more creative pedagogy. By taking the behaviour and interests of their children into account, making meaning and planning accordingly, the emergent curriculum approach enabled the teachers to become more confident in their own abilities to develop appropriate curricula. The teachers remarked that they had become more aware of children's behaviour interests and drawings, and could use their knowledge of the children's behaviour interests to enhance their planning. As the teachers observed, made meaning, made decisions and planned around children's interests, the desirable dispositions for teachers, curiosity, collaboration and reflection (Stacey, 2009, p. 15), became more evident. By having to reflect as part of the emergent curriculum process, the teachers were forced to think more deeply about their roles as teachers and mediators of learning.

8.2.5 Teacher Professional Development

Teachers as professionals are defined as having professional accountability and a knowledge base (Eraut, 1995, p. 230). Eraut (1995) says that teachers should:

- develop "processes for acquiring information" (p. 230) about their students;
- follow routines and yet be intuitive;
- analyse contexts, reflect and devise plans of action; and
- evaluate their behaviour and modify or rethink their practice.

Eraut (1995) contends that the notion of reflective practice implies teachers recognizing the relationship between theory and practice and not being prescribed to by external experts; and that they can change their practice. Eraut (1995) furthermore suggests that reflective practice should be a process and that it has a professional element. Lunenberg & Korthagen (2009) propose the three components of theory, experience and practical wisdom. In this study, Phases I, II and III were designed to develop the teachers' knowledge and expertise in the field of teaching

space and shape through visual arts activities. The emergent curriculum approach, which closely followed Huberman's "open Collective Cycle" (1995, p. 213), described in Chapter Three, Section 3.7, which was embedded in this study had the goal of developing the above-mentioned professional skills and enabling the teachers to become reflective practitioners in their own contexts. The teachers' analyses and reflections on their teaching showed that they were developing new insights into their role as teachers.

8.2.6 Space and Shape

Teaching Grade R children about space and shape requires an understanding of the concepts of space and shape, and also an awareness of the problems that children face when learning about space and shape. Using visual arts to teach the concepts requires teachers to incorporate their knowledge of space and shape with their understandings of children's behaviour in order to plan relevant and appropriate activities. During Phase III, as the teachers accomplished the space and shape tasks that I had prepared, several points were noted. These are discussed here:

- Most participant teachers were not aware of the vocabulary attached to shape and space, nor of the correct names in their own languages.
- Many teachers acknowledged that they had had little or no experience themselves in doing the shape and space tasks and activities that they gave their Grade R children to do.
- The drawing activities were the most difficult for the teachers. Most of them expressed their fear and dislike of drawing maps and still lives. I had also expected too much by wanting the teachers to draw the still life from the opposite side, rather than merely what they saw. Most of the teachers' drawings showed symbols rather than representations of real objects. This could mean that on the whole they had had little experience of drawing.

The teachers' lessons on space and shape showed that they were taking the children's interests and schemas into account when planning. Some teachers planned an entire theme around an aspect of shape or space in order to extend the children's thinking and learning. They also reflected on the lessons they had implemented, giving recommendations for future lessons. This

showed that the participant teachers were using an emergent curriculum process effectively and thus implemented a more creative pedagogy.

8.3. Lessons to be Learnt

This section suggests lessons to be learnt within the context of this case study, for teaching Grade R children about space and shape through visual arts activities. These are articulated according to the phases of the study.

8.3.1 Lessons to be Learnt Arising from Phase I

Lesson 1: *Teachers of Grade R children should be enabled to cultivate creative environments for children.*

My research revealed that the participant teachers did not have a clear understanding of creativity nor how to effectively implement it in their classrooms. They need to learn more about the role of the teacher in the implementation of creativity as described by Craft (2002, 2005). Teachers also need nourishment in the form of personal and professional development in order to allow a creative environment to flourish (Craft, 2002). Teacher development programmes should therefore explore the nurturing of creativity in Grade R children, and also encourage professional communities which support and collaborate with each other.

