

**The Development of the Number Concept in Grade R: A case study of a school  
in the Wellington area**

**by**

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**in the Faculty of Education**

**at the**

The logo of the University of the Western Cape, featuring a classical building with columns and a pediment.

**UNIVERSITY of the  
WESTERN CAPE**  
**University of the Western Cape**

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**Cape Town**

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## DECLARATION

I, Lynn Louise Le Grange, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the University of the Western Cape.

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**Signed**

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**Date**



## ABSTRACT

### THE DEVELOPMENT OF NUMBER CONCEPT IN GRADE R: A CASE STUDY OF A SCHOOL IN THE WELLINGTON AREA

Systemic evaluation undertaken by the Department of Basic Education as part of the Literacy and Numeracy Strategy 2006 – 2016 posed a serious challenge in South African schools. The numeracy and mathematics results in 2009 stated that 35% of learners in Grade 3 achieved the required level of competence in Mathematics. This has, however, improved to 48.3% in 2010 but dropped to 47.6% in 2011. The development of early number concept in countries such as the Netherlands, Singapore and Helsinki has shown that early intervention is essential for reaching mathematical success in schooling. The Curriculum and Assessment Policy Statement (CAPS) integrates the three learning programmes: Literacy, Numeracy and Life Skills for Grade R into a daily programme of activities. Within this daily programme it specifies that 35% of each day must be used towards Numeracy. The Grade R method of teaching emphasizes the fact that teaching must take place informally but planned formally. The purpose of this study is to examine how early mathematics is taught in an integrated and informal setting to improve number concept. The theoretical framework underpinning this study is based on the constructivist views of Piaget and Vygotsky and how these theories lay the foundation for the development of number concept in Grade R. Number skills to develop number concept were identified in nine lessons to underpin the content area 1, Numbers, Operations and Relationships as determined by the Grade R Mathematics Curriculum and Assessment Policy Statement (CAPS). The methodology employed to answer the research question were video-recordings, observations and interviews. The findings identified number skills such as emergent number concepts: distinguishing numerosity, imitating resultative counting and symbolizing by using fingers as well as growing number concepts: discovering different meanings of numbers, oral counting, one- to- one correspondence, rote counting, perceptual subitising, resultative counting, representing and symbolizing numbers, ordinality, place value, emergent object-based counting and calculating and golden moments. The discussion of the findings focused on the CAPS content area and how these number skills were used to achieve the demands of the content area 1. The major findings of this study presented a case of the utilization of number skills to achieve the development of number concept in Grade R, how mathematics should be made fun, and how incidental learning, “golden moments” can be used to introduce key mathematical concepts informally. This study has implications for teachers of Grade R and for the training of pre-service Grade R teachers at tertiary level.

## DEDICATION

**This academic study is dedicated to:**

My Father, Danfred and my late mother, Katrina Le Grange for believing in me  
and granting me the opportunities to achieve my goals in life,

My late brother Hyron who passed away in my week of completion. He had a passion  
for Mathematics and would have been so proud of me

and

My daughter, Sayuri Iscah my inspiration.



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# CHAPTER 1

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## Rationale for the study

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### 1.1 Introduction

This study focused on the early number development of Grade R children. This chapter provides a background on current teaching in Early Childhood Development (ECD) and the teaching of Mathematics in Grade R. The significance of this study will be addressed and the research questions for this specific investigation will be posed. The context of the school, current practices, challenges and the limitations are identified and an overview of this thesis is provided.

### 1.2 Background to the study

Approximately 40% of young children in South Africa grow up in conditions of abject poverty and neglect. (White Paper 5, 2001) Children raised in such poor families are most at risk of infant death, low birth-weight, stunted growth, poor adjustment to school, increased repetition and school dropout. These factors make it imperative for the Department of Education to put in place an action plan to address the early learning opportunities of all learners but especially those living in poverty. Timely and appropriate interventions can reverse the effects of early deprivation and maximise the development of potential. The challenge for the Government is to help break the cycle of poverty by increasing access to Early Childhood Development (ECD) programmes, particularly for poor children, and to improve the quality of these programmes (White Paper 5, 2001)

As a Learning Support Advisor in the Cape Winelands and Overberg Region for eight years this predicament became clear to the researcher. Grade R programmes lays the foundation of all learning programmes. For the past seven years the researcher has been working as a lecturer at Cape Peninsula University of Technology lecturing Mathematics in Education, Language in Education, Grade R and Professional Studies to first-year students who focus on Grade R. One of the

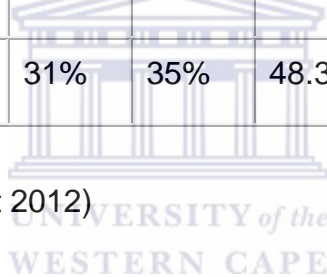
challenges within this study is improving number concept in Grade R as a foundation to improve Mathematics in the higher grades.

The Department of Education, Western Cape Provincial Government, (15 November 2007) stated as part of the Western Cape Education Department’s Literacy and Numeracy strategy that diagnostic testing is being done on a regular basis to determine the level of Grade 3 and Grade 6 learners. During the 2011 diagnostic testing of Grade 3 learners, research has shown a slight improvement in Numeracy but not satisfying in regards to the National standards. Improvement is shown from the results in 2002. The results are as follow:

TABLE 1: Results of the systemic evaluation of Grade 3 learners

	2002	2004	2006	2008	2011
Literacy	35.7%	39.5%	47.7%	53.5%	30.4 %
Numeracy	37.1%	37.3%	31%	35%	48.3%

(Western Cape Government 2012)



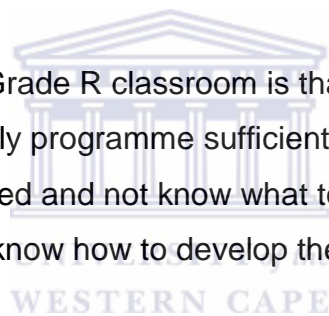
This result is worrying: less than half of the Grade 3 learners had a sufficient sense of number concept, which forms the basis of numeracy (WCG 2012)

Curriculum requirements state that formally planned Mathematics should start at Grade R (five/ six year old learners), at this level mathematics has a strong integrated approach. It is integrated within all the activities of the daily programme, and 35% of every day has to be allocated for it. The teacher needs to be observant to identify the “golden moments” / incidental learning in all activities so that informal teaching can take place. Not all teachers have the didactic background to see the “golden moments”; therefore the moment can be lost forever. Number names become a rhyme or rote counting and learners do not have any number concept.

### **1.3 Grade R challenges**

Teaching Grade R is full of challenges, despite these challenges Grade R was included in the Foundation Phase of the National Curriculum in 2003. However in schools, practitioners are allowed to teach without a formal Teaching Qualification. Many practitioners have Matric and an ECD certificate but no formal teaching qualification. The teachers who do have a teacher's qualification and teach in Grade R do not receive a salary from the Education Department but are paid by Governing Bodies and receive subsidies from the Education Department and Department of Social Services. This in itself can become one the biggest problems for improving ECD programmes. Some teachers receive a small salary. This can demotivate them and education will suffer the consequences. That is why many of the qualified Grade R teachers prefer to teach in Grades 1 – 3 because they receive a departmental salary.

A further challenge for the Grade R classroom is that not all Grade R classes have all the facilities to teach the daily programme sufficiently. It is possible that a teacher can have all the resources needed and not know what to do with it and a qualified teacher can have no resources but know how to develop them.



The researcher's own challenges for this study are that she was trained to be a Foundation Phase teacher when Gr. R was not included in the Foundation Phase. After some years as a Learning Support Advisor, the researcher worked with teachers in Grades 1 – 9 and realized how the lack of a good Grade R foundation can influence a child's schooling for life. Learning Support focuses on perceptual development and the foundations for learning. This gives a good background on the readiness of learners when entering Grade 1. Having a good background to pre-schooling and further research and lecturing Grade R stands the researcher in good stead but the lack of teaching Grade R may be a disadvantage

### **1.4 Policy and ECD**

Early childhood development refers to a comprehensive approach to policies and programmes for children from birth to nine years of age with the active participation

of their parents and caregivers. Its purpose is to protect the child's rights to develop his or her full cognitive, emotional, social and physical potential. Consistent with Education White Paper 1 on Education and Training (1995) and our Interim Policy for Early Childhood Development (1996), we define early childhood development as an umbrella term that applies to the processes by which children from birth to at least nine years grow and thrive, physically, mentally, emotionally, spiritually, morally and socially. (DBE, 2001) This is an important part of any child's life. This is where the foundation for all learning is being laid.

A child's early years are critical for the acquisition of the concepts, skills and attitudes that lay the foundation for life-long learning. These include the acquisition of language, perception-motor skills required for learning to read and write, basic numeracy concepts and skills, problem-solving skills and a love of learning. With quality ECD provision in South Africa, educational efficiency could improve, as children could acquire the basic concepts, skills and attitudes required for successful learning and development prior to, or shortly after, entering the system, thus reducing their chances of failure. The system could be freed of under-age and under-prepared learners, who have proven to be the most at risk in terms of school failure and drop-out. While it is never too late for children to improve in their health and development, to learn new skills, overcome fears or reflect on beliefs, more often it is the case that when they do not get the right start, they never catch up or reach their full potential. (DBE: 2001) This research examines the foundation for one of these lifelong learning foundations namely, basic numeracy concepts and skills.

The main ECD policy priority addressed in this White Paper 5 is the establishment of a national system of provision of the Reception Year for children aged 5 years that combines a large public and smaller independent component. In this regard, the medium-term goal (2010) is for all children entering Grade 1 to have participated in an accredited Reception Year Programme. (DBE, 2001) The Department of Education sees this as a medium term goal, but by 2014 there is still little improvement.

## 1.5 The basic programme for a Grade R classroom and the Curriculum and Assessment Policy Statement for Mathematics.

Different practices take place in the Grade R classroom but the basics for a Grade R daily programme are as follows:

1. Morning Circle (Including religion, Discussion ring)
2. Literacy Focus area
3. Creative activities
4. Educational play
5. Breakfast
6. Music / Movement
7. Outdoor activities
8. Numeracy Focus area
9. Story time

Grade R, as mentioned before, has a strong integrated approach so all eight learning areas included within this programme. Informal strategies are being used but formal planning takes place. In this study the focus falls on Mathematics integration with special emphasis on Content Area 1.

Content 1: Numbers, Operations and Relationships

Development of number sense that includes:

- The meaning of different kinds of numbers
- The relationship between different kinds of numbers
- The relative size of different numbers
- Representation of numbers in various ways; and
- The effect of operating with numbers.

(DBE: 2011)

In Grade R the main focus is on numbers 1 – 10 by counting, saying and using, knowing the symbols, comparing, problem-solving, simple addition and subtraction and using different techniques.



These foci are the basics of all mathematics and a good foundation of these concepts will increase the learner's mathematical thinking and the solving of problems. A good structured mathematical programme is needed for all Grade R classes; so that teachers will see the "golden moments" and know how to develop the foundation for mathematical learning.

## **1.6 Context of the school**

The school where this study was conducted is situated in Wellington in the Cape Winelands District, Western Cape, South Africa. The school is located in a good socio-economical area but receives children from a wide range of socio-economic backgrounds. There are five classes with learners varying from ages 4 to 7; There are Afrikaans classes, English Classes and Dual Medium Classes. The children's mother tongue varies from Afrikaans, English and IsiXhosa. The school has big classrooms with sufficient space and a large playground including areas for sand play, water play and fantasy play. It has good sanitation and security. The class used in this study has an English-speaking teacher and 22 learners with English, Afrikaans and IsiXhosa speaking children with English as Language of Learning and Teaching.

A qualified Foundation Phase teacher with ten years Grade R teaching experience participated in this study. Her Grade R background was strengthened by in- service training and the workshops given by the Department of Education. She taught Grade 1 for many years and knows exactly what is expected from a learner when entering Grade 1. This adds value to the foundation of this teacher in teaching Grade R. The researcher's institution has a good relationship with the school. The school annually hosted pre-service teachers from the researcher's institution over a number of years. The reason for selecting this Grade R teacher's class was because during the researcher's first year of lecturing Grade R level, the researcher visited her classroom and found the teacher's approach supportive of the learners. She displayed novel, interesting and challenging teaching strategies. Her classroom was well organized and she had a sound relationship with her learners so learning could take place easily. She made provision for learners with difficulties: Literacy and Numeracy were a top priority. The teacher was enthusiastic about Grade R and well prepared with a good structured programme. The teachers at this school had a good

working relationship and lesson planning took place on a regular basis. The principal of the school welcomed the research and the founder of the school was enthusiastic about the outcomes of the study.

### **1.7 The Research Problem**

The WCED's results of the systemic evaluation state that fewer than half of learners in Grade 3 have mastered Numeracy (WCED 2012). Number concept is an important factor to master Numeracy. McDermott & Rakgokong (1996) refer to number concept as the "feeling for" and understanding of "how manyness" or value of number. Many practitioners and teachers in the Grade R schools have a Mathematical Didactic background but the Curriculum in South Africa has changed four times over the past 20 years. The demands of the Curriculum have changed to create structure in teaching and to develop learners to be at the same level. Grade R's main focus is to keep learning informal but plan formally but the content mastered is often formalised.

The purpose of this study is to examine how early Mathematics can be taught in an integrated, informal setting to improve number concept in Grade R. The researcher intended to use the data to restructure the teaching curriculum of the lecturing subject to emphasize the importance of number concept and establish the theoretical depth that underlies the number skills used to develop number concept. These number skills are linked to the Curriculum and Assessment Policy Statement.

### **1.8 Research question**

In addressing the research problem, the following research question will be investigated:

***What number skills are used to develop the number concept of learners in a Grade R classroom?***

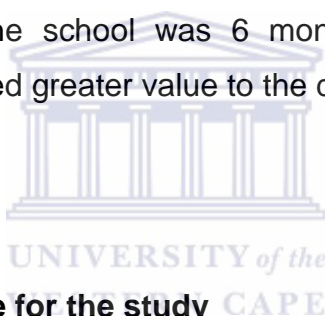
## 1.9 Significance of the Study

The investigation is significant for a number of reasons. First, it attempts to identify number skills needed to develop the number concept of Grade R learners in the content area *Numbers, Operations and Relationships* in the Curriculum and Assessment Policy Statement. Second, the study provides unique baseline data on Grade R teaching and learning with regard to the development of the learners' number concept. Third, the study adds to the limited literature on mathematization in Grade R for training in institutions of higher learning and for practitioner application.

## 1.10 Limitations

The limitations of this study include that only one school is being used as a case study and only one teacher's method of teaching is being investigated. The period of investigation allowed by the school was 6 months and an extended period of investigation may have added greater value to the data collected and analysed

## 1.11 Structure of thesis



### 1.11.1 Chapter 1: Rationale for the study

This chapter provides a background on the current teaching in Early Childhood Development, and the teaching of Mathematics in Grade R. The research question for this specific study emanated from a description of the research problem within the context of the school, current practices and the limitations.

### 1.11.2 Chapter 2: Literature Review

This chapter considers the literature consulted and provides a theoretical framework. The constructivist views based on the theories of Piaget and Vygotsky are fundamental to the method of research and recent literature is presented to consider studies with regard to the development of number concept. South African and International studies highlight research conducted across the globe on number concepts.

### **1.11.3 Chapter 3: Methodology**

This chapter provides a detailed description of the methodology employed to investigate this study. The data collection procedures, theoretical framework and data analysis used to answer the research question are described.

### **1.11.4 Chapter 4: Findings**

The purpose of this chapter is to report on the findings of the research. The findings are based on the data collected and the process of analysis incorporated in this study.

### **1.11.5 Chapter 5: Discussion**

The discussion chapter focuses on the number skills the Grade R teacher used to respond to the demands of the CAPS document for Grade R. The teacher's views of the skills used were included to substantiate her reasons for using these skills.

### **1.11.6 Chapter 6: Conclusions and recommendations**

This chapter provides a summary of the study and highlights the major findings, implications of the study, limitations and recommendations.



## **1.12 Summary**

This chapter provides the rationale for this study and highlights the curriculum content that the study is based on and the context in which the study is conducted. The research problem is described and the research question posed. The next chapter examines the current literature on number concept development and provides a theoretical frame work that will underpin this study.

# CHAPTER 2

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## Literature Review

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### 2.1 Introduction

The previous chapter orientates the study by way of introduction. This chapter scrutinizes the literature consulted and provides a theoretical framework for the research. Current standards for mathematics and science curriculum and instruction take a constructivist view based on the theories of Jean Piaget and Lev Vygotsky (Charlesworth & Lind, 2007). This chapter considers the various number skills put forward in recent literature to assist with the development of number concepts: it highlights South African and international studies in the development of number concept for teachers and learners.

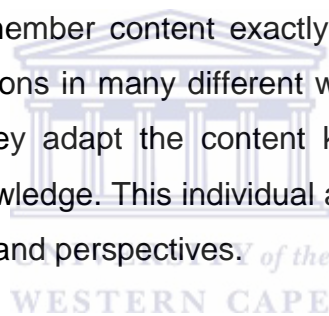
### 2.2 Constructivist view of learning

This study is underpinned by the theory of constructivism which is firmly rooted in the cognitive school of psychology and the theories of Piaget dating back at least as far as 1960. Constructivism rejects the notion that children are blank slates. They do not absorb ideas as teachers present them. Rather, children are creators of their own knowledge (Van de Walle & Lovin, 2006). The learner learns by constructing what has been learnt into a mental network, in a unique and personal way (Mc Dermott & Rakgokong, 1996). This is especially seen in the first year of teaching Grade R. Children come to school with a prior knowledge from their own social environment. This differs from learner to learner because of the wide range of social environments in South Africa, especially in the rural areas of the Western Cape.