Lesson 2: *More guidance should be given on creativity in relation to visual arts activities.*

Consistent with the idea of merely exposing children to resources, some teachers considered the provision of art media e.g. crayons, paper and paint as sufficient for visual arts to result. They did not consider themselves as having an active role in encouraging children's expressions of meaning. Providing activities like cutting pictures from magazines and requiring the children to produce a replica of the teacher's example may develop fine muscle skills and certain visual perceptual skills, but they do not allow for children's expressions of meaning. Children's expressions of meaning go hand in hand with a creative environment and the encouragement of creativity. Teachers need guidance on the purpose of visual arts activities as children's expressions of meaning in such an environment.

Lesson 3: *Observation of children's behaviour and interests is a skill which should be practiced more widely by Grade R teachers.*

Being aware of the interests and schemas that children are displaying, helps teachers to make meaning of their behaviour and plan accordingly, by incorporating the children's interests into the curriculum. Fleer (2010) explains that children learn more competently when their interests are included in the learning programme. It follows therefore that an awareness of the meanings of children's schemas also helps to deepen teachers' understandings of children's interests. A positive approach would be for teachers to use anecdotal note-taking techniques, rather than merely remarking on behaviour and deficit models of performance in the children they teach. Eraut (1995) also implies that teachers as professionals should be able to "read the emergent situation" (p. 230), thus observing children and noting their behaviour and interests is vital for teachers.

8.3.2 Lessons to be Learnt Arising from Phase II

Lesson 4: *Grade R children should have a variety of materials and media available for expressing themselves through mark making.*

This research has shown that many Grade R children do not have sufficient opportunities to express themselves through mark making. Sometimes the reason for this lies in the lack of resources, and other times it is because the curriculum does not make the time or resources available for the free expression that is required. Planning should therefore take into account the need for young children to draw, paint, model, cut and stick.

Lesson 5: *Grade R teachers should be given guidance on how to critically analyse published lesson plans and worksheets.*

With the plethora of published lesson plans and worksheets available, teachers are prone to using them uncritically, without questioning whether or not they are appropriate for their own contexts. Generic lesson plans published on the internet are often used indiscriminately, even though the context for which they are planned is entirely different. Because of the teachers' acceptance of "top down" rules and regulations concerning curricula, they use them without asking what the lessons and worksheets are teaching, and how children will be able to express their own understandings using such materials. This alludes to the confidence of teachers in their own

abilities to plan curricula around the interests of children. This relates closely to teachers being reflective practitioners, who are able to plan around the needs of the children they teach.

8.3.3 Lessons to be Learnt Arising from Phase III

Lesson 6: *Grade R teachers need more experience in doing space and shape activities themselves.*

The space and shape tasks in which the teachers engaged during contact session 3 revealed that many of them had had little experience with space and shape problem solving. In my view, the teachers would feel more comfortable teaching concepts like space and shape if they themselves engaged with tasks such as the ones offered during contact session 3. They would also then be more inclined to offer such activities to the children they teach. The fact that the majority of the teachers avoided certain tasks such as drawing, and expressed their fear of this activity, reveals that they have a lack of experience and confidence with the concepts of space and shape.

Lesson 7: *Teachers should know the correct terminology for the properties of shape in the language of instruction.*

In order to develop deep conceptual understanding which will enable them to progress through the van Hiele levels of geometric understanding, Grade R children should be taught vocabulary around the properties of shape and space, and be able to use these words and understandings (Ryan and Williams, 2007; Clements & Battista, 1992; Clements et al., 1999). This view is consistent with research which shows that children learn concepts best if they are taught in their mother tongue. It is vital therefore, that Grade R teachers teach the children the correct terminology in their home language.

Lesson 8: *Grade R teachers should be provided with many ideas and suggestions for interesting visual arts activities using a variety of media, and be allowed to experience them before implementation in the classroom.*

Generally, the teachers tend to present the same visual arts activities that they have used many times before. Even though they were provided with manuals of suggested activities during the initial intervention which formed the background to this study, they did not use them. Perhaps if they were allowed to experience them beforehand, teachers would feel more confident about presenting them to children. An example is the doily cutting task which some teachers had not tried before, but then presented to their classes.

Lesson 9: *Grade R teachers should be provided with more guidance regarding their role as teachers and facilitators of learning.*

Grade R teachers in my view often tend to see their role as a passive one. They provide the learning environment and then scaffold learning as the children learn through discovery. Fleer (2010) describes a more structured play environment, where questioning is directed around the concepts that the teacher wants the children to learn. Ginsburg et al. (2008) also explain that the teacher's role is an active one. They exhort "... teaching mathematics to little children is as complex and challenging as is teaching it to older children" (p. 284).

8.4. Limitations of the Research Intervention

As a case study with a small group of Grade R teachers in a particular context, this study has limitations. Although the group is fairly diverse, with teachers from a range of schools and backgrounds that reflect the demographics of South Africa, the study may however not be applicable to other Grade R teachers in South Africa. One aspect which made this group unique was that most of the participants have received in-service training and had not had opportunities to experience other contexts and environments. Their own schooling had also been accomplished in poorly resourced environments. If they had received conventional full-time teacher training with opportunities to experience other contexts, they might perhaps have responded differently. However, it is beyond the scope of this research study to investigate how prior learning could affect the uptake of this particular intervention.

In investigating how space and shape could be taught in Grade R using visual arts activities, another approach would have been for me, as researcher, to work directly with a group of children. Practically, this was not possible, hence I was reliant on the participant teachers to interpret and implement the ideas. They brought their own understandings into the process, so the study was extended to become a curriculum intervention in teacher education. The limitation which resulted from this is that teachers brought their own understandings to the process, understandings which were different to mine. On the other hand, this limitation broadened the study because instead of being limited to one group of children as it would have been if I had been

researching directly with children, it was extended to include a variety of different contexts, as well as other teachers.

Another consideration which may limit this study is that because of time and financial constraints I was only able to conduct one classroom visit per teacher (before the research intervention). I was reliant on the participant teachers' reports on the assignment tasks they completed, which provided evidence in the form of photographs and children's work. I was thus not able to directly observe their implementation of the activities in their classrooms, but had to rely on their reports which could be influenced by other factors. If I had managed to conduct classroom visits at a later stage of the research intervention, I could have gauged better the teachers' implementation of space and shape through visual arts, could have given greater practical support. However, as an interpretive study, this research set out to examine the participants' understandings. One should bear in mind that understandings could be interpreted differently in the process of their reporting and my reading.

This research intervention took place over a period of three months, involving five contact days in all. It formed a small portion of the three year in service BEd degree programme. If such an intervention was initiated for a longer period of time earlier in the programme, the notions presented in this study would underpin the teachers' knowledge base and development as reflective practitioners.

The tenets mentioned above will be able to guide future in-service BEd degree programmes.

8.5. The Emerging Significance of this Research Intervention

This research study grew from a review of the Maths and Science through Arts and Culture curriculum intervention. The evaluation and subsequent critical review of the curriculum intervention thus became the impetus for my Master's research. My premise was that it is not enough to introduce teachers to resources and ideas without examining their basic teaching beliefs and ideas. By instigating a research intervention in three phases, and introducing the teachers to the notion that the curriculum they use can be suited to the interests of the children

they teach and the contexts they teach in, this study has provided insight into how a curriculum intervention might take place.

By taking part in this study, a group of teachers has learned valuable skills which will serve them well in whatever grade they teach in the future and which can be used cross-curricularly. They have become action-researchers in their own practice, and in the process learnt how to observe, make meaning, plan and reflect, necessary skills for being professionals (Zeichner & Liston, 1996; Eraut, 1995; Huberman, 1995).

8.6. Implications for Future Studies

This study investigated the teaching of space and shape through visual arts activities. Possible ideas for future research could be:

- examining classroom practices of participant teachers more closely. A mentorship programme could provide support to teachers whilst they implement the activities, and help them to overcome challenges.
- the researcher working directly with children, conducting a programme of action research whilst implementing the three phases of the emergent curriculum process.
- examining the previous education of participant teachers to discover how this affects the uptake of an intervention programme.
- investigating how a teacher education programme rich in visual arts experiences would influence the teachers' implementation of these activities.
- instilling the notion of reflective practice from the beginning of the in-service BEd degree programme would enable the teachers to become more confident reflective practitioners.