The basic tenet of constructivism is simply: *Children construct their own knowledge*. To construct or build something in the physical world requires tools, materials and effort. How we construct ideas can be viewed in an analogous manner. The tools we use to build understanding are our own existing ideas, the knowledge that we already possess. The materials we act on to build understanding may be things we see, hear,

or touch: elements of our physical surroundings. Occasionally the materials are our own thoughts and ideas. The effort that must be supplied is active and reflective thought. If minds are not actively thinking, nothing happens (Van de Walle & Lovin, 2006). According to Smith (2001) ideas form the basis for constructivism that views children as creating knowledge by acting on experience gained from the world and their discovery of meaning in it. In a Grade R classroom the teacher constructs active thinking through play in context-based settings. The teacher puts mathematical concepts in a contextual setting so that learners can create mathematical knowledge in their everyday world and employ it in many situations

Different learners use different ideas to give meanings to the same new idea they encounter. What is significant is that the construction of an idea is almost certainly different for every learner, even in the same environment or classroom (Van de Walle & Lovin, 2006). Mc Dermott and Rakgokong (1996) describe this phenomenon by saying learners do not remember content exactly as it is presented, but that they interpret instructional situations in many different ways. The Grade R class used for this study was diverse: they adapt the content knowledge provided to their own discrete forms of social knowledge. This individual adaptation of content is consonant with constructivist priorities and perspectives.



To construct and understand a new idea requires active consideration of it. Mathematical ideas cannot be “poured into” a passive learner. Children need to be mentally active for learning to take place. Constructing knowledge requires reflection, deliberation and concentration in a sustained manner (Van de Walle & Lovin, 2006). Mc Dermott & Rakgokong (1996) agree by citing Piaget who concludes that children are not empty vessels into which knowledge must be poured. Knowledge is created actively and not received passively.

The general principles of constructivism are based largely on Piaget’s processes of assimilation and accommodation. Learners take an active part in “constructing” learning through direct experiences of the world. These experiences may challenge their existing perception of the concept, called a schema which involves learning to accommodate new experiences by modifying schema to assimilate new information. Once this process of assimilation and accommodation has taken place, a state of

equilibrium is attained. Vygotsky and Bruner's work evolved from these ideas and led to a consideration of the impact of social experience upon learning. (Turner 2013).

Constructivism is the theoretical consideration of how knowledge construction takes place. Constructivism suggests that teaching is not a matter of transferring information to students: nor is learning matter of passively absorbing information from a book to a teacher. Effective teachers assist students to construct their own ideas drawing on their individual imagination and information from their specific cultural and socio-economic backgrounds. The manner in which a class is conducted, the social climate established within the classroom and the materials available for students to work all have an substantial impact on what is learned and how well it is understood (Van de Walle & Lovin, 2006). Due to context-based learning in Grade R, the teacher's materials and effective planning for each day plays a vital role in constructing mathematical knowledge.

For classroom practice, constructivism implies that there should be communication between the teacher and the learners and among the learners themselves. A language-centred classroom is required. Language, through which meaning is communicated, negotiated and shared, is essential in the construction of mathematical knowledge (Mc Dermott & Rakgokong 1996).

Mc Dermott & Rakgokong (1996) defines constructivism in four principles:

1. Knowledge can be based on past constructions – each person's network of knowledge is constructed as he or she develops while interacting with the environment and trying to make sense of experiences.
2. Constructions come about through assimilation and accommodation – assimilation refers to the use of information already existing in our own personal networks of knowledge to interpret new information received. If the new information is contradicted during assimilation, it is accommodated by adapting our existing concepts.
3. Learning is a process of intervention – Learning in constructivism is not seen as an accumulation of facts: the learner needs to experience, hypothesise, manipulate objects, ask questions, pose questions, investigate and negotiate.

4. Meaningful learning takes place through reflections – knowledge is constructed through processes of reflection, inquiry and action on the part of the learner.

According to Lichtenberg & Troutman (2003), constructivism is a theory that grew primarily out of the pioneering work of Jean Piaget (1896 – 1980), a Swiss psychologist, and Lev Vygotsky (1896 – 1934), a Russian psychologist. Both were interested in how the growth of knowledge takes place. Though their approaches were somewhat different, their conclusions have important similarities.

## **2.3 Cognitive development**

### **2.3.1 Piaget**

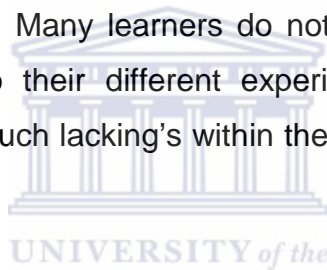
Jean Piaget contributed substantially to understanding the development of children's thought (Charlesworth & Lind, 2007). Each of us interacts in our environment. As we perform actions on things in our environment, we build mental images, networks, paths and voices that we use to store concepts and relationships we discover. These structures or schemes are what we call internal representations. As we have new experiences in our environment, we modify and refine these internal representations so that we accommodate new information received through new interactions. Each new representation that we build is a refinement of the one that came before it To study how these mental representations develop, Piaget designed tasks to interview students of various ages, and many of these tasks involved mathematical concepts (Lichtenberg & Troutman, 2003).

Piaget identified four periods of cognitive, or mental, growth and development. Early childhood educators are concerned with the first two periods and the first half of the third (Charlesworth & Lind, 2007). The first period identified by Piaget, called the sensorimotor period (from birth to about age two), is described as the first part of the unit. It is the time when the children begin to learn about the world. They develop all their sensory abilities: touch, taste, sight, hearing, smell and muscular. They increase their growing motor abilities so as to grasp, crawl, stand, and eventually, walk.



Children in this first period are explorers and need opportunities to use their sensory and motor abilities to learn basic skills and concepts. Through these activities the young child assimilates, takes into mind and comprehends a great deal of information. By the end of this period, children have developed the concept of object permanence. That is, they realize that objects exist even when they are out of sight. They develop the ability of object recognition. They learn to identify objects using the information they have acquired about features such as colour, shape, and size. As children near the end of the sensorimotor period, they reach a stage where they can engage in representational thought; that is, instead of acting impetuously, they learn to think through a solution before attacking a problem. They enter into a time of rapid language development (Charlesworth & Lind, 2007).

This period has a great impact on the Grade R learner: the development of object permanence can lead to the recognition of numbers and the quantity of objects of what they see immediately. Many learners do not have the opportunity to develop fully in this period due to their different experiences: the teacher provides an opportunity to supplement such lacking's within the daily programme so that learners can grow fully.



The second period, called the preoperational period, extends from about age two to seven. During this period, children begin to develop concepts that are more like those of adults but these are still inchoate in relation to what they will be like in maturity. These concepts are often referred to as pre-concepts. During the early part of the preoperational period, language continues to undergo rapid growth, and speech is used increasingly to express concept knowledge. Children begin to use concept terms such as big and small (size), light and heavy (weight), square and round (shape), late and early (time), long and short (length), and so on. This ability to use language is one of the symbolic behaviours that emerge during this period. Children learn to use symbolic behaviour in their representational play, where they may use sand to represent food, a stick to represent a spoon, or another child to represent father, mother, or baby. Play is a major arena in which children develop an understanding of symbolic functions that underlie the later understanding of abstract symbols such as numerals, letters and written word (Charlesworth & Lind, 2007). Structured play is used as the most vital tool to construct knowledge in Grade R.

Through structured play concepts, numbering and mathematical vocabulary is taught within the boundaries of the daily programme, as seen during the daily activities of this particular study.

An important characteristic of preoperational children is centration. When materials are changed in form or arrangement in space, children may see them as changed in amount as well. This is because preoperational children tend to centre on the most obvious aspects of what is seen. For instance, if the same amount of liquid is put in a tall, thin glass and a short, fat glass, preoperational children often say there is more in the tall glass “because it is taller”. When the physical arrangement of material is changed, preoperational children are frequently unable to hold the original picture of its shape in mind. They lack reversibility; that is, they cannot always reverse the process of change mentally. The ability to hold or save the original picture in the mind and reverse physical change mentally is referred to as conservation. The inability to conserve is a critical characteristic of preoperational children. During the preoperational period, children work with the precursors of conservation such as counting, one-to-one correspondence, shape, space, and comparing. They work on seriation (putting items in logical sequence, such as fat to thin or dark to light) and classification (putting things in logical groups according to some common criteria such as colour, shape, size, use, and so on (Charlesworth & Lind, 2007).

For Piaget, classification, order and seriation were the proper topics for the early childhood classroom (Smith, 2001). However many mathematical tasks, such as conservation of numbers, volume, or capacity are not achieved until the next stage, the concrete stage, ages 7 to 11. Teachers have found that many children who have had an extensive preschool education and parental teaching can perform a variety of tasks at earlier stages (Smith, 2001). This situation is seldom witnessed in the South African schooling system. Benchmarking and Assessment Standards has been set but many of the teachers in Grade R are not qualified teachers and lack the specific skills and values to teach Grade R. The education department does not pay a Grade R teacher a teacher’s salary and qualified teachers prefer to teach in the Higher grades.

According to Piaget’s view, children acquire knowledge by constructing it through

their interactions with the environment. Children do not wait to be instructed to do this, they continually try to make sense out of everything they encounter. Piaget divides knowledge into three areas. Physical knowledge is the type that includes learning about objects in the environment and their characteristics: colour, weight, size, texture, and other features can be determined through observation and are physically within the object (Charlesworth & Lind, 2007). In this study, Grade R learners use exploration to discover new knowledge in learning Mathematics especially within outdoor play.

Logico-mathematical knowledge is the type that includes relations each individual constructs: such as same and different, more and less, number, classification, and so on, to make sense out of the world and organize information (Charlesworth & Lind, 2007). In this study, these concepts are integrated within the Grade R daily programme and informal teaching takes place to initiate learning these concepts. Social, or conventional, knowledge is the type that is created by people: such as rules for behaviour in various social situations. Physical and logico-mathematical knowledge depend on each other and are learned simultaneously. That is, as the physical characteristics of objects are learned, logico-mathematical categories are constructed to organize information. For example, in the popular story Goldilocks and the three bears, papa bear is big, mama bear is middle sized and baby bear is the smallest (seriation), but all three (number) are bears because they are covered in fur and have a certain body shape with a combination of features common only to bears (classification).

Intellectual autonomy develops in an atmosphere in which children feel secure in their relationship with adults, where they have the opportunity to share their ideas with other children, and where they are encouraged to be alert and curious, come up with interesting ideas, problems and questions, use initiative in finding answers to problems, have confidence in their abilities to figure out things for themselves, and speak their minds with confidence. Young children need to be presented with problems to be solved through games and other activities that challenge their minds. They must engage with concrete materials and real problems (Charlesworth & Lind, 2007). The Grade R teacher in this study provides learners with concrete objects and uses classroom situations to solve problems. This is coherent and valid for

mathematical learning of all children. Through this active participation most of the mathematical concepts for Grade R can be developed. It is sustainable and not learned by rote.

Piaget's general conception of learning has much validity for today's classroom. The strengths of the Piagetian approach include a focus on the child's thinking, or the process, not just the answer, self-initiated, active involvement in a rich environment,, and viewing the role of the teacher as a guide or resource person (Smith, 2001).

### **2.3.2 Vygotsky**

Like Piaget, Lev Vygotsky was a cognitive development theorist. Vygotsky contributed a view of cognitive development that recognized both developmental and environmental forces. Vygotsky believed that just as people developed tools such as knives and tractors, they develop mental tools. People developed ways of cooperating and communicating new capacities to plan and think ahead. These mental tools helped people to master their own behaviour. These mental tools Vygotsky referred to as signs. He believed that speech was the most important sign system because it freed us from distractions and allowed us to work on problems in our minds. Speech enables the child to interact socially and facilitates thinking. In Vygotsky's view, writing and numbering are important sign systems (Charlesworth & Lind, 2007).

This is referred to as Natural and Cultural development. Natural development influences learning as the result of maturation. Cultural development results from the child's interaction with other members of a particular cultural environment and is enhanced by the use of language (Smith, 2001). Communication is the basis for learning in a Grade R classroom. We make use of questioning as a forum to convey information and develop thinking strategies.

While Piaget looked at development as if it came mainly from the child alone, from the child's inner maturation and spontaneous discoveries, Vygotsky believed it was true only until the age of two. At that point, culture and the cultural signs were necessary to expand thought. He believed that the internal and external forces

interacted to produce new thoughts. Vygotsky placed greater emphasis than Piaget on the role of the adult or more mature peer as an influence on children's mental development (Charlesworth & Lind, 2007). In any classroom situation, children come from different cultural backgrounds: it is important to find common ground for learning to take place. Learning to solve problems by working from the known to the unknown grants children the opportunity to share their experiences and so learn from one another, especially when experiences differ. The Grade R teacher in this study was actively involved in the learning environment. She walked with them, counted with them and was interacting with their thinking processes by asking continuous questions.

Vygotsky argued that to develop intellectually, individuals must be active, but more than that, the culture or environment must be active. He believed that the "tools" in the environment, which aid children in conceptualizing, change the very nature and potential of their learning compared to what would have taken place without the tool. Vygotsky claimed at the age of 6, children tend to label everything. This is in accord with the child's acquisition of language, the tool that connects them to the outside world. The child connects the properties or functions of a thing to a label. The label provides a means for storing and retrieving internal representations. Once a label is attached to something, the child is resistant to modifying its meaning (Lichtenberg & Troutman, 2003). This signification becomes a reality when children start using mathematical language; concepts are built by giving them labels within their active environment.

Piaget places an emphasis on children as intellectual explorers making their own discoveries and constructing knowledge independently. Vygotsky developed the concept of the zone of proximal development (ZPD). This suggests that the concept's or relationship's internal representation lies somewhere between being ready for development and being developed to its fullest potential (Lichtenberg & Troutman, 2003). The ZPD is the area between where the child is operating independently in mental development to where she might go with assistance from an adult or more mature child. Cultural knowledge is procured with the assistance or scaffolding provided by more mature learners (Charlesworth & Lind, 2007). A collaborative attainment of knowledge can be an effective method for learning to take place. In this

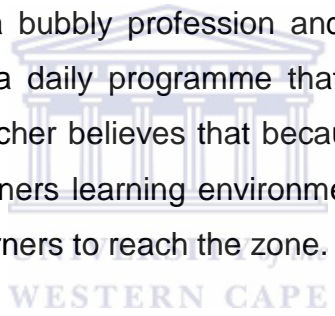
study it is often seen that learners help each other with counting objects and finding solutions to classroom activities. As children learn, they guide their thinking by talking to themselves – private speech. Adults use private speech when they mentally compose a list of what they want to accomplish during the day and talk themselves through it. In a cooperative learning group, children hear other people’s thoughts and assimilate their ideas into their own private speech (Smith, 2001).

A mediator (teacher, parent, older child), according to Vygotsky, is an important factor in the learning process. By working through problem situations with a child who is in the proximal zone, the mediator helps the child to focus on pertinent properties of a concept or relation and consequently makes it possible for the child to internalize concepts and relationships not only more quickly and more accurately, but beyond his or her autonomous capability. The mediator enables the child to reach a potential beyond what the child could achieve independently. An important part of this mediation process is the nature of the dialogue that takes place between the mediator and the child. Appropriate, effectively nuanced dialogue helps the child construct an inner voice that assists the child in considering, sorting and analysing problem situations, even when the mediator is not present (Lichtenberg & Troutman, 2003). This is important for learning mathematical concepts as seen during this study when the teacher asks questions to guide the learners. An important question asked in this study is “How many”. The teacher uses this question to stimulate or prompt the thinking process and for learners to later construct their own inner voice of asking “How many”. This can be a valuable tool for developing number concept.

According to Vygotsky, good teaching involves presenting material that is a little ahead of development. Children might not fully understand it at first, but they understand it in time, with appropriate scaffolding (Charlesworth & Lind, 2007). Vygotsky argues that children in the early stages of learning need a great deal of support or scaffolding in order to grasp a task. Later this guidance or set of prompts is gradually reduced so the child can master the skill independently. Teachers can encourage “talking aloud” about how a student finds the answer and can encourage listening skills while other students explain their solutions (Smith, 2001). As mentioned before, the use of questions is a well-proven method in Grade R because that is the way learning takes place. Therefore listening skills must be improved for

learners to expand on their knowledge and exchange cultural background signifiers. Instruction should not impose pressure on development. Instruction supports it as it moves ahead. Concepts constructed independently and spontaneously by children lay the foundation for the more scientific concepts that form part of the culture (Charlesworth & Lind, 2007). For example: When a child is busy with structured play in a classroom and discovers that a 2l bottle is too heavy to carry, and his mother asks him to fetch the 2l bottle of Coke on the table or she will immediately tell her that it is too heavy to carry. So the concepts of light and heavy are established independently and spontaneously.