8.7. Concluding Remarks and Critical Reflections

This research programme set out to investigate how the concepts of space and shape could be taught through visual arts activities. A critical review of the MStAC curriculum intervention, which formed the backdrop to my study led to a research intervention being initiated amongst the Grade R teachers with whom I was working. The research intervention was then implemented in three Phases, with data being generated and analysed at each phase.

My initial research idea, investigating how visual arts activities could be used to teach the concepts of space and shape involved far more than I had ever anticipated. Instead of merely investigating the implementation of visual arts activities in a Grade R classroom, it involved research intervention comprising teacher education on pedagogy, curriculum, creativity and visual arts. The entire research project has been a learning experience of immense proportions. What follows is a brief description of the path that led me to this research.

As a teacher who enjoyed providing visual arts activities for young children, seeing the benefits of creative activities and observing the children's enjoyment in doing them, I was convinced of the intrinsic worth of such pursuits, especially to enhance learning experiences. However, as a teacher educator, my classroom visits to students always left me disappointed when I observed the poor variety of visual arts activities on display. Further, there was little or no evidence of mathematics teaching taking place. When the CDP offered to present a curriculum intervention in the form of the MStAC course, I arranged for the BEd in-service teachers to attend as I hoped that this would provide them with ideas and resources for implementing mathematics in a more accessible, exciting way. However, when I evaluated the teachers' uptake of the course ideas, I discovered that they were not using many of the suggested ideas or resources. This led me to question why the course had not achieved its goals, and to wonder what I could do to encourage the participant teachers to use visual arts activities to teach space and shape. The result is the research intervention described in this research study.

I am indebted to the teachers who took part in the study, implementing the assignment tasks, reflecting and writing reports. They, as well as I, have learnt a great deal from the study which will serve them well as teachers as they finish their degrees this year. I know that the ideas in this research study will remain strong interests in my life and I will continue to read, research and grapple with them, in whatever context I find myself.

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Appendices

Appendix 1

Case Records for Phase I

Data File 1 [DF 1]	
Coloured response sheets	Generated through focus group discussions
Data File 2 [DF 2] Completed Assignments	
Assignment 1.1	Observation notes 1.2, 1.3, 1.4 and 1.5
Assignment 1.2	Collections of Grade R children's art work
Assignment 1.3	Written report on an environment "rich in opportunities for learning"
Assignment 1.4	Written report on three incidents of scaffolding
Assignment 1.5	Written reflections on the experience of observation
Material File 8 [MF 8]	
DVD	"Schools kill Creativity" (Robinson, 2006)
Material File 9 [MF 9]	
Powerpoint presentation	Creativity
Material File 10 [MF 10] Resource pack 1: Readings on Creativity	
Reading 1	Creativity quotes and poems (from Potter, Picasso, Fuller, Fromm, Nietzche, Piaget)
Reading 2	Reflecting on creativity and cognitive challenge: visual representations and mathematics in early childhood – some evidence from research. (Worthington, 2009)
Reading 3	Mark making matters (DCSF, 2009)
Reading 4	Four views of learning (from Carruthers & Worthington, 2006)
Reading 5	Research4U - Making your mark (Thompson, 2010)
Reading 6	Schemas (from Carruthers & Worthington, 2006; Athey, 2007)
Reading 7	Emergent curriculum (from Stacey, 2009)
Material File 11 [MF 11] Assignments	
Assignment 1.1	Observation journal Observe the children you teach. Document your observations of their play, work and visual representations. (Anecdotal notes, written narratives, collections of photocopies of children's visual representations, photographs, videos and audio-recordings)
Assignment 1.2	Collection Make a collection of children's visual representations (at least 50). (write the date and comments behind them)
Assignment 1.3	Reflective report Describe the environment "rich in opportunities for learning" which you have prepared for the children to represent their learning spontaneously. Illustrate your essay with photographs and diagrams.
Assignment 1.4	Reflective report Describe how you have supported children's thinking by scaffolding their learning.

	Report on at least 3 incidents.
Assignment 1.5	Reflective report Reflect on the process of observing children's behaviour and visual representations.
Material File 12 [MF 12]	
Powerpoint presentation	Schemas and Emergent curriculum

Appendix 2

Case Records for Phase II

Data File 3 [DF 3]	
Photographs	Grade R children's art sorted and classified according to schemas
Data file 4 [DF 4] Completed task sheets	
Completed task sheets	Curriculum Studies Group Task Sheets
Data File 5 [DF 5] Completed assignments	
Assignment 2.1	Written reflective report on making meaning of children's behaviour and interests
Assignment 2.2	Written reflective report on implementation of activities planned during the class group session.
Assignment 2.3	Presentation to class: describing initial observations, describing activities which were planned, explaining how the activities were implemented and how learners responded (Supported with photographs, slides, pictures or recordings)
Material File 12 [MF 12]	
Powerpoint presentation	Visual representations, schemas and emergent curriculum
Material File 13 [MF 13] Movies on DVD	
Scaffolding movie 1	Problem solving, reasoning and numeracy: Getting ready to go out. Downloaded from http://nationalstrategies.standards.dcsf.gov.uk/node/85560?uc=force_uj
Scaffolding movie 2	Problem solving, reasoning and numeracy: A bed for a giant. Downloaded from http://nationalstrategies.standards.dcsf.gov.uk/node/85584?uc=force_uj
Scaffolding movie 3	Problem solving, reasoning and numeracy: A picture of my family. Downloaded from http://nationalstrategies.standards.dcsf.gov.uk/node/85491?uc=force_uj
Scaffolding movie 4	Problem solving, reasoning and numeracy: Talking about monsters. Downloadedfrom http://nationalstrategies.standards.dcsf.gov.uk/node/85536?uc=force_uj
Material File 14 [MF 14] Readings for Phase II	
Department for Children, Schools and Families (2009) *Children thinking mathematically: PSRN essential knowledge for Early Years practitioners.* Downloaded from http://nationalstrategies.standards.dcsf.gov.uk/node/257449	
Material File 15 [MF 15] Assignments	
Assignment 2.1	Reflect on the process of making meaning of children's behaviour and planning to enhance and extend their learning in these areas.
Assignment 2.2	Plan the implementation of the activities you planned during the class group session. Implement them. Describe how they took place. Reflect on the process.

Assignment 2.3	Make a presentation to the B Ed class based on reflective report 2.2: Describe your initial observations. Describe activities you planned. Describe how the activities were implemented and how your learners responded. (Support your presentation with photographs, slides, pictures or recordings)

Appendix 3

FOCUS GROUP TASK SHEET

Carter and Curtis (2000) suggest examining children's play from three perspectives: the child's story, the learning and development story, and the teacher's story. (Stacey, 2009, p 68)

On the table below, list at least 5 behavioural incidents and schemas that members in your group have observed:

THE CHILDREN'S STORY What fascinates the children? Why do you think this is so? Why do they keep returning to these activities? What are their previous experiences with this scenario?	LEARNING AND DEVELOPMENT STORY What common factors do the children's activities and drawings have? What does this mean in relation to the children's development?	THE TEACHER'S STORY What delights or puzzles you about what you are seeing? How can you find out more?
1.		
2.		
3.		
7.		

What are the big ideas, repetitive topics and long-lasting interests emerging from the above?

Now, taking all the above factors into account, suggest some activities which you might provide for your learners in order to enhance and extend their learning in these areas.

ACTIVITY What activities will you provide?	PRACTICALITIES How will you provide these? What time of the day? Where? How will you support the children in their learning?	RESOURCES REQUIRED What do you need in order to make these activities available? How will you get/make them?
1.		
2.		