Teachers need to identify each student's ZPD and provide developmentally appropriate instruction. Teachers will know when they have hit upon the right zone because children will respond with enthusiasm, curiosity and active involvement (Charlesworth & Lind, 2007). The programme is just as good as the teacher presenting it. Grade R is a bubbly profession and the teacher needs to build the enthusiasm by presenting a daily programme that is structured, well-planned and most of all, fun! The researcher believes that because this Grade R teacher was so actively involved in the learners learning environment, she made a good attempt to facilitate the process for learners to reach the zone.



## **2.4 Curriculum and Assessment Policy Statement (CAPS) Content area**

The Curriculum Policy has five different content areas namely, (1) Numbers, Operations and Relationships, (2) Patterns, Functions and Algebra, (3) Space and Shape (Geometry), (4) Measurement and (5) Data Handling. This particular study will focus on the first content area for Grade R. An outline of the content area *Numbers, Operations and Relationship* from the CAPS policy is found in Appendix H.

## **2.5 Number concept**

### **2.5.1 Definition of number concept**

Mc Dermott & Rakgokong (1996) refer to number concept as the “feeling for” and understanding of “how manyness” or value of number. The concept of number or understanding number is referred to as number sense. Number sense makes the

connection between quantities and counting. Number sense underlines the understanding of relative amounts; the relationship between space and quantity or number conservation, and parts or wholes of quantities. Number sense enables children to understand important benchmarks such as 5 and 10 as they relate to other quantities and measurements (Charlesworth, 2000). The concepts of “more”, “less” and “same” are basic relationships contributing to the overall concept of number” (Van de Walle & Lovin, 2006).

### **2.5.2 Definition of emergent number concept**

The emergent number concept is similar to the development shown by learners when dealing with printed text in the early stages of reading and writing. In the same way that they make their first attempts to read and show their first writing as scribbles on paper, so learners begin to understand numbers. This developing number sense takes place within real-life contexts and physical objects (van den Heuvel-Panhuizen et al., 2012).

### **2.5.3 Definition of growing number concept**

During this stage, the learners’ number concept is further developed as they begin to master some significant number skills. These skills include correctly reciting the counting sequence (oral counting); directly recognizing a particular number (perceptual subitizing); finding the total of a collection through counting (resultative counting); roughly saying how many objects a collection contains (estimating); representing and symbolizing numbers, and building up and breaking down numbers. In stage 1, these number skills are applied to the number range up to 10 and beyond) (Van den Heuvel-Panhuizen et.al 2012).

### **2.5.4. Number Skills needed to acquire number concept**

#### **2.5.4.1 Emergent number concept (see 2.5.2)**



### **(i) Distinguishing numerosity**

During this stage learners develop an awareness of what number is about. This is shown when they mention a number in relation to a collection of numbers. They recognize numerosity (the cardinal value) as a quality of the collection that is different from shape and colour, for example. This behaviour is a first indication of distinguishing numerosity. (Van den Heuvel-Panhuizen et.al, 2012). The cardinality principle states that when a counting action is completed the last number name uttered indicates the numerosity of the group of objects counted ("The how manyness") (Mc Dermott & Rakgokong, 1996). In this study the teacher used the "how-manyness" question during all the lessons; she used it as a tool for learners to develop numerosity.

### **(ii) Imitating oral counting**

In addition to distinguishing numerosity, learners attempt to recite the counting sequence. Initially, this is not related to actually counting quantities, but rather it seems as if the counting sequence is recited as a sort of nursery rhyme or as if it is just one long word. In most cases, the counting sequence is learnt and used in the context of daily games and activities. This is evident, for example, when learners play hide and seek and recite "*One, two, three... here I come, ready or not!*" When learners are in this stage, they imitate and extend this verse on their own; counting sequences, such as, "*one, three, seven, four, ten!*" (Van den Heuvel-Panhuizen et.al 2012).

Mc Dermott & Rakgokong (1996) refers to procedural counting or rote counting and argue that this process is not as meaningless as is sometimes believed. It has a definite role to play in learning about numbers. Three principles are known to be prerequisites for the development of procedural counting skills. These are the stable order principle, the one-to one principle and the abstractions principle. Children use the stable order principle of counting before they learn the correct sequence of counting. This principle states that children repeat the same counting words over and over again before they start using the correct sequence. They have not grasped the one-one principle which states that when counting, each number name must be paired with one object that is being counted. This eliminates counting errors

such as skipping an object or counting an object twice. Within this study certain learners were still imitating the counting sequence by reciting the numbers as the teacher or other learners were counting paired., But when they had to count on their own they were not able to do it. This is not so meaningless because this gives them the opportunity to practise the correct number sequence.

### **(iii) Imitating resultative counting**

Another indication of the emergent number concept is that learners develop a vague understanding of resultative counting. This means that they build up an idea of counting a collection of objects (counters, pictures, fingers, and so on) with the aim of determining how many objects there are. Resultative counting is a complex skill that needs a lot of practice. It emerges in contexts when learners deal with physical objects. Often the development starts with imitating the resultative counting of older learners and adults. Learners watch what other people are doing, but they do not fully understand the meaning of the actions (Van den Heuvel-Panhuizen et.al 2012).

When learners imitate resultative counting, they do not have a clear idea of all the aspects and characteristics of resultative counting. For example, they skip numbers, do not keep to the one- to- one correspondence, or do not follow the counting sequence in the correct order. The learners understand that the last mentioned counting number indicate the total of the quantity that is counted. Understanding resultative counting is demonstrated when learners are aware that there is something not quite right when they count a particular collection in two different ways;for example from left to right and then from right to left and get two different numbers as a result. When learners show surprise at getting two different outcomes, they have reached a real understanding of resultative counting (Van den Heuvel-Panhuizen et.al, 2012). This insight was demonstrated in this study when certain learners counted the objects but because the sequence was wrong they would give the wrong numeral for the number of objects counted.

#### **(iv) Symbolizing by using fingers**

Apart from working with concrete quantities and objects that are physically present, learners are able to think of quantities that are not visible or tangible. This is when they first see the need to represent quantities symbolically. The natural way of doing this is by using fingers. A clear example of this is the way learners show their age; by raising three fingers to show they are three years old (Van den Heuvel-Panhuizen et.al, 2012). According to McDermott & Rakgokong (1996) learners should be allowed to use the counting strategy of their choice. If they prefer to use their fingers to count on, they should be allowed to do so. In general, fingers are useful to represent small numbers of things. These representations help a child to think of quantities in a more abstract or formal number-focused way. As children learn to symbolize numbers using their fingers, they develop the ability to subitize (instantly perceive the number of items in front of them). Using their fingers to represent numbers prepares children for the “five structure”, which plays a key role in later stages of counting and calculation (Van den Heuvel-Panhuizen et.al, 2012). This development was observed in this study when the teacher showed or asked learners the “how manyness” question or showed them a numeral. The learners responded by showing the number with their fingers.

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#### **2.5.4.2 Growing number concept (see 2.5.3)**

##### **(i) Discovering different meanings of number**

Understanding of number now becomes more specific. As learners encounter all kinds of numbers in their everyday surroundings, they begin to realize that numbers can be used differently in different situations; and in this way learners are learning different meanings for number. Learning different number meanings indicates that learners comprehend that the five that expresses that there are five of something, has a different meaning to the five that indicates a particular bus route, or the five in “being fifth in a row”, or the five that results from measuring (Van den Heuvel-Panhuizen et.al, 2012). In this study discovering different meanings of numbers was observed when the teacher exposed the learners to ordinal numbers and emphasized that “3” goes with third and the learners responded correctly.

## **(ii) Oral counting**

Another important step in this development is the correct reciting of the names of the numbers in the order of the counting sequence. Such oral counting is a prerequisite for resultative counting. Later learners become skilled at continuing the counting sequence from other numbers. In order to recite the counting sequence correctly, learners should have frequent opportunities to practise. Learners need a constant repetition of the counting sequence through rhymes and oral counting in action games (Van den Heuvel-Panhuizen et.al, 2012). In this study oral counting was observed in the Grade R lessons when the teacher asked the learners to count objects aloud to determine the number present.

McDermott and Rakgokong (1996) state that counting is a complex process. If learners recite numerals in order it does not mean that they can count. Counting skills emerge gradually and learners encounter various counting experiences before counting becomes meaningful.

## **(iii) One- to- one correspondence**

Van den Heuvel-Panhuizen et.al (2012) refers to this as pointing at consecutive objects while recalling the counting sequence. The last mentioned number indicates the total of the quantity that is counted. To obtain the correct result, it is important that learners count in sequence and synchronously. The latter means one-to-one correspondence between pointing at an object and recalling the corresponding number word.

One-to-one correspondence is the most fundamental component of the concept of number. One-to-one correspondence is the understanding that one group of objects contains the same number of objects as another group of objects. Counting one-to-one correspondence involves coordinating the skills of partitioning and marking or keeping track of the objects counted. The learner performs both actions simultaneously and coordinates these actions by pointing to each object as it is counted (McDermott & Rakgokong, 1996). This was evident when the teacher asked learners to point to the objects

counted especially when the result of a collection had to be given.

**(iv) Rote counting**

Rote counting involves reciting the names of the numerals in order of memory (Charlesworth & Lind, 2007). In this study the teacher made use of rote counting when she wanted learners to give a visual representation of the number counted by making use of number symbols.

**(v) Perceptual subitizing**

Perceptual subitizing is the ability to perceive the number of a collection instantly. This means that learners can recognize how many objects there are immediately without counting them. Often, they can link this to using their fingers to express numbers. Subitizing is possible only with a small number of objects, usually up to five, and the maximum number is limited, even for adults. Subitizing forms a strong foundation for resultative counting.

Later, subitizing can be extended to larger numbers of objects as learners make use of their knowledge of number arrangements. This is called “conceptual subitizing”. The five structure (grounded in the whole hand) is a useful means to overcome the maximum number of perceptual subitizing (Van den Heuvel-Panhuizen et.al, 2012)

Mc Dermott & Rakgokong (1996) agree by saying that young children often accurately represent small numbers perceptually. This direct perceptual-apprehension of number is sometimes called subitizing. Young children seem to subitize small numbers up to four or five, but after that the counting process breaks down which may indicate that young children do not really count, they subitize. Subitizing only takes place for small numbers. Learners who are able to subitize small numbers will later fare better in a part-whole understanding of numbers.

Charlesworth and Lind (2007) add by saying conceptual subitizing involves seeing number patterns within a group such as the larger dot patterns on a domino. Perceptual subitizing is thought to be the basis of counting and

cardinality (understanding the last number named is the amount in a group). Conceptual subitizing develops from counting and patterning; it helps develop number sense and arithmetic skills. Preschoolers can subitize perceptually. Conceptual subitizing for small quantities begins in first grade. Within this study subitizing was evident when learners were expected to tell number of objects or dots seen during action games and educational games.

#### **(vi) Resultative counting**

Resultative counting involves counting a collection of objects with the aim of determining how many objects there are. For example, the teacher puts four blocks on the table and the learners have to say how many blocks there are. The result of the counting act is that learners know the numerosity or cardinal value of the collection. Subitizing is a form of resultative counting, but learners do not use the counting sequence explicitly to find the total number. (Van den Heuvel-Panhuizen et.al, 2012)

Learners who develop resultative counting are able to find the total number of a collection of objects; they are able to use the reverse skill – they can select a given number of objects. In practice, this means that learners should be able to put four blocks on a table when the teacher asks for four blocks (Van den Heuvel-Panhuizen et.al, 2012).

During this stage of the growing number concept, resultative counting is done mostly by counting one by one (see 5.6.2.4). Learning resultative counting is a complex process that goes through several sub- stages as identified below:

- *Context-based resultative counting*  
Learners will be able to tell how old a friend is by looking at the candles on the birthday cake
- *Object-based resultative counting*  
Learners show a more advanced method of resultative counting when they are able to answer questions about how many there are when shown loose objects or, later on, pictures of objects. This is called object-based resultative counting. This skill was observed when the

learners had to give the result of objects collected or given. The teacher often asked the “how manyness” question to develop this skill.

- *Number-based resultative counting*

Learners progress to number-based resultative counting when they are able to work with numerals (number symbols), and can use number knowledge to find the total number. This means they no longer need to have loose objects to count in order to arrive at the total. For example, learners are able to count how many rands are shown in the picture.

These sub-stages describe how learners develop resultative counting, starting with answering context-based implicit ‘how many?’ questions, and ending with being able to find the total of a collection without physically counting loose objects. The latter prepares learners for counting and calculating, which is the next stage in number development. (Van den Heuvel-Panhuizen et.al ,2012)

### **(vii) Estimating**

Resultative counting is not limited to finding the exact number of a collection. Learners need to develop estimation skills, so that they are able to say “how many” objects there are in a collection. This lays the foundation for estimating. In stage 1, estimation skills and understanding what it means to estimate can be encouraged through tasks that require comparison. Learners compare the numerosity of two collections and say which of the two contains the larger number of objects. Approximate resultative counting occurs when learners use number terms such as “a lot”, “very many”, “more than enough” or “too many”. When learners use these terms, teachers should not think that their learners lack resultative counting skills. The use of these terms reflects an important ability that should be acknowledged (van den Heuvel-Panhuizen et.al, 2012). This important skill was not evident in this study as it was not part of the planning for particular lessons presented.

### **(viii) Representing and symbolizing numbers**

At this stage, learners increase their repertoire of representing and symbolizing numbers. What starts with expressing age by showing fingers, gradually expands into a variety of ways to represent a number. Using

symbols to indicate the numerosity of a collection is an abstraction from the number of physical objects in that collection. The first step towards abstraction in using countable representations, such as counters, that stand in place of the real objects (which possibly cannot be brought to the classroom).. This leads to the next abstraction, in which learners use symbols to represent numbers and in most cases, no longer need concrete representations. (Van den Heuvel-Panhuizen et.al, 2012). The Grade R teacher in this study often asked the learners to represent the number symbol of objects collected or presented.

### **(ix) Ordinality**

Generally if children can count meaningfully forward and backward, they can easily acquire ordinal concepts such as 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and so on. However, there is one important concept to consider. When using ordinal numbers, there is always a reference involved. When you say “first in line at the water fountain,” the water fountain is the reference. (Troutman & Lichtenberg, 2003). In this study, the teacher created a scenario of a train and the places the passengers took on the train to teach ordinals to learners.

### **(ix) Place Value**

As children enter the concrete operations, they perfect their informal knowledge of numbers above 10 and move on to whole number operations with numbers above 10. To fully understand what they are doing when they use whole number operations involving numbers above 10, they must be able to conceptualize place value. Place value pertains to an understanding that the same numeral represents different amounts depending on which position it occupies. For example, consider the numbers 3, 30 and 300. In the first instance 3 stands for 3 1's and is in the 1's place. In 30, 3 stands for three 10's and is in the 10s place. In 300, 3 stand for three 100s and is in the 100s place. In each of these cases, 0 indicates there is no quantity in the place that it holds. In the number 32, 3 is in the place of 10s, and 2 is in the place of 1s. Place value is one of the most difficult concepts for young children to grasp (Charlesworth & Lind, 2007). Even though place value is not part of the Grade R content areas the opportunity for incidental learning occurred and the Grade



R teacher handled it accordingly.

**(x) Emergent object-based counting and calculating**

Although stage 1 focuses on counting and developing number knowledge, the activities in this stage often have an element of calculating. This skill was evident when learners were asked to count the amount of learners present to determine the absenteeism of the class.

## **2.6 South African studies in development of number concept**

Only a few studies in number concept development have been completed in South Africa. The researcher selected these studies for their relevance to this study.

In a study by Kühne, van den Heuvel- Panhuizen and Ensor (2005), researchers investigated teacher's perceptions about the ways in which children learn number skills and concepts. Data was collected by means of simulated – recall interviews and open-ended questions based on four classroom vignettes; teacher's comments were analysed in terms of accepted theories on learning and acquisition of number. It was constructed in such a way that they could act as prompts to encourage teachers to reflect on, and express their opinions about, certain aspects of learning and teaching numbers in different contexts. The theoretical framework used for the analysis in this study drew on Steffe;s (1992, 2001) model which outlines four basic counting schemes or stages, and on the notion of emerging counting as used by Wright (1998). This framework was founded on the idea that the advancement through these stages begins from the ability to invent informal context-related solutions, to the creation of various levels of efficient solution strategies (short cuts) and schematisations, and the acquisition of insight into the underlying principles and the discernment of even broader relations. The framework identifies the following stages for early number learning:

1. Emergent Counting
2. Perceptual Stage
3. Figurative Stage
4. Initial number Sequence Stage
5. Tacitly-nested Number Stage

## 6. Explicitly-nested Number Sequence Stage.

In addition to the hierarchy of stages, the framework contains an explicit description of behaviour which can be expected of most children at each stage and an overview of children's knowledge, strategies and solutions to number problems. This study revealed that teachers have a limited understanding of how children learn numbers and gives support to the idea that a learning pathway description may assist with broadening understanding of learning and teaching numbers. From this study it does not appear that teachers are able to describe a long term overview of the process of learning and teaching number that connects the different development stages and offers a framework for didactical decision-making. These findings are perhaps surprising given that all teachers attended in-service mathematics courses. This suggests the need for a more elaborate form of in-service education with a framework or trajectory for learning and teaching number: such a trajectory would present mathematical understanding and content in a progressive and structured way and encompasses the cognitive and didactic continuum (Kühne<sup>1</sup> et al., 2005).

In a study by Cranfield, Kühne, van den Heuvel-Panhuizen, Ensor, Lombard and Powell (2005) the authors investigated how Grade one to three children in South Africa learn early number concepts. The development of a learning pathway for number in the early grades of the South African Primary school (Foundation Phase) is intended as a mathematical guide for planning instructional sequences. The learning pathway for number is research-based and highlights the main features of children's early number development and describes how number knowledge, number sense, mental and written calculation, estimation and algorithms are developed and relate to each other within and across the Foundation Phase. The aim of the project was to show a productive, efficient and sustainable way to lift learner's performance in mathematics. Three schools were included and involved 222, 257 and 240 students in grade one to three respectively. The tests were piloted at a primary school in the city. An analysis of performance, misconceptions and errors made by the learners in each grade was achieved through an in-depth analysis of 48 learners. A framework was developed and used to assess the children's level of understanding and used to analyse their strategies in solving number problems. The analysis of the learner responses showed that the strategies used for solving problems from Grade

1 to grade 3 did not change, showing little progression across the grades. Grade 3 learners in particular used counting strategies (count all and count on). There was no evidence of a calculation by structuring, for example grouping or breaking up numbers. The majority of learners wrote down the answers. Field staff reported the learners were counting either on their fingers or their toes. Learners used tally marks or circles to represent the problem and to assist in their counting and calculating. As the numbers increased, however, errors in counting became common. None of the learners displayed higher order thinking skills.

The results suggested that the majority of learners were unable to solve straight calculations, employing the strategy counting all and counting on. None engaged in formal or innovative methods. There is no progression in terms of conceptual mathematical development across the foundation phase. In conclusion, the fact that the tests were conducted early in the year (only three months into the year) some concepts may not have been taught, revised or consolidated by the teachers at the schools: this may have caused the series of poor responses on a number of concepts or test items. This only improved slightly in November, despite a year's training. Based on the four stages of development, the grade 3 learners are operating at grade 1 and grade 2 stages. The insights gained from the testing will be used for the development phase to be implemented in 2005 (Cranfield et al., 2005).

A study by Botha, Maree and De Witt (2005) involved developing and piloting the planning for facilitating mathematical processes and strategies for preschool learners. The authors focused their attention on early numeracy, a concept that has been singled out for particular attention in South Africa's recently adopted Curriculum 2005, which defines numeracy as the purposeful use of mathematics to meet the diverse demands placed on individual persons by his/her environment. The authors stated that mathematics learning and teaching in South Africa is far from adequate. In the Third International Mathematics and Science Study (TIMSS-R) South African Mathematics learners achieved significantly poorer results than all the other participating countries, including Marocco and Tunisia, and were older than all other learners (Howie, Botha, Maree & de Witt 2005). The aim of this study was to investigate the way in which teachers plan and present mathematical activities in grade R classrooms by determining the extent to which teachers use mathematical

knowledge, processes, techniques and strategies in the planning and presentation of mathematics to young learners. The possible influence of teacher qualification on the presentation of mathematics to young learners was analysed. The population was defined as all pre-primary teachers attached to Grade R classrooms in the Free State Province of South Africa. A convenience sample was drawn. A group of 90 persons, consisting of 73 grade R teachers and other interested participants attended the workshop on the study. The rest of the group comprised departmental officials, student teachers and those teaching the age group 0-4 years. The researchers chose a multi-method mode of inquiry, involving a combination of quantitative and qualitative methods. They selected an explorative, interpretative approach, implying that the aim was to understand epistemologically in a trustworthy way; nonetheless accepting that researchers' perceptions of reality not only vary but, in fact, differ greatly.

The qualitative part of the research comprised of a literature study, conducting a workshop and interviews with teachers to discuss the results obtained from administering a structured questionnaire to obtain information regarding the way educators plan and teach mathematical activities to young children. The purpose of the workshops was to demonstrate challenging and innovative ways to introduce young children to the world of mathematics. The theoretical framework for the learning activities was based on the cognitive developmental theories of Piaget, Sternberg, Vygotsky and Gardner's theory on multiple intelligences to accommodate different learning styles. The quantitative part of the study comprised the administration of the questionnaire and making statistical comparisons between teacher's views since the development of early mathematical knowledge, processes and strategies form an integral part of the learning and teaching programme for preschool learners. After the workshop, a structured-open questionnaire was administered to all the workshop attendees. They used the following aspects:

- The qualifications of the respondents
- Ways in which they presented mathematics to young learners
- Age range in which they taught; and
- Mathematical knowledge, processes, techniques and strategies used in the teaching of mathematics.

The researchers asked the teachers to indicate to what extent they had introduced the five outcomes number, patterns, geometry (shapes) and space, measurement, and data analysis as planned activities in their programmes prior to attending the workshop. The data analysis made it clear that educators do not provide equally for the different modalities of mathematical knowledge, processes and strategies in their planning and presentations. Educators will have to be aware of the importance of the developmental characteristics of young learners and will need to build on this in their planning and presentation of mathematics. An understanding of the different modalities of mathematical knowledge, processes and strategies is of crucial importance. Educators will not plan for these equally unless they themselves know the modalities.

The researchers stated that in traditional Grade R classrooms, the phrase 'integrated mathematical activities' referred to the integration of mathematical activities into language-related, perception-type, music-movement-free play activities, and so on. They stated that integrated activities can be planned. Current developments on education in South Africa and against the background of a nationally introduced education system made the introduction of formal mathematical activities in Grade R classrooms compulsory. This research included how integrated mathematical activities were introduced as opposed to the formal planning of mathematical activities. The researchers stressed the fact that significant learning could take place during "unplanned activities" (namely integrated, unplanned sessions in Grade R classrooms). Planned activities' may not necessarily yield optimal results. An educational difference between what teachers intended teaching children and the actual outcome of their intervention could occur (Botha et al., 2005)

## **2.7 International studies on the development on the number concept**

Research on number concept internationally has been widely developed. In a study by Ee, Wong and Aunio (2006)) the authors investigated the early numeracy skills of pre-school children (4-7yrs) in three cities: Singapore, Beijing and Helsinki. The three specific research questions were:

1. Are there any gender differences in the numeracy skills among Singapore, Chinese and Finnish young children?

2. What numeracy skills are achieved by children of different age groups in each city?
3. How do the children in the three cities compare in their numeracy skills?

The children's numeracy skills were tested individually. Rapport was established with the child before proceeding with the series of interview tasks. This was to ensure a non-threatening climate for the children. The findings generally supported the notion that readiness skills were easier than formal counting skills. Thus, teachers need to ensure mastery of these readiness skills in pre-schools and lower primary levels. This may be done by engaging young children in meaningful and interesting activities using concrete materials, exciting games, and role plays that use mathematics in daily situations. This message should be made known to pre-service teachers for early childhood and lower primary education. The findings of no gender differences at a very young age suggest that young children have not been affected by socio-cultural factors or gender stereotyped behaviours that may be prevalent in their community. Extra care should be taken by parents, teachers, and significant others so that undesirable gender factors do not adversely affect subsequent development of mathematics among children. As mathematics becomes an increasingly important subject in the modern technological world, it is crucial that both boys and girls continue to study and master mathematics to the best of their abilities without any obstacles that arise from destructive socio-cultural influences. In conclusion, this study sheds light on the levels of early numeracy skills among children from three different cities. It has not examined factors such as socio-economic influences or pre-school education that might explain how young children develop numeracy skills (Ee, Wong, & Aunio, 2006).

In an effort to determine the most efficacious manner to deliver professional development training to early childhood educators, a study by Rudd, Lamber, Satterwhite & Smith (2009) investigated the effect of a 2 hour workshop followed by side by side classroom coaching. Twelve early childhood educators with 4-year degrees teaching in a university child development centre participated in the study. All participants were female. The twice weekly classroom observations were analyzed for the use of mathematics mediated language. Results indicated a 56% increase of mathematics mediated language following the professional development. The greatest increase (39% increase over professional development condition)

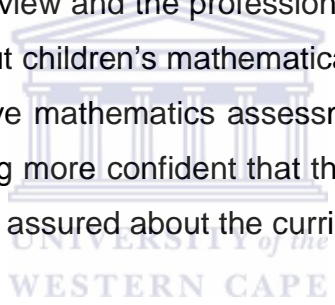
occurred during the side by side coaching phase of the treatment. These results corroborated previous findings that implementation of teaching strategies presented in professional development trainings can be enhanced by coaching teachers on the use of strategies. Overall, professional development had a positive effect on the frequency of Math Mediated Learning (MML). However, the greatest increase in MML was observed during the coaching condition. The increases of MML were consistent with the manipulation of experimental conditions despite the staggered implementation during the coaching condition. (Rudd, Lambert, Satterwhite & Smith, 2009).

In a study by Gervasoni (2005), the author provided a brief overview of the development and use of growth points to describe young children's number learning. The aim was to enhance the mathematical learning of young children (5-year olds to 8-year olds) through increasing the professional knowledge of their teachers. Following the review of available research, the ENRP (Early Number Research Project) team developed a framework of growth points for number (incorporating the domains of counting, place value, addition and subtraction strategies, and multiplication and division strategies), measurement (incorporating the domains of length, mass and time) and space (incorporating the domains of properties of shape, and visualisation and orientation). Within each mathematical domain, growth points were stated with brief descriptors in each case. There are typically five or six growth points in each domain and each growth point was assigned a numeral so that the growth points reached by each child could be entered into a database and analysed. For example the growth points for the counting domain are:

1. Rote counting of the number sequence to at least 20, but is unable to reliably count a collection of that size
2. Counting collections, confidently counts a collection of around 20 objects
3. Counting by 1s (forward/backward, including variable starting points: before/after) counts forwards and backwards from various starting points between 1 and 100, knows numbers before and after a given number
4. Counting from 0 by 2s, 5s, and 10s, can count from x by 2s, 5s, and 10s to a given target beginning at variable starting points.
5. Counting from x (where  $x > 0$ ) by 2s, 5s, and 10s, can count from x by 2s, 5s, and 10s to a given target beginning at variable starting points

6. Extending and applying, can count from a non-zero starting point by any single digit number, and can apply counting skills in practical tasks.

Each growth point represents substantial expansion in mathematical knowledge, and it is acknowledged that much learning takes place between them. In discussions with teachers, the research team described growth points as key “stepping stones” along paths to mathematical understanding. Both the interview and the framework of growth points were refined through the first two years of the project in response to data collected from more than 20,000 assessment interviews with children participating in the project. The assessment interviews provided teachers with insights about children’s mathematical knowledge that otherwise may not have been forthcoming. Teachers used this information for planning to provide children with the best possible opportunities to extend their mathematical understanding. In conclusion the ENRP framework of growth points, the professional knowledge gained through the ENRP assessment interview and the professional development program, and the analysis of ENRP data about children’s mathematical learning provided teachers with many insights about effective mathematics assessment, learning and teaching. This culminated in teachers being more confident that they were meeting the instructional needs of children, and more assured about the curriculum decisions they made.



## **2.8 Summary**

This chapter provided the educational theories underpinning this research, as well as national and international studies about number concept and learning. The following chapter will detail the methodological aspects of this research.



# CHAPTER 3

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## Methodology

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### 3.1 Introduction

The purpose of this chapter is to provide a description of the research methodology employed to describe the lesson implementation in a Grade R classroom at a school in Wellington in the Western Cape. The chapter addresses the research data collection procedures, design and approaches used in this study.

### 3.2 Research question

In addressing the research problem, the following research question will be investigated.

*What number skills are used by the teacher to develop the number concept of learners in a Grade R class?*

### 3.3 Research Techniques and approaches used in this study

#### 3.3.1 Qualitative research

According to Henning, Van Rensburg, & Smit (2004), the instrument of research in qualitative research is the human mind. Therefore in the development of the competent researcher, the process of learning to become a researcher is an on-going one. This statement re-states the focus of my research; lifelong learning is an on-going process. Understanding the number concept is constantly changing as children change.

A qualitative approach requires individual interviews, focus groups, observations, a review of existing documents or a combination of these. Although these data sources result in a wealth of rich information, considerable time and resources may be

required to adequately represent the area being studied (Hancock & Algozzine, 2006). In qualitative research, the goal is to understand the situation under investigation primarily from the participants' and not the researchers' perspective. Because the researcher is the primary instrument for data collection and analysis in qualitative research, significant amounts of time were spent in the environment of those being studied (Hancock & Algozzine, 2006).

The researcher is unequivocally the main instrument of research and makes meaning from her engagement in the project – meaning that she will present her findings or what she has interpreted to be the meaning of the data. This does not mean that the voices of the setting are lost or that she biases the study 'Thick description' gives an account of the phenomenon (a) that is coherent and that (b) gives more than facts and empirical content, but that also (c) interprets the information in the light of other empirical information in the same study, as well as from the basis of a theoretical framework that locates the study (Henning et al., 2004).

In moving beyond exploration and description, which have become the hallmarks of qualitative research, comes the next level, namely explanation. Although the general characteristics of qualitative research are the same, differences exist between specific types of qualitative research. In this particular study I have decided to use a case study. It is different from other types in that it has intensive analyses and descriptions of a single unit or system bounded by space and time. Topics often examined in case studies include individuals, events and groups. Through case studies, researchers hope to gain in-depth understanding of situations and meaning of those involved. Merriam (2001) suggests that insights gleaned from case studies can directly influence policy, procedures and future research. Although case studies are discussed extensively in the literature and employed frequently in practice, little has been written regarding the specific steps one may use to successfully plan, conduct, and share the results of a case study project (Hancock & Algozzine, 2006).

TABLE 1: Comparison of general research traditions (Hancock & Algozzine, 2006)

Qualitative studies	Case studies
Researcher identifies topic or questions of interest, collects information from a variety of sources, often a participant observer, and accepts the analytical task as one of discovering answers that emerge from information that is available as a result of the study.	Researcher identifies topic or questions of interest, determines appropriate unit to represent it, and defines what is known based on careful analysis of multiple sources of information about the “case”
Research process is designed to reflect, as much as possible, the natural, ongoing context being investigated, information is gathered by participant observers (individuals actively engaged, immersed, or involved in the information collection setting or activity).	Research process is defined by systematic series of steps designed to provide careful analysis of the case.
Information collection may last a few months or as long as it takes for an adequate answer to emerge, the time frame for the study is often not defined at the time the research is undertaken.	Information collection may last a few hours, a few days, a few months, or as long as is necessary to adequately “define” the case.
Report of outcomes of the process is generally narrative, consisting of a series of “pages to the story” or “chapters to the book”	Report of outcomes of the process is generally narrative of nature, consisting of a series of illustrative descriptions of key aspects of the case.

### 3.3.2 The case study approach

#### (i) The nature of case studies

A case study is a single instance of a bounded system, for example a child, a clique, a class, a school, a community. It provides a unique example of

real people in real situations, enabling readers to understand ideas more clearly than simply by presenting them with theories or principles. Indeed a case study can enable readers to understand how ideas and abstract principles can fit together. Case studies can penetrate situations in ways that are not always susceptible to numerical analysis. (Cohen et al, 2000).

In education, case study has enjoyed considerable prominence as a research methodology for some decades. More traditional forms of research on daily educational practice lack impact, and conversely, educators' show frustration at the apparent 'non translatability' of many research findings:

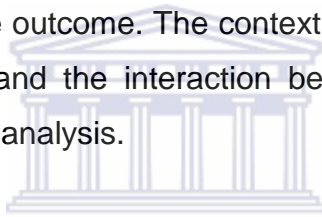
“Too much of teacher education is unbearably generic, offering vague and general principles and maxims that purport to apply broadly to a vast range of situations” (Schulman, 1996).

The goal of a case study, in its most general form, is to put in place an inquiry in which both researchers and educators can reflect upon particular instances of educational practice. The topics of a case study research vary widely. For example, case studies of programs, events, persons, processes, institutions, social groups, and other contemporary phenomena have been completed. Sometimes people use the term case study as a catchall category for research that is not a survey, an observational study, or an experiment and is not statistical in nature (Merriam in Freebody, 2003). Hancock & Algozzine(2006)state several important characteristics that define a case study.

Case study research sometimes focuses on an individual representative of a group; more often it addresses a phenomenon: the two are not mutually exclusive. The phenomena being researched are studied in a natural context, bounded by space and time. Context is important in case study research and its benefits are intensive investigations of individuals or groups as well as events, situations, programs, activities, and other phenomena of interest.

Third, case study research is richly descriptive, because it is grounded in deep and varied sources of information. It employs quotes of key participants, anecdotes, prose composed from interviews, and other literary techniques to create mental images that bring to life the complexity of the many variables inherent in the phenomenon being studied. Information is explored and mined in the case study environment for a more thorough examination of the given phenomenon. Doing case study research means identifying a topic that lends itself to in-depth analysis in a natural context using multiple sources of information (Henning et al, 2004).

A case study as a format for design is thus characterised by the focus on a phenomenon that has identifiable boundaries. Data that are not applicable to the case are not utilised unless they indirectly reflect the nature of the case. Merriam (Henning et al., 2004) points out that the process is more important than the outcome. The context is also more than part of the case – it is the case and the interaction between context and action that is usually the unit of analysis.



## **(ii) Strengths and weaknesses of the case study approach**

Gomm, Hammersley and Foster (Bassegy, 2004) offer a compilation of ten articles written in the last half of the twentieth century on different aspects of case study. The editors recognise that the term “case study” is ill-defined; they see it not as an experiment, not as a survey, but essentially as investigation in considerable depth into one or a few cases in naturally occurring social situations. They focus on the problem of generalizability, causal or narrative analysis, the nature of theory in case study, and issues of authenticity and authority. Bassegy (2004) states the characteristics of good educational research in terms of a case study. The outcomes are trustworthy. In a case study he prefers the term validity and reliability. The conduct of enquiry and its report must be ethical, particularly in terms of respect for persons. An outcome of the research must be that it says something significant to someone (teacher, manager, policy maker, parent, learner etc.), thereby informing her or his work and potentially helping to improve it. The research must be reported in forms which are meaningful

and readable to the various audiences who may read it.

Bassey(2004) discusses his concern for case studies and the issue of generalizability. In the place of scientific generalization, which states what is, he has introduced the idea of fuzzy generalization. With this perspective it is possible to generalize (in fuzzy terms) from a single case. But, of course, the statement that something may be true embraces the idea that it may not be true. This has led him to the idea of BET, that is, a best estimate of trustworthiness – which is a professional judgement, based on experience in the absence of research data.

Henning et al., (2004) state case studies are not the “easy way out” for researchers who have not developed their methodological expertise. To collect data on a topic and then to label it a “case study” is often a methodological and design mistake. Design questions should be asked: “What is this study a case of? Does the topic warrant being referred to as a ‘case’?” It was found that case studies require multiple methods to capture the case in some depth. It is therefore a way of establishing the design validity – Does this study require multiple methods in order to capture the full case? Usually, if the answer to this question is “yes”, and if there is a bounded system with a clear unit of analysis, the study will warrant a “case” design type.

**(iii) Application of the case study approach in this research.**

The case study approach was used in this investigation to evaluate the integration of the Learning Programme Numeracy in an integrated daily Programme in Grade R. The research question addresses the development of number concept in this integrated daily programme. The researcher identified the topic due to the needs of the students in her lectures and the uncertainty of integration must take place. The researcher focused on one individual classroom and one teacher. Twenty-one lessons were recorded from which nine lessons were selected for analysis purposes.

### **3.3.3 The narrative as a research technique**

#### **(i) The nature of the narrative**

Shkedi (in Freebody, 2003) states that the case study methodology rests on an important assumption concerning the ways in which teachers represent their professional knowledge to themselves and to one another: this knowledge assumes a “narrative” format, and , research that privileges that format has more chance of impacting on practice among beginning and experienced teachers. Similarly, Stake (in Freebody, 2003) stresses the benefits of qualitative case study methodology arising from its emphasis on the uniqueness of each case, and the educator’s subjective experience of that case.

Narratives or stories have a structure, known as a story grammar, and it is this natural form of expression and representation that intrigues the narrative analyst in the social sciences. A story grammar consists of sets of rules that govern the language action in narrative (like discourse implies specific types of language action that reflect social life and the human condition in structures) (Henning et al., 2004)

Catherine Kohler Riessman (2000) who is known for her writing on narrative analysis says: “Personal narratives are, at core, meaning-making units of the discourse. They are of interest precisely because narrators interpret the past in stories rather than reproduce the past as it was”. In analyzing data that are partially or wholly narrated information, the analyst applies characteristics of narrative used by the participant to try to, once again, find patterns of language (story grammar) action that may be of significance. (Henning et al., 2004).

To start with, a set of data (that has narrative potential) is selected. The data do not have to be from a narrative interview only, but may consist of excerpts from other data in which story or part of a story, is evident. Kohler Riessman (2000) suggests that you analyse the data as “performance”,

meaning that the data not only represents, but present and act. The story itself is the object of the study – not the elements of content within the story. She means the personal narrative will be edited and adjusted to reflect a “performed, preferred self” in which the speaker narrates with a purpose – and that is what the analyst wishes to capture.

The way narrators position themselves, the way they portray others, the way they emphasize certain parts of the storyline are all discursive indicators of the “preferred” self. In analysis procedures the analyst may capture this positioning, but there is more to the analysis than that. In identifying different components of story grammar, such as characters, plot, action, setting, outcome, conclusion and so forth, the analyst reasons systematically about the nature of these and tries to see their discursive implications.

In trying to see the pattern of the narrative and its implications for understanding the social action, the phenomena and ultimately the human condition played out in the story of a school, the analyst needs to remain particularly close to the data. Extracting the indicators and grouping them in categories (or networks) of shared meaning should culminate in a pattern. Like all data patterns, it should show regularity, rhythm and cohesion (Henning et al., 2004).

## **(ii) Application of the narrative approach in this research**

The narrative inquiry to analysis of data was used in this study to provide a detailed description of the activities taking place within a daily programme. An unstructured narrative is used to make meaning of the video recordings. The “performance’ of the teachers and the children in this particular classroom is used to interpret “happenings” and data collected. The story of this classroom, activities and the integration used is the object of the story. The researcher narrate with a purpose and select only what she wants to capture by identifying certain characters, actions and plots to come to a conclusion. The use of a table with the contents of the learning cycle is then used to group certain activities into the characteristics of the



theoretical framework – the learning cycle.

### **3.3.4 Interviews**

#### **(i) The nature of Interviews**

Interviews are a common form of data collection in case study research. Interviews of individuals or groups allow the researcher to attain rich, personalized information (Mason in Hancock & Algozzine, 2006). To conduct a successful interview, the researcher should follow several guidelines. Firstly, the researcher must identify key participants in the situation whose knowledge and opinions may provide important insights regarding the research questions. Participants may be interviewed individually or in groups. Secondly, the researcher should develop an interview guide (sometimes called an interview protocol). This guide will identify appropriate open-ended questions that the researcher will ask each interviewee. These questions are designed to allow the researcher to gain insights into the study's fundamental research questions; hence, the quantity of interview questions for a particular interview varies widely. Thirdly, the researcher should consider the setting in which he or she conducts the interview. Although interviews in the natural setting may enhance realism, the researcher may seek a private, neutral and distraction-free interview location to increase the comfort of the interviewee and the likelihood of attaining high-quality information. Fourthly, the researcher should develop a means for recording the interview data. The best way to record the interview data is to audiotape the interaction. Before audio taping, however, the researcher must obtain the participant's permission. After the interview, the researcher transcribes the recording for closer scrutiny and comparison with data derived from other sources. Fifthly, the researcher must adhere to legal and ethical requirements for all research involving people. Interviewees must give permission to be interviewed and should not be deceived but protected (Hancock & Algozzine, 2006).

Hancock & Algozzine (2006) state interviews may be structured, semi-structured or unstructured. Semi-structured interviews are particularly well-suited for case study research. Using this approach, researchers ask

predetermined but flexibly-worded questions, the answers to which provide tentative answers to the researchers' questions. In addition to posing predetermined questions, researchers using semi-structured interviews ask follow-up questions designed to probe more deeply issues of interest to interviewees. In this manner, semi-structured interviews invite interviewees to express themselves openly and freely and to define the world from their own perspectives, not solely from the perspective of the researcher. Various authors have addressed a "non-standardized" way of interviewing in which "talk as social action" is investigated. (Baker in Henning et al., 2004) Interviewing the respondents may be seen as social actors interacting with an interviewer and who are at the same time involved in discursive practice.

**(ii) Advantages and disadvantages of interviews**

The critique of the standardised interview in its broadest sense involves many issues. They mostly have to do with the fact that in this practice the interview process itself is not seen as a data making process, but just as a data eliciting mechanism. What is meant by this critique is that the process of interviewing itself gives rise to a type of interaction that cannot be completely neutral. Two people are interacting and their very engagement with each other is already a text or subtext in a context. There are other criticisms levelled against the standardized interview and its inherent logic: that there is neutrality and that data – if elicited in a non-biased way by the interviewer – will yield "pure" information that may be analysed for its content. The only proviso's are that the interviewer should guide the interview, should not ask "leading questions", should prevent "contamination" of the data, and should not force the speaker into a "confessional mode" if the person is clearly not ready for it (Henning et al., 2004).

**(iii) Application of interviews in this research**

An individual was interviewed during this research, the teacher. The teacher was the planner of sessions as well as the active engager. The interview guide was compiled during the observations in the classroom to make the interview a social action. The setting used for this interview was the classroom itself so that referrals can be made back to situations. Semi-structured interviews were

used so that follow-up questions can be asked.

### **3.3.5 Observations**

#### **(i) Observations as a research tool**

A frequent source of information in case study research is observations of the research setting by the researcher. Unlike interviews, which rely on people's potentially biased perceptions and recollections of events, observations of a setting by case study researcher may provide more objective information related to the research topic. However conducting meaningful observations requires skill and persistence. (Hancock & Algozzine, 2006)

The principles relating to data acquired by means of interviewing also apply to observation. What is observed (seen and heard) is the researcher's version of what is "there". Again, guided by the purpose of the research, a researcher will focus, often without awareness, on certain aspects of a *mise en scène* (a prepared stage for "acting" – in the social and not the theatrical sense). Field notes and video-recordings will inevitably reflect this focus (Henning et al., 2004).

In Hancock & Algozzine(2006) five factors for conducting observations are evident. The most important factor is for the researcher to identify what must be observed in order to shed light on possible answers to the research questions. Secondly, similar to the interview guide, a case study researcher should create an observation guide – a list of features to be addressed during a particular observation. This schedule includes time / date / location of observations, names, positions, activities etc. related to the research questions, and initial impressions and interpretations of the activities and events under observation. Thirdly, a case study researcher must gain access to the research setting. Anticipating that participants in the setting may be suspicious of the researcher's goals, the researcher must be prepared to explain why, how, and for whom the investigation is occurring. Fourthly, the researcher must recognize his or her personal role and biases to the research.

Fifthly, a case study researcher must follow all ethical and legal requirements regarding research participants.

The observer thus observes and records in such a way that she will be able to use these data as building blocks when, ultimately, the *bricoleur* becomes the author of the research text. The observer by then will have looked at (observed) the data twice – first in direct contact with the occurring events, when the actors or participants were representing how they make meaning. This will be evident in what they do, how they do it, what they use, and against what setting or backdrop they do it. The researcher will thus observe language in use and symbols, such as pictures, utensils, art, books and all artefacts that are used in the setting. Secondly, the researcher will “observe” through her notes and other documented data such as videos or photographs. She therefore interprets twice, through the interpretation and presentation of the actors in the setting, and then through the text that she has created from the observation. (Henning et al., 2004)

Henning et al. (2004) also stated that it is wise to keep in mind that the field observes the consequences of the observation, the note taking and the reflection upon or the interpretation, are dependent on meticulous crafting of the recording of the observed site. Many researchers who observe a site do so without real participation. They do not become “part of the furniture” and usually go to the scene of everyday life to explore issues that will reveal more data that they acquired through interviews or in documents and artefacts.

Observation methods are powerful tools for gaining insight into situations. As other data collection techniques, they are beset by issues of validity and reliability. Even low inference observation, perhaps the safest form of observation, is itself highly selective, just as perception is selective (Cohen, Manion, & Morrison, 2000).

Cohen et al. (2000) furthermore suggests that observation places the observer into a moral domain and that it is inadequate to simply describe observation as a nonintrusive, non-interventionist technique; abrogating responsibility for the

participants involved. Observers, like other researchers, have obligations to participants as well as to the research community.

## **(ii) Application of observations in this research**

Using the research question as a guide, video- recordings were selected as the main source of data collection to observe how number concept development takes place in the classroom. Twenty-one lessons were observed from which nine were selected to see how the integration took place and if number concept was developed through this process. Nine lessons were selected namely, the morning circle, indoor play and outdoor play. The researcher gained access to the research setting by explaining to the principal, teacher and parents the reason for the research and the necessary protocol in terms of ethical clearances obtained (Appendix A, B and C). The researcher's role during the data collection process was as an observer with no involvement in the lesson implementation.

### **3.4 Data Sources**



#### **3.4.1 The school and the environment**

To provide the context of this study, a brief description of the history of this school, school building and surroundings is included. The school was founded on 10 October 1980 by a well-known Grade R teacher in the Wellington area. She later did her Doctorate in emergent literacy, lectured Grade R at Cape Peninsula University of Technology (CPUT) and has since written a Grade R guideline to be published in this coming year. The school grounds were donated by a local church with the intention of using it for educational purposes where the local orphanage children are to be accommodated. The school grounds are 6866m<sup>2</sup>. The school building belongs to a local trust and is 643m<sup>2</sup>. The socio-economic status of children in the school varies from high to low and children from Mbekweni, Uitsig, Van Wyksvlei, Newtown, Weltevrede, Berg and Dal, Wellington, surrounding farms and a local orphanage are accommodated. The school is independently owned but has recently (after the study was done) begun to receive a WCED subsidy.

The school has 5 teachers, one secretary and one general worker. There are 2 pre-Grade R classes and 3 Grade R classes and currently accommodates 118 children, ages 4 – 6; they have no class assistants. The school governing body consists of 5 parents, the principal, secretary and two teachers. The school grounds are some of the biggest in this town; it has an animal farm, vegetable garden, riding track, jungle gym, mini town, see saw, slide, water play area, sand play area and fantasy- play area with an old car, old tractor and a tree house. This school is seen as a community friendly school and is involved in different activities in the town. CPUT students do practice teaching at this school right through the year and students help out with projects frequently.

#### **3.4.2 The classroom**

The classroom is organized and the learning environment is experienced when you walk into the classroom. The classroom has a fantasy corner with a reading area on top, block-area, construction area, puzzles / educational play area, writing corner, big carpet and 4 tables for activities to take place. In the class every child has a locker to store bags, food and other personal educational equipment. The class also has a drying rack with every child's name on to structure painting activities. The walls are decorated with educational posters and the children's work is displayed.

#### **3.4.3 The class teacher**

The class teacher is a qualified teacher with a Junior Diploma in Education (Grade 1 to 3). She has been teaching for 20 years, 13 years in a Grade 1 class and 7yrs in a Grade R class. So has no formal Grade R qualification but attended all the WCED's courses and other courses offered by the surrounding institutions. The role of a teacher is central in the development of number concept and the teacher informed me that she knows what is expected of a Grade R learner. During my observations at the school it was evident that this teacher has a passion for education and gives her best to educate learners.

#### **3.4.4 The learners**

There are 22 learners in this classroom. This class is the only English medium Grade R at the school. The learners' socio-economic backgrounds vary from high to low but in the classroom they are all equal. Some learners are outspoken and others introverted. There are two learners who are siblings and also older than the rest of the learners (7 years and 8 years old) but they fit in comfortably.

### 3.5 Data collection

Table 2 provides a summary of the data collection process in order for the researcher to answer the research questions.

TABLE 2: Summary of data collection procedures

Research question	Data Collection Instruments	Source of Data Collection
<i>What number skills are used by the teacher to develop the number concept of learners in her Grade R class?</i>	Observation schedule Interviews schedule Video recordings	Teacher Learners Classroom Outdoor play

#### 3.5.1 Observations

Observations were made over a period of five months. The researcher observed the setting of the classroom, mathematical language used, activities done and resources used to develop number concept. The researcher used an observation schedule in the class and completed it as the lessons proceeded. Later these observation schedules were viewed in conjunction with the video-recordings. The final observations of the lessons (see Appendices E, F and G) were completed using both sources.

#### 3.5.2 Video- recordings

The transcribing of a video-tape enables the researcher to comment on all of the non-verbal communication that was taking place in addition to the features noted only from audio-tape. The issue here is that it is often inadequate to transcribe spoken words only because other data are pertinent (Cohen et al

2000). Comprehensive audio-visual recording can overcome the bias of the observer's view of a single event and can overcome the tendency towards recording frequent occurrences. Audio-visual data collection has the capacity for completeness of analysis reducing both the dependence on prior interpretations by the researcher, and the possibility again of only recording events which happen frequently. (Morrison 1994)

After observations were made, nine lessons (out of total of 21) were selected from the video-recordings for data analysis purposes. The video-recordings were transcribed for in-depth analysis to sight the occurrence of number concept. Observation started 08h00 – 12h30 each day.

### **3.5.3 Interviews**

Four interviews with the Grade R teacher were conducted during the research. The first interview was used to set the scene to find out more about the teacher, her skills and capabilities. The other three was conducted after each recording so that questions were directed at occurrences, the integration of mathematics within the daily programme and the planning. The duration of each interview would differ from 15 minutes to 30 minutes.

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## **3.6 Data Analysis**

An overview of the analysis process was based on a model from Smith et al. (2010).

### *Step 1 - Transcription*

Verbatim transcription of the content of each interview and video-recording done by the researcher. (See appendixes D, E, F,G )

### *Step 2 – Reading and re-reading*

Immersion in the data, active engagement with the searching for richer, detailed sections.

### *Step 3 – Initial noting*

Detailed examination of data to note the mathematical concepts of number,



shape, size, colour and time. (see Appendixes E,F,G)

#### *Step 4 – Developing emergent themes*

Reducing volume of data to only using the mathematical concept of number. Mapping the use of number to relate to number skills identified in the literature review. (see Appendixes E,F,G)

#### *Step 5 – Searching for connections across emergent themes*

Searching for the connection of how these number skills fit to the demands of the CAPS document to relate to the research question. (See Chapter 5)

### **3.7 Validity and reliability**

The concepts of validity and reliability are multi-faceted, meaning there are many different types of validity and reliability. Hence there will be several ways in which they can be addressed. It is unwise to think that threats to validity and reliability can ever be erased completely; rather, the effects of these threats can be attenuated by attention to validity and reliability throughout a piece of research (Cohen et al., 2000). Validity is an important key to effective research. If a piece of research is invalid then it is worthless (Cohen et al., 2000). Reliability according to Eisner (Golafshani, 2003) is a concept used for testing or evaluating quantitative research; the idea is most often used in all kinds of research. Testing as a way of information elicitation and the most important test of any qualitative study is its quality.

#### **(i) Validity and reliability in observations**

According to Cohen et al. (2000) there are several threats to validity and reliability. Firstly the researcher in exploring the present, may be unaware of important antecedent events: secondly, the presence of the observer might bring about different behaviours (reactivity and ecological validity), and thirdly, the researcher might “go native”, becoming too attached to the group to see it sufficiently dispassionately. Lincoln and Guba in (Cohen et al., 2000) state that trustworthiness replaces more conventional views of reliability and

validity, and that this notion is devolved on issues of credibility, transferability, confirmability and dependability.

In this study the teacher prepared the students for the video-recordings and for the presence of the researcher in the class. In the recordings the students were comfortable with the setting and set-up and almost no attention was drawn to the researcher. As researcher I also kept my distance to ensure that I do not get too close to the group. When certain events occurred, for instance emotional situations that could involve the children's capabilities, the teacher informed me.

### **(ii) Validity and reliability in interviews**

According to Cohen et al., (2000) the most practical way of achieving greater validity is to minimize the amount of bias as much as possible. The sources of bias are the characteristics of the interviewer, the characteristics of the respondent, and the substantive content of the questions. More particularly, these will include:

- The attitudes, opinions, and expectations of the interviewer,
- A tendency for the interviewer to see the respondent in her own image
- A tendency for the interviewer to seek answers that support her preconceived notions
- Misperceptions on the part of the interviewer of what the respondent is saying
- Misunderstandings on the part of the respondent of what is being asked.

A trustworthy relationship was established with the Grade R teacher and she appeared comfortable when answering my questions during the interview. During discussions after the class, issues that could lead to misunderstandings and misperceptions were resolved.

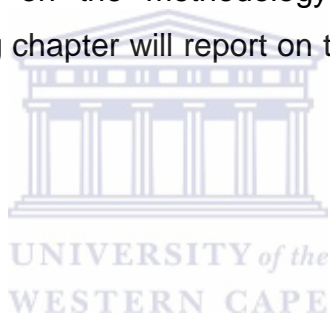
### **3.8 Ethical considerations**

Firstly, respondents needed to give informed consent to participate (Henning et al., 2004). This meant they had to be fully informed about the research in which the study will be used. Permission to conduct the research was sought

from the principal, teacher and parents of learners in the classroom. In a letter of consent, which was pre-drafted by the researcher, the Grade R teacher gave consent to these and any other ethical issues that may be relevant. Consent forms were signed by the principal, the teacher and parents or legal guardians of learners. The school is semi- private so the principal assured me no permission was necessary from the Western Cape Education Department. Henning et al., (2004) also states that they need to know their privacy and sensitivity will be protected and what is going to happen with their information after recording. All participants involved in the study were assured of anonymity and all information was handled as confidential. Individuals who were observed had the right to end an observation.

### **3.9 Summary**

This chapter focused on the methodology used to answer the research question. The following chapter will report on the findings as a result of the data analysis.



# CHAPTER 4

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## Findings

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### 4.1 Introduction

The previous chapter was devoted to the methodology used in this study. The purpose of this chapter is to report on the findings of the study in response to the research question.

*What number skills are used by the teacher to develop the number concept of learners in a Grade R class?*

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### 4.2 Number skills used to develop the number concept of learners

As indicated in Chapter 2 number concept refers to a value attributed to, and associated with a number. Number concept also has a close relation with number sense which makes a connection between quantities and counting. In a Grade R class the teachers is expected to make explicit the numbers of zero (0) to ten (10) and to relate the various aspects that impact on the understanding of numbers, operations and relationships including counting, sizes, correlations, etc. These are important measures for the Grade R learner to grasp and to interact with. It is therefore imperative that the learning cycle of the class be structured in such a way as to facilitate the understanding of number concept and how it relates to the learners' understanding.

It is important to identify the number skills needed by teachers. These number skills include emergent and growing number concepts. A total of nine lessons

were analysed (see Appendix E, F, G) using the number skills identified in the literature review (Chapter 2). Each of the number skills is reported on below with a view to consider the implementation of number concept development in the Grade R class that is used as this case study. Examples from the lessons are considered as evidence of the teachers' application of particular skills to ensure development of learners' number concept.

#### **4.2.1 Emergent number concepts**

##### **4.2.1.1 Distinguishing numerosity**

Van den Heuvel Panhuizen et al. (2012) describe this stage as one where learners recognize the cardinal values. Learners are able to mention a number in relation to a collection of numbers. They develop an awareness of what a number is. It can also be referred to as "the how manyness".

In lesson 2 the teacher asked the learners about the days of the week, and months of the year. The learners became aware that number was used to describe the collection of days and months. They were able to answer the "how manyness" question. "She then asked them how many days in a week? A learner responded "seven" and she asked them to double check and the learners counted the days together, with the teacher pointing to the days on the chart. She asked the students: *"Do we come to school for 7 days?"* The learners responded by saying: *"No, 5 days"*. The teacher continued: *"Two days they stay at home because it's weekend"*. She then asked: *"How many months in a year?"* A learner responded: *"twelve"*; *to which the whole class nodded their heads.*

The Grade R teacher therefore used the days chart to distinguish numerosity incidentally.

##### **4.2.1.2 Imitating resultative counting**

Van den Heuvel-Panhuizen (2012) refers to this stage when learners imitate other children or adults in counting but they do not keep to one on one correspondence or do not follow the counting sequence in order. They

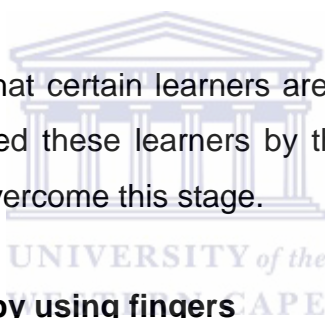
understand that the last mentioned number indicates the total but because they do not follow the correct sequence they come to the incorrect quantity.

In lesson 2 one of the learners had 5 stones, he counted but came to the conclusion he had 8 stones. It could be assumed that he imitated the other learners. After the teacher helped him count by using one- to- one correspondence he came to the right quantity.

“The learner counted with the teacher using his finger. He had five stones and took out the number eight. The teacher asked him to count it again. She asked him what number he must take out. He said five. She responded by saying: *“Yes, the man with the fat tummy”* referring to the sketch on the card.

[L2 Addendum F]

It was thus evident that certain learners are still imitating resultative counting but the teacher guided these learners by the using the skill of one- to- one correspondence to overcome this stage.



#### **4.2.1.3 Symbolizing by using fingers**

Van den Heuvel–Panhuizen (2012) states that learners have the need to represent quantities symbolically. The natural way of doing this is by using their fingers. Children see quantities all over their bodies, fingers (five), eyes, ears, arms, legs (two). By using their fingers they also develop subitizing (instantly perceive the number of items in front of them) because they know one hand has 5 fingers. The five structure is important for later stages in counting and calculating in the curriculum. Mc Dermott & Rakgokong (1996) say that if children prefer to count on their fingers they should also be allowed to do so.

In lesson 2 the teacher asked the learners to symbolize numbers by using their fingers.

She asked them to show her 10 fingers and then 9, then 5 and put them in their lap. The teacher showed number symbols and the learners' answers individually.'

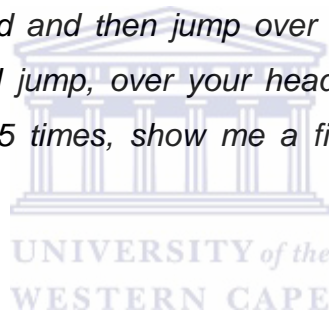


[L2 - Addendum F]

Similarly in lesson 7 the teacher instructed the learners to jump over a hula-hoop five times, she asked them to show the number of jumps with their hands. They showed her one hand and she agreed by saying one hand, five fingers.

"The teacher explained to the learners:

*"You are going to be springboks so you take the hula-hoop, put it over your head and then jump over it with both feet. Over your head and jump, over your head and jump! You have to do this for 5 times, show me a five with your hand. One hand, 5 fingers!"*



[L7]

The learners showed the teacher one hand symbolizing the quantity of 5. In the same lesson the learners had to make 5 jumps as indicated above. The teacher asked one of the learners how many jumps she had made already.

The learner replied by showing 2 fingers. The teacher asked: *"How many more must you make?"*

The learner replied by showing his hand. The teacher then showed her hand and took two away fingers, and asked: *"If I take two fingers away, how many more must you make?"*  
The learner replied: *"three more"*



[L7]

The learners represented quantities by using their bodies; the teacher

encouraged them to do so. The five structure of the hand is an important skill for counting at later stages. As Mc Dermott and Rakgokong (1996) stated if learners prefer to count on their fingers they must be allowed to do so.

## 4.2.2 Growing number concept

### 4.2.2.1 Discovering different meanings of numbers

Van den Heuvel – Panhuizen et al. (2012) describe this skill when learners realize that numbers can be used in many ways and that a number can have different meanings in different situations. They start to understand that the 7 in 7de laan, is the same 7 in, I must be seven to go to school, but also being 7<sup>th</sup> in a row. In lesson 8 the teacher instructed a learner to sit on the third chair, she reminded him that third goes with three, so the learner can make the connection of third and three.

“The learners stood up and went back to their places. She now asked another learner to sit on the third chair. The teacher took out her number symbol cards and asked the learner to fetch the card that suited her chair. She said remember 3 and third goes together.”



[L7]

The teacher created the opportunities for learners to experience the different meanings of numbers by introducing them to ordinality.

### 4.2.2.2 Oral counting

According to Mc Dermott and Rakgokong (1996) reciting numerals is not an indication that learners can count but it takes various counting experiences for counting to become meaningful. Van Den Heuvel-Panhuizen et al. (2012) agrees and states that this is an important step for resultative counting. Learners must therefore have enough practice of this in rhymes and action games.



In Lesson 1 the teacher does a head count and the learner counted orally with the teacher.

“The learner counted with the teacher touching every learners head up to 21. She asked how many children were absent and the learners replied: *“One learner”*”

[L1 – Addendum E]

Similarly in Lesson 5 the teacher asked the learners to count the number of pictures representing day and those representing night. They counted together.

“The teacher now asked the learners to count the number of pictures. They counted together. There were 5 pictures on either side. The teacher told them: *“Yes, we have 5 on either side they are equal”*”

[L5]

Also in Lesson 7 the learners were playing an action game and they were instructed to count four times as they jumped. They counted their jumps aloud.

“The learners at the balls were encouraged to take their four steps and the teacher motivated them by saying: *That’s good, very clever Learner A, four steps forward”*. The children now all took their four steps and you could see how each of them counted.”

[L7]

The same happened in a different section of the game; the learners had to jump 3 times. “When they were finished they moved on to a next hula where they had to jump three times.”

The teacher created many opportunities for the learners to count aloud individually and in groups so they can practice the correct sequence of numbering.

### 4.2.2.3 One- to- one correspondence

Van den Heuvel-Panhuizen et al (2012) refers to this skill when learners know the counting sequence and they recite this by touching every object counted. They will soon realize that the last number mentioned is the correct number of objects.

In lesson 2 the teacher showed dotted cards to practice subitizing (knowing the quantity without counting). One of the learners could not subitize and the teacher asked her to come and count the dots on the card.

“One of the learners did not know the number on the dotted card and the teacher asked her to count the dots to make sure.



[L2 – Addendum F]

Similarly in the same lesson the learners had to pack out the stones picked up in the previous lesson and count them. A learner had 7 stones but put out the number 8. The teacher asked her to count touching every stone.

“Another learner had only 7 stones and put out an 8. The teacher then counted with her making sure she touches every stone.



[L7]

Also in lesson 3 the learners were playing with dough and had to make 5 eggs for the nest they previously constructed. One of the learners wanted to see if she had the right amount of eggs and counted them by touching every egg.



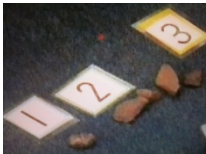

“One learner made her 5 eggs and checked if she was correct by counting every egg with her finger.”






[L3 – Addendum G]

One- to- one correspondence occurred in 13 other scenarios. See table below.

TABLE 4: Representing the occurrence of one- to- one correspondence

<b>ONE- TO- ONE CORRESPONDENCE</b>	
<p>The learner counted with the teacher touching every learners head up to 21. She asked how many children were absent and the learners replied: <i>“One learner”</i></p>	
<p>One learner told the teacher I have seen two birds. The teacher replied: <i>” Then you must have two stones, do you have two stones?”</i></p> <p>The learner did not respond. The teacher asked another learner if he had seen a bird. The learner just shook his head. The teacher assisted him to where she saw a bird and guided him to pick up a stone. The same learner then sat on the ground and counted the stones in his container.</p>	
<p>Some learners were not sure of the number they must take out. The teacher assisted and said: <i>“Count with me. Put your finger on the stone”.</i></p>	
<p>Another learner packed out the numbers above every stone from 1 – 3.</p>	
<p>Another learner had only 7 stones and put out an 8. The teacher then counted with her making sure she touches every stone.</p>	
<p>At the dough table one learner showed the other he had 8 eggs as asked for and counted it with his finger touching every egg.</p>	
<p>Today the teacher asked one of the children to do the head count. She told the learner to touch every child’s head gently when counting</p>	

<p>The children showed her the “moon side” by pointing to them. She asked the children to make a straight line so they can count. The teacher and the learners counted whilst the teacher touched every learners head. They count up to nine and the teacher told them: “Yes, <i>there are nine moon children</i>”.</p>	
<p>They now counted the “sun children” The teacher and the learners counted together whilst the teacher touches each learners head.</p>	
<p>Now the teacher said: “<i>Let’s count the chairs</i>” The teacher and the learners count together: “<i>One, two, three, four, five</i>”</p>	
<p>When they were done, the teacher said: “<i>Count with your fingers touching your card, let me see.</i>”</p>	
<p>At the dough table one of the learners were really struggling with making six beads. The teacher put the concrete amount of beads on top of the dough board to help him.</p>	
<p>At the drawing table one of the learners counted the amount of dots on the lion’s beard to make his exactly the same.</p>	

This Grade R teacher encouraged one- to- one correspondence as a skill to help learners realize that the last number mentioned when counting in the correct sequence is the quantity of the objects counted.

#### 4.2.2.4 Rote counting

Rote counting can also be linked to oral counting. Charlesworth & Lind (2007) describes this skill as learners reciting the names of numerals in the correct order.

In lesson 2 the teacher asked one of the learners to count how many stones he had. He counted very softly initially but the teacher asked him to count

louder so she could hear him. The teacher wanted to determine if he was counting in the right sequence. The learner knew that the last number mentioned was correct and indicated that he had 12 stones.

*Another learner did not have his number representation yet. The teacher asked him to count the stones. He counted very softly and she asked him to count louder so she can hear him. The teachers tried to ensure that the rote counting was in line with him touching the stones. The learner ultimately declared he had 12 stones.*

*[L2 – Addendum F]*

The Grade R teacher gave learners the opportunity to recite the names of numerals in the correct sequence individually, in groups and by counting with them.

#### **4.2.2.5 Perceptual subitizing**

According to Charlesworth and Lind (2007) preschoolers subitize perceptually. Perceptual subitizing can be the basis for later counting and cardinality. Van den Heuvel-Panhuizen et al (2012) describes it as learners knowing what the amount is without counting. It takes place with small numbers, usually up to five.

In lesson 2 the teacher was doing group work with the whole class. She showed them dotted cards and the learners had to name the quantity.

The teacher then used dotted cards and followed the same concept.



*[L2 – Addendum F]*

Similarly in lesson 3 the learners were playing educational games. They were playing snakes and ladders. The learners knew the amount on the dice

without counting them and moved the correct amount on the play board.

“Some of them knew the amount to play without counting the dots and others counted the dots on the dice and then moved their counter on the board.



[L3 – Addendum G]

Also in lesson 8 the teacher was doing discussion ring on the big five. The teacher asked them how many animals they saw on the board. The learners responded immediately without hesitation, “it’s five”.


“The teacher asked them: “How many animals do you see? The learners answered: “5”.

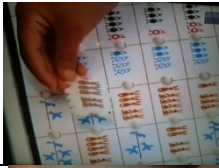

[L8]

Perceptual subitizing occurred 11 times within the rest of the data. See Table 5 below.



TABLE 5: Representing the occurrence of perceptual subitizing

PERCEPTUAL SUBITIZING	
The teacher asked a learner how many stones he had. He replied: “two”	
She asked them to show her 10 fingers and then 9, then 5 and put them in their lap. The teacher showed number symbols and the learner’s answers individually.	
The learners clapped and the teacher responded saying “That’s three” Meaning three syllables.	
The teacher asked: “How many stones do you have?” The learner responded and said 5. The teacher asked her to look for the number 5.	
They understood the use of the dice and played it efficiently.	 very
Some of the learners struggled and the teacher told them to remember the	

<p>bottom lockers are under. <i>“Put them back, let’s make it difficult then, put the 0 and the 10 in your container, put the 1 and the 5 in your container, the 5 is the man with the hat and the fat tummy, ok, put the 6 and the 8 in your container, ok, put the 9 and the 7 in your container. How many numbers are left? The learners replied: “three!”</i></p>		
<p>Some learners started a matching game; they had match cards to right amount of figures on the</p>		<p>to board.</p>
<p>Some them counted each figure first and others by recognizing immediately.</p>		<p>fitted it</p>
<p>Some of them ran from group to group realizing they were 4 and looking for another group.</p>		
<p>They almost shoved the extra one out of the group, or called another to complete the group</p>		
<p>The last number is shown and then they are all individual again.</p>		

It is therefore evident that learners knew the number of objects presented without always counting how many there were.

#### 4.2.2.6 Resultative counting

According to van de Heuvel-Panhuizen, et al (2012) resultative counting is when learners have to count how many objects there are. Resultative counting goes through several sub-stages: One of these stages, object-based resultative counting was prominent in the data presented.

##### 4.2.2.6.1 Object-based resultative counting

According to van den Heuvel-Panhuizen, et al (2012) object-based resultative counting occurs when learners demonstrate that they are able to answer questions about how many there are when shown loose objects, or pictures of objects.

In lesson 1 the teacher started with absenteeism by counting each learner and requesting learners to identify a number as soon as he/she is touched. In this

way the object-based resultative counting skill is enhanced by learners identifying the next number following on the number heard from the previous individual touched. When the teacher highlighted the final total after touching the last learner, the class was asked to state the number of learners absent. The total learners for the class was 22 and only 21 were present.

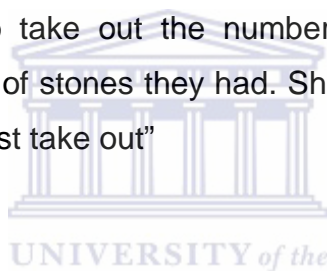
[L1 – Addendum E]

Similarly, in lesson 8 the teacher made a “train with chairs” and the learners had to count how many “tickets” for seats there were. She asked them to count how many chairs there were. “Now the teacher said: *“Let’s count the chairs”* The teacher and the learners counted together: *“One, two, three, four, five”*

[L8]

Also in lesson 1 the learners picked up stones in the previous lesson and the teacher asked them to count how many stones they have picked up.


“She asked them to take out the number card from their containers that matched the amount of stones they had. She said: “Count them, so you know what number you must take out”



[L1 – Addendum E]

Object-based resultative counting occurred 15 times in this data (see Table 6 below).

TABLE 6: Representing the occurrence of resultative counting

<b>OBJECT-BASED RESULTATIVE COUNTING</b>	
The teacher asked a learner how many stones he had. He replied: <i>“two”</i>	
Some learners were not sure of the number they must take out. The teacher assisted and said: <i>“Count with me. Put your finger on the stone”</i> .	
The learner counted with the teacher using his finger. He had five stones and took out the number eight. The teacher asked him to count it again. She asked him what number he must take	



out. He said five. She responded by saying: *“Yes, the man with the fat tummy”*.

Another learner had only 7 stones and put out an 8. The teacher then counted with her making sure she touches every stone.

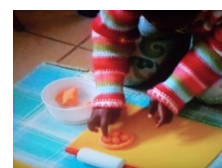


Another learner didn't have his number yet. The teacher asked him to count the stones. He counted very softly and she asked him to count louder so she can hear him. I think she was making sure that the rote counting is in line with him touching the stones. He had 12 stones.

The teacher ended of the lesson asking the learners to make groups with the number symbol she was showing. She showed the 3 first and they physically made groups of 3.



One learner made her 5 eggs and checked if she is correct by counting every egg with her finger.





At the dough table one learner showed the other he had 8 eggs as asked for and counted it with his finger touching every egg.

I asked one of the learners at the dough table if he had the right number of eggs and he counted it with his fingers correctly.

The child counted while the others counted with her, she also didn't forget to count herself. There were 21 children that day. Once again one child was absent and the teacher asked the children if they knew who was absent and they immediately replied by giving the child's name.

The children showed her the “moon side” by pointing to them. She asked the children to make a straight line so they can count. The teacher and the learners counted whilst the teacher

<p>touched every learners head. They count up to nine and the teacher told them: <i>“Yes, there are nine moon children”</i>.</p>
<p>They now counted the “sun children” The teacher and the learners counted together whilst the teacher touches each learners head.</p>
<p>Play dough was being used, they had a card with example 3 stars and 2 moons. They had to roll out the dough aand then use the plastic forms to make the amount of stars and moons as instructed by the card</p>
<p>At the dough table the learners were experiencing success in making their 6 balls but they struggled to make it round enough to be a bead for a necklace.</p>  <p>At the dough table some learners made more beads then necessary some made fewer than asked to do.</p>  <p>The teacher asked them how many they must have and told them to count it by touching every bead. I would have liked to ask them how many more than and how many lesser than 6.</p>

The Grade R teacher guided the learners to answer questions about how any objects were presented and object-based resultative counting was achieved.

#### 4.2.2.7 Representing and symbolizing numbers

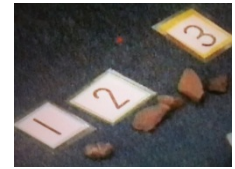
According to van den Heuvel-Panhuizen, et al (2012) learners reach a stage where their knowledge of numbers has increased and they are able to represent number to a collection of physical objects. When learners start to use the symbols frequently they do not need concrete representation anymore.

In Lesson 2, the learners had to pack out the number of stones picked up in the previous lesson. They had to represent the number of stones with a

number symbol. The teacher asked the learners to take out the number card from their containers that matched the number of stones they had. She said: “Count them, so you know what number you must take out”

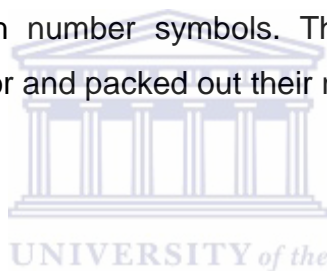
[L2 – Addendum F]

In the same lesson one of the learners misunderstood the activity and packed out her number on top of every stone. The learner placed the numbers on top of each stone from 1 – 3.



[L2 – Addendum F]

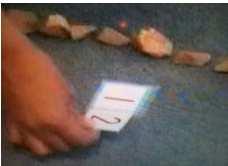
In lesson 8 the teacher asked the learners to fetch their containers with numbers in it. The learners had to pack the numbers in the right order; they were now substituting the physical objects with number symbols. The learners placed their number containers on the floor and packed out their numbers 1 - 10 in front of them.




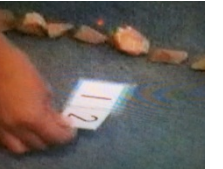




[L8]

Representing and symbolizing numbers occurred 27 times in the data (see Table 7 below)

TABLE 7: Representing the occurrence of representing and symbolizing numbers

<b>REPRESENTING AND SYMBOLIZING NUMBERS</b>	
The learner counted with the teacher using his finger. He had five stones and took out the number eight. The teacher asked him to count it again. She asked him what number he must take out. He said five. She responded by saying: “Yes, <i>the man with the fat tummy</i> ”.	
The learners with more than 10 stones had a problem. In the container they only had the numbers 1-10. One learner had 27 stones, and the teacher helped him with putting a 2 and a 7 together.	
The teacher helped him taking the 1 and the 2, not taking the 10 and putting the 2 on top of it.	

<p>One of the learners had 23 stones. He already put out his 2 and 3 together. This was the same learner who ran around on the playground without his container, picking up stones everywhere. Another learner had 7 stones but put out a 2.</p>	
<p>She had 12 stones and had her 1 and 2 ready to put out to make 12 but she puts it the other way around and made 21</p>	
<p>The teacher showed number symbols and the learner's answers individually.</p>	
<p>Then the teacher showed a number symbol to all the boys, then all the girls and some individually..</p>	
<p>The teacher asked: <i>"How many stones do you have?"</i> The learner responded and said 5. The teacher asked her to look for the number 5.</p>	
<p>The learners with more than 10 stones had a problem. In the container they only had the numbers 1-10. One learner had 27 stones, and the teacher helped him with putting a 2 and a 7 together.</p>	
<p>The teacher helped him taking the 1 and the 2, not taking the 10 and putting the 2 on top of it.</p>	
<p>One of the learners had 23 stones. He already put out his 2 and 3 together</p>	
<p>One of the learners had 23 stones. He already put out his 2 and 3 together. This was the same learner who ran around on the playground without his container, picking up stones everywhere. Another learner had 7 stones but put out a 2.</p>	
<p>He finished his task and he also made the number symbol "6" with the dough.</p>	
<p>The teacher assisted the boy who painted with only black crayons, he</p>	

had the card with the 5 eggs he struggled with earlier and the teacher reminded him, it's the man with the fat tummy.

The teacher now took out number cards and she asked one of the moon children to look for the number card with nine.



Learner E now finds the number 9 card and the teacher motivated him by saying: *“Very good, pick it up”*

The learners now picked up the rest of the numbers. The teacher gave the instruction: *“ If I touch your head you must pick up the number I tell you”* The teacher now touched certain children and asked them to pick up that number. Recognition of number symbols took place. The teacher now asked these children to bring her the numbers as she called them out.



The learners stood up and went back to their places. She now asked another learner to go sit on the third chair. The teacher took out her number symbol cards and asked the learner to come fetch the card that suited her chair. She said remember 3 and third goes together.







She asked another learner to sit on the first chair and picked up the number, this learner struggled but the rest of the class helped him

She then asked another learner to sit on the fourth chair, he ran straight to the number 4, another learner on the second chair and she picked up the 2 immediately. Another learners to sit on the fifth chair and he picked it up immediately.

She now told them they are in a train and the passengers must show their tickets!



The teacher now said: *“Number three put your number card down and go sit”*

<p>The teacher now asked the learners to fetch their number containers and they had to pack out their numbers 1 - 10 in front of them.</p>	
<p>One of the learners packed out her cards, but some of the numbers were upside down.</p> <p>The teacher told her: <i>“Some of your numbers are turned on their heads, turn them around, they are going to get dizzy.”</i></p>	
<p>She told them: <i>“I will now tell you to put certain numbers on the top of your number row. First 3 and 5”</i></p>	
<p><i>“Put it back... Let’s see if you are really so clever. Put the 4 and the 6 on the bottom”</i></p>	
<p>Some of the learners struggled and the teacher told them to remember the bottom lockers are under. <i>“Put them back, let’s make it difficult then, put the 0 and the 10 in your container, put the 1 and the 5 in your container, the 5 is the man with the hat and the fat tummy, ok, put the 6 and the 8 in your container, ok, put the 9 and the 7 in your container. How many numbers are left? The learners replied: “three!”</i></p>	
<p>The teacher continued: <i>“What numbers are left?”</i> The learners replied: <i>“2, 3 and 4”</i></p>	

It was evident that learners knowledge of numbers had increased and the frequent use of number symbols were an indication that concrete representation will soon not be needed anymore.

#### 4.2.2.8 Ordinality

According to Troutman & Lichtenberg (2003) ordinal concepts are easily acquired when learners can count forwards and backwards. When you are using ordinals there must always be a reference involved. For example: first in line at the water fountain. The water fountain is the reference.

In lesson 8 the teacher packed out 5 chairs, the teacher and learners counted the chairs and the teacher told them what the ordinal sequence was.

“The teacher and the learners counted together: *“One, two, three, for, five”*

She told them: *“Can you see, one is first, two is second, three is third, four is fourth, five is fifth but you can also say last”*



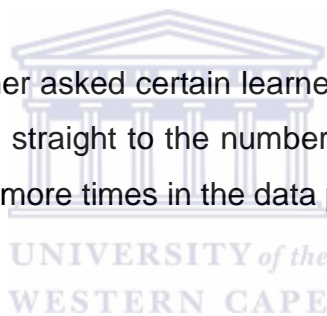
[L8]

Similarly the teacher asked one of the learners to sit on the third chair and reminded them that 3 goes with third. . The teacher took out her number symbol cards and asked the learner to come fetch the card that suited her chair. She said remember the learner that 3 and third goes together.”



[L8]

Also in this lesson the teacher asked certain learners to sit on the fourth, second and third chair. The learners ran straight to the numbers and picked it up before they sat down. Ordinality occurred 2 more times in the data provided.



[L8]

TABLE 8: Representing the occurrence of ordinality

ORDINALITY
The learners stood up and went back to their places. She now asked another learner to go sit on the third chair
She asked another learner to sit on the first chair and picked up the number, this learner struggled but the rest of the class helped him

The teacher used this scenario of the train to introduce the ordinal number to learners.

#### 4.2.2.9 Place value

According to Charlesworth & Lind (2007) place value is one of the most difficult concepts to grasp. Place value pertains to the understanding of what amount a number holds in the position it is.

In lesson 2 the learners were counting their stones and one of the learners had 12 stones.

One learner did not have his number yet. The teacher asked him to count the stones. He counted very softly and she asked him to count louder so she could hear him.. He had 12 stones. The teacher helped him taking the 1 and the 2, not taking the 10 and putting the 2 on top of it.”



[L2 – Addendum F]

Similarly in the same lesson one of the learners had 23 stones. He already put out his 2 and 3 together. This learner previously ran around on the playground without his container, picking up stones everywhere.




[L2 – Addendum F]

Also in lesson 4 the children played a game and they had to count the amount of sun and moon children afterwards. They counted and there were 12 children. The number range for Grade R is 1-10. The learners hesitated when they had to count eleven and twelve. They had to make a plan to show the number card for 12. They teacher saw the apprehension and guided Learner F to put 1 and 2 together to make 12.”

[L4]

Place value occurred 2 more times in the data provided.

TABLE 9: Representing the occurrence of place value

PLACE VALUE	
The learners with more than 10 stones had a problem. In the container they only had the numbers 1-10. One learner had 27 stones, and the teacher helped him with putting a 2 and a 7 together.	
She had 12 stones and had her 1 and 2 ready to put out to make 12 but she puts it the other way around and made 21	



Even though place value is not a content area used for Grade R, the opportunity presented itself and the teacher used it to introduce learners to the understanding of number and the amount a number holds in the position it is.

#### **4.2.2.10 Emergent object-based counting and calculating**

According to van den Heuvel-Panhuizen, et al (2012) emergent object-based counting and calculating is object-based which means that learners use concrete countable objects to perform an element of calculating.

In lesson 1, the teacher did the head count for the day. There are 22 learners in the classroom; after counting there was determined there are only 21 present which means 1 is absent. One learner was asked to count with the teacher touching every learners head up to 21. She asked how many children were absent and the learners replied: *“One learner”*

Similarly in lesson 7 the learner had to make 5 jumps with her hula- hoop. She made 2 and the teacher asked how many more she has to make, by a show of the teacher hand, they subtracted 2 fingers and concluded she still has to make 3 jumps with her hula-hoop.

In lesson 9 the teacher was explaining an activity to the learners. The learners were making a necklace and they had to make 6 beads. The teacher divided the clay in 2 pieces and then divided one of the pieces into 3 smaller pieces to make the round beads. The teacher asked them, how many pieces they still needed to make 6. The learners responded by saying 3 more.

The teacher guided the learners through everyday classroom situations to do emergent object-based counting and calculating.

### **4.3 Golden moments**

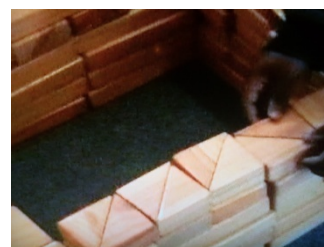
The CAPS document makes reference to incidental learning as a method of creating learning opportunities. These incidental learning moments are often referred to as the golden moments. The teacher of this classroom was skilled in recognizing the golden moments. When asked about this topic, the teacher explained that she saw

mathematics as an everyday, all-day activity and that it started from the moment the learners enter the classroom, till they leave at the end of the day.

*I always believed that Numeracy starts at the beginning of class and it ends when the children leave, because Numeracy is always there, the whole day. Even when you say good afternoon to your teacher, its a skill or a Mathematic aspect that you teach the child about the concept of time then, in the morning you say good morning, so it starts from the beginning of the day till the child leaves.*

[T1 I1 – Addendum D]

This was seen in many instances in the classroom. For example, in lesson 9 two boys built a tower with seriated blocks. They used rectangles to build the tower and there weren't enough rectangles to finish the tower. They didn't know what to do next but then one of the learners told the other that they must start using squares because two of them fit on a rectangle. When the squares were finished, they started to make squares by using triangles. The teacher never intervened on the building activity but she looked at what they were doing and encouraged them. The researcher asked her about this incident during the lesson and she replied she did not want to interfere with the incidental learning taking place but if they had struggled for a longer time she would have intervened. Similarly in lesson 3 the learners were playing a game called laces: they had to match shapes with one another using a card with an image of a shoe at the back and if the matching was correct the laces will be in the right order. The teacher saw the learners were struggling and she intervened by taking the opportunity to help them with shapes and conservation.



*There's a card with shapes that matched (shapes ex. Triangles, half a circle) and at the back there was a shoe that showed they had done it correctly. The teacher saw them struggling and explained to them that they should start where the arrow is and then match it to the shape to complete the shoe at the back.*



[L3 – Addendum G]

Thus it is clear that the teacher used naturalistic situations to intervene and create a learning opportunity.

#### **4.4 Summary**

In this chapter the focus was on the number skills needed to develop number concept. Each number skill was individually defined with scenarios as seen within lessons. The next chapter will discuss the use of these number skills and how the teacher introduces these different elements into her lesson.



# CHAPTER 5

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## Discussion

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### 5.1 Introduction

The previous chapter focused on the research findings that identified the number skills used by the teacher during each of her lessons. In this chapter we will discuss these findings to highlight how these skills underlie the content areas stated by the Curriculum and Assessment Policy Statement (CAPS) of the Department of Education.

### 5.2 Number Skills vs Mathematics content areas

At the Grade R level in CAPS a number of content areas are required to be completed as part of the development of number concept (see Appendix H). In order to achieve this it is imperative that the Grade R teachers utilize number skills which form the foundation of emergent numeracy. The discussion of the findings will consider the application of the identified number skills within the prescribed content areas of the curriculum for Grade R.

#### 5.2.1 NUMBER CONCEPT DEVELOPMENT: Count with whole numbers

The CAPS requirements for Grade R necessitates that counting of objects take place including objects of concrete nature. The following statements are prescribed explicitly for the content area:

- I. Estimate and count to at least 10 everyday objects reliably

[CAPS DoE, 2011]

- A. *Distinguishing numerosity (see 4.3.1.1)*

In the Grade R classroom estimating and counting was a valuable tool to develop number concept. The Grade R teacher used counting in many situations as an exercise so that learners at a later stage are able to recognize the cardinal value of a

number, be able to mention a number in relation to the collection and to develop an awareness what number is. For example when the teacher introduced the week days she made learners aware of how numbers are associated with the days of the week (see 4.3.1.1). This skill described by Van den Heuvel Panhuizen as distinguishing numerosity was also applied on a number of occasions when the teacher introduced new areas in her teaching. She used this skill in the beginning of every morning cycle in lessons 2, 4 and 6. She used it as an introduction to the day and learners were taught through the application of this number skill. The teacher placed this skill into a real-life situation, thus putting it in context so that learners can relate to it easily. This process is in line with the theory of constructivism which rejects the notion that learners are blank slates so their social knowledge is used to construct numerosity (see 2.2). Hence the teacher builds on the learners' prior knowledge to introduce new concepts through distinguishing numerosity. The more exercise learners in this class received in counting objects, the more confident they became in recognizing the number in relation to a collection without physically counting the objects. This is clearly evident when the teacher provided the learners with the opportunity to use their existing knowledge to numerically distinguish between week days as school days and week-ends as non-school days. Within social knowledge described by Piaget (see 2.3) knowledge created by people is used as a basis to distinguish numerosity. Even though the goal is to count without physical objects, they need to start with physical objects building on the didactic principle of Piaget that emphasizes that we should work from the concrete to the abstract (see 2.3).

*B. Imitating resultative counting (see 4.3.1.2)*

In the Grade R class counting happened throughout the daily programme. The learners counted, paired with their teacher and peers. For example in lesson 1 when the learners and the teacher counted how many learners were present and how many learners were absent on that day (see 4.3.2.2). There were some learners in the classroom who struggled to count in the correct sequence, they would therefore count the objects but omit certain numbers and would then name the last number mentioned as the amount of the collection counted. In lesson 2 one of the learners had 5 stones and after counting one- to- one corresponding decided it was 8 stones. Van de Heuvel- Panhuizen refers to this as imitating resultative counting. This happens because these learners are imitating how others are counting but omit

certain numbers and come to the wrong result. Imitating counting has an important role to play in resultative counting because learners may not come to the right answer but they realize that the last number said is the result of the counters counted. The Grade R teacher was actively involved in the teaching process and this was evident in lesson 2 (see 4.3.1.2). She intervened and helped the learner by doing paired counting and touching every stone counting in the correct sequence and then coming to the last number said to be the correct number of the collection. As this developed and the learners started to know the correct number sequence they realized that when counted in the correct sequence the last number spoken is the correct number for the collection as seen in lesson 8 when the learners were counting the number of chairs and they knew that there were 5 chairs (see 4.3.2.6.1).

### *C. Symbolizing by using fingers (see 4.3.1.3)*

Children in general symbolize numbers by the use of fingers from an early stage of their lives. For example, when asked how old they were, they would answer by the show of hands. Similarly the learners in this classroom were asked to symbolize numbers by using their fingers - as seen in lesson 2 when shown number symbols, the learners had to respond by using their fingers. Van den Heuvel Panhuizen refers to this as symbolizing by using fingers (see 4.3.1.3). Children used this method because they saw quantities all over their bodies (hands, feet, eyes, ears etc.). Mc Dermott & Rakgokong (1996) says that if children prefer to count on their fingers they must be allowed to do so. In the researchers' observations, learners used their fingers to count small quantities. Van den Heuvel Panhuizen (2012) stated that children use their fingers to subitize (instantly perceive the number of items in front of them) because they know that one hand has 5 fingers. This can be seen in lesson 7 when the learners were asked to jump five times. When the teacher asked one of the learners how many times she had jumped, she answered by showing 2 fingers. The teacher took her full hand and put down 2 fingers and asked her how many more she should make and she answered "3 more". (see 4.3.1.3). In this way the Grade R teacher continually made use of symbolisation with fingers and hands and linked these indications to the expression of numbers.

#### *D. One- to- one correspondence (see 4.3.2.3)*

Mc Dermott and Rakgokong (1996) refers to one- to- one correspondence as the most fundamental component of the concept of number. It involves coordinating the skill of partitioning and marking or keeping track of the numbers counted. The learner performs both actions simultaneously and coordinates these actions by pointing to each object as it is counted. This skill occurred on many occasions during this study. For example, when the teacher asked the learners to subitise by showing them dotted cards, one of the learners could not subitise and the teacher asked her to come to the front of the class and count the number of dots by using her finger (lesson 2). Van den Heuvel-Panhuizen (1996) describes this as pointing at an object and recalling the corresponding number word. In lesson 3 the learners had to make a certain number of objects using dough, according to number cards. One of the learners wanted to make sure that she had the right number of objects. She counted aloud touching every object with her finger. This displayed that the learners could use this skill independently and that this learner had mastered this skill. During the interview the researcher asked the teacher about when she started to ask learners to count objects. She indicated that she introduced it right from the beginning of the year and that initially up to the number 5. For example she would ask them to make 5 objects so that learners could get the feel for the number.

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*No, I do it right from the beginning and up to 5. So they are used to doing that. Even if they do it with the play dough, sometimes I would ask them to make 5 balls with the play dough they feel the 5 and I write it with my finger on their backs.*

*[Teacher Interview 1 (T1 I1)]*

#### *E. Object-resultative counting (see 4.3.2.6.1)*

By the use of the latter skill, learners start to demonstrate that they are able to answer questions about how many there are when shown loose objects. Van de Heuvel-Panhuizen et al (2012) refers to this as object-resultative counting. This skill occurred frequently during this study especially when the teacher asked the “how many” question. The teacher used this skill with the use of objects, for example when the learners had to count stones and represent how many there were by using a number symbol in lesson 2 but also actively when they had to make physical groups. The teacher used a number symbol and the learners had to make a group of

example 5 at the end of lesson 2 (see 4.3.2.6.1). The learners subitized but they also counted how many they were in the group. They would easily ask if they needed one more learner for their group or tell a learner to look for another group if they were too many. This skill is essential for emergent object-based counting and calculating that takes place at a later stage of Grade R (see 4.3.2.10) when learners start to use countable objects to complete an element of calculating that leads to pure mathematical calculating according to van den Heuvel-Panhuizen et al. (1996).

#### *F. In Summary*

The teacher used the above-mentioned skills to develop the skill of estimating and counting objects from 1 to 10 reliably. These skills are exercised throughout the daily programme and learners count independently in a natural setting showing they have mastered these skills to count from 1 to 10. The numbers one to ten are significant because these numbers are found in any place value. When numbers 1 to 10 are mastered the other place values will be mastered more easily. During the interview the teacher was asked when a learner really understands the quantity of a number. The teacher explained that she first does numbers 1 – 5 and that she does every possible way a number can be placed in, so when the learners hear a number they must be able to visualize the number.

*I personally, when I speak to their moms and dads about it, when I see a child struggle with it, I also tell them to not go any further than 5. Start with 1 and stop at 5. If the child can do the number concept from 1 to 5, the rest of the numbers from 6 to 9 goes very easily. To me personally it's very important that they understand the whole concept. They must know what the symbol looks like and recognize four dots and they must know how to write four, the whole thing about four. Then the rest of it comes easily.*

*(T1 I2)*

*That comes in with each number that we do. Like I said in the beginning, we first do 1 to 5. So whenever I work with a one specific number for example when I do the number 3 I do everything about the 3, so now if I should then say 3, they should in their heads figure out 3 cars for example. If I find that a child don't know that by now, like for*



*instance I did the play dough, they had to do 6 beads, and i noticed one child, couldn't do it. She didn't understand. I put 6 there and she must count it with me and then compare her 6 with my 6. Up to now there are still children struggling with that concepts.*

*(T1 I3)*

In this way the Grade R teacher used every opportunity to illustrate to her learners how the numbers play an essential role in their everyday counting.

II. *Count forwards and backwards in ones from 1 to 10, Use number rhymes and songs and say and use number names in familiar context.*

[CAPS DoE, 2011]

*A. Discovering different meaning of numbers (see 4.3.2.1)*

Number can be used in many ways: for learners to grasp the concept of number the learner must be able to use a number in different contexts. Van den Heuvel-Panhuizen et al (2012) refers to this as discovering different meanings of numbers (see 4.3.2.1). By understanding this skill learners start to see the different meaning of numbers by understanding that 7 can be: 7 sweets, they have to be 7years old to go to Grade 1 or be 7<sup>th</sup> in a row. This is well demonstrated in lesson 8 when a learner is asked to sit on the 3<sup>rd</sup> chair, the teacher reminded the learner that 3 goes with 3<sup>rd</sup> (see 4.3.2.1). Thus the understanding of number becomes more specific, learners start to encounter different kinds of numbers in their everyday surroundings and they realize that numbers can be used differently in different situations. This is very important for learners when growing in their understanding of number concept, as they develop to master significant number skills.

*B. Oral counting (see 4.3.2.2)*

Many parents and practitioners are under the impression that if learners can recite numerals in sequence they can count. Mc Dermott & Rakgokong (1996) disagree: they claim that reciting numerals is not an indication that learners can count. In their view it takes various counting experiences for counting to become meaningful. When the teacher was asked about this topic she indicated that parents often proudly refer to their children's recitation of numbers in a cumulative sense as learners' understanding of mathematics. But this performance often lacks an appreciation of

the value associated with a number.

*Some of the parents say their children knows numbers up to 100 but they can learn that easily like a rhyme but then they do not have a clue what numbers is about.*

*(T1, I2)*

The teacher demonstrated different counting experiences in order for learners to count orally. For example in lesson 1 the learners must take a head count for the day; they count aloud with the teacher and their peers to determine how many learners are present and how many are absent that day. Similarly in lesson 5 the teacher asked the learners to count the number of pictures for day and pictures for night to determine if there are an equal number of pictures or not. Van de Heuvel-Panhuizen et al (2012) states learners need constant repetition of the counting sequence through rhymes and oral counting in action games. In lesson 7 the learners are playing an action game and they have to count while jumping. (see 4.3.2.2) This is important so that learners learn the correct sequencing of numbers thus when resultative counting becomes meaningful, learners are skilled at the correct sequencing to make the correct calculation. The Grade R teacher created these opportunities to improve counting skills in her classroom.

#### *C. Rote counting (see 4.3.2.4)*

Similarly to oral counting, the term rote counting can also be used. Charlesworth and Lind (2007) described it as learners reciting the names of numerals in the correct order. This is clear in lesson 2 when the learners are asked to count their number of stones and link them to the correct number symbol. The learners had to count in the correct order to be able to give the correct number symbol (see 4.3.2.4). The learners were only counting forward and at a later stage they should be able to count backwards as well.

#### *D. In Summary*

The teacher used the above-mentioned skills to develop forward counting and use number names in familiar contexts. The teacher did not focus on counting backwards because it was not part of her planning for these sessions. Counting with whole numbers is an important part of developing number concept. It is the foundation for

all the other number facets to follow. When a child is able to count forwards and backwards in different situations they start to understand the sequence of numbering. The sequence of numbering allows the child to do calculations, know the position of numbering for further counting and use whole numbers in different familiar contexts.

### **5.2.2 NUMBER CONCEPT DEVELOPMENT: Representing whole numbers**

- I. Recognise, identify and read number symbols 1 to 10,
- II. Recognise, identify and read number names 1 to 10

[CAPS DoE, 2011]

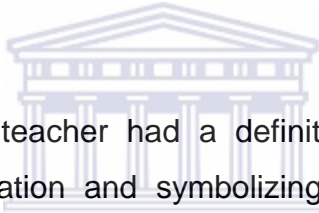
#### *A. Representing and symbolizing numbers (see 4.3.2.7)*

Fostering a sound understanding of number concept is important throughout the Grade R programme. The primary goal for the grade R teacher was that learners should reach the point where they are no longer dependent on concrete representation to present number. According to Van den Heuvel-Panhuizen, et al. (2012) learners increase their repertoire of representing and symbolizing numbers from the point where they show their fingers to represent their age to a variety of ways to represent number. The use of this skill occurred the most in this study. The study was undertaken in the third term of the school year and it was evident that the teacher was trying to break the cycle of learners' dependency on the use of concrete apparatus to represent numbers. In most of the exercises where it was expected of learners to count, the teacher asked them to represent the symbol of the number of objects counted. Some learners had mastered this skill, but some learners were finding it very difficult. For example in lesson 2 one of the learners counted the objects and represented the number 8, while the teacher was facilitating she noticed he had only 5 objects. She asked him to count the objects with her and then represent the right number symbol. He struggled to find the number symbol and the teacher told him to look "for the man with the fat tummy". In lesson 8 the teacher asked the learners to put the number symbols in the right order. She asked them to look for certain numbers in the number line formed. When they identified the number symbols the teacher named, she asked them to put it on top or at the bottom of the number line. The learners were identifying numbers and most of them had mastered this skill (see 4.3.2.7). On other occasions the teacher would ask individual learners

to pick up certain numbers during games and also to identify numbers as a group of girls or group of boys. The teacher explained that she introduces the number symbol with a dotted card (showing the quantity) in an informal way. She does it during a play activity and learners were introduced to the representation of the symbol with the collection of objects or dotted cards for the first two terms of the year. In the third term she started to introduce numbers formally and her goal was that every learner should be able to recognize numbers to the value of 10.

*Whenever I start with the numbers, I introduce the number as well as the cards, for example number 2 with the card with the 2 dots next to it. So they know the first time that they see the number, I show them the number. I don't emphasize it that much. Only in term 3 where they start with formal numbers, recognizing it, they should be able to know like that's a 5 or a 4. But right at the beginning it's more play-play*

[T1 I1]



In this Grade r class the teacher had a definite goal for learners to reach an independence of representation and symbolizing number without using concrete apparatus. This is an important skill for formal mathematics in higher grades. The CAPS content areas describe this as the representing of whole numbers, an outcome for the development of number concept.

### **5.2.3 NUMBER CONCEPT DEVELOPMENT: Describe, compare and order whole numbers**

The CAPS document prescribes the following functions to illustrate the above content area.

Describe whole numbers up to 10, Compare which of two given collections of objects is big, small, smaller than, bigger than, more than, less than, is equal to, most, least, fewer up to 10, Order more than two given collections of objects from smallest to biggest up to 10, Use ordinal numbers to show order, place or position, Develop an awareness of ordinal numbers first, second, third up to sixth and last.

[CAPS DoE, 2011]

#### A. Ordinality (see 4.3.2.8)

Ordinality is a concept that Grade R learners do not easily grasp. Troutman & Lichtenburg (200) state that children acquire this skill quickly when they can count forwards and backwards, a content area mentioned above. There must be a reference involved. For example, first in line at the water fountain (the water fountain is the reference here). Children must be able to know the counting sequence well to refer to ordinality. In lesson 8 the teacher packed out 5 chairs and asked specific learners to sit on these chairs. She asked them to pick up a card with the number of chair they are sitting on. She told the learners that they are sitting in a train and the number cards are their tickets. She then referred to the cards and introduced the learners to the mathematical language of ordinality (third and fourth for example). The learners understood this very well. The CAPS document states that children should develop an awareness of this concept: the teacher therefore only introduced the learners to the concept. When asked about this assessment, the teacher mentioned that this particular activity was set out as one of the assessment tasks for the week and that every learner would get the opportunity to name the ordinal of the chair they were going to sit on. She made sure the learners understood the concept by repeatedly saying 3 goes with third and 4 go with fourth and so on.

*Most of the time it happens as the day goes by, but in between that there is always planning involved. Like today we did the placing of 1st, 2nd and 3rd, it is part of our weekly assessment that we do for this week, so I will specifically do that for the day, but the rest of it I do every day, whenever I feel