Appendix 4

Case Records for Phase III

Data File 6 [DF 6]	
Task sheets	Space and shape activities
Data File 7 [DF 7] Completed assignments and task sheets	
Assignment 3	Written report on a Space and Shape lesson
Material File 16 [MF 16]	
Powerpoint presentation	Visual representations, schemas and emergent curriculum
Material File 17 [MF 17]	
Task sheets	Group activity translating and describing shapes
Material File 18 [MF 18] Mathematics Resource Pack I: Readings for Phase III	
Reading 1	Ginsburg, H.P. & Amit, M. (2008) "What is teaching mathematics to young children? A theoretical perspective and case study".
Reading 2	Gauteng Department of Education (2009) "Guidelines for teaching Numeracy". Johannesburg: Gauteng Department of Education.
Reading 3	Dept of Basic Education, SA. (2010) "Numeracy Handbook for Foundation Phase Teachers"
Reading 4	Carruthers, E.& Worthington, M. (2006) "Developing children's written symbols"
Reading 5	Reading 5: Carruthers, E. & Worthington, M. (2006) "Challenges young children experience with written mathematics".
Material File 19 [MF 19]	
Assignment 3	Describe a lesson on an aspect of Space and Shape. Use the following headings to guide you: 1. The interests/schemas/behaviours your learners are exhibiting 2. The aspect of Space and Shape you will be teaching (explain why you have chosen this aspect) 3. Describe the lesson, giving: • the introduction • teaching and scaffolding of the topic (use the list of teacher behaviours on p. 284 of the Ginsburg & Amit reading to guide you) • the visual arts activities the children will do to reinforce learning • how you will assess their learning. Describe what worked well, what did not work, and how you would change it next time (being reflective and reflexive)

Appendix 5

DEFINITIONS: SHAPE AND SPACE

It is important that children are taught the correct shape names so that they develop a good understanding of shapes. In groups make meaning of the names of these shapes

Name	Description/translation
Polygon	
Equilateral triangle	
Isosceles triangle	
Scalene triangle	
Quadrilateral	
Square	
Rectangle	
Rhombus	
Parallelogram	
Trapezium	
Kite	
Pentagon	
Pentagram	
Circle	
Polyhedron	
Prism	
Pyramid	
Tetrahedron	
Cube	
Sphere	
Cylinder	
Plane	
Face	
Vertex	
Edge	
Angle	

Appendix 6

SHAPE ACTIVITIES

ACTIVITY 1: JIGSAW PUZZLE

Build the puzzle with a partner, helping each other.
Describe how you went about doing it.

ACTIVITY 2: TANGRAM

Use the tangram shapes to make the pictures.
Would you use this activity with your own learners?
Why/why not?

ACTIVITY 3: SYMMETRY

Fold a piece of paper into 4 and use scissors to cut shapes out of it to make a symmetrical doily.
What's the most important piece of advice you would give someone doing this activity?

ACTIVITY 4: DRAWING FROM A DIFFERENT PERSPECTIVE

1. **Draw the arrangement on the table as if you are sitting on the opposite side of the table.**
2. **Draw the arrangement from the top.**
3. **Describe how you went about doing this activity:**

ACTIVITY 5: LOGI-SHAPES

1. **Place the correct shapes into the outlines.**
2. **Try to create your own shapes**
   Is this activity easy or difficult?
   Why?

ACTIVITY 6: SHAPE BUCKETS

1. **Post the shapes into the correct holes in the bucket lid. Time yourself.**
2. **Take them out again and see if you can do it faster this time.**
3. **Write down your time:**
   i. **_____minutes, _____ seconds**
   ii. **_____minutes, _____ seconds**

How would you be able to do it even faster? Would this work with your own learners?

ACTIVITY 7: MAKING BOXES

1. **Fold a box from this template whilst timing yourself**
2. **Take it undone and do it again, timing yourself.**
3. **Write down your time: _____minutes, _____seconds**

ACTIVITY 8: MAP DRAWING

Draw a map of the route you take to get from your home to your school.
Describe how you feel about this activity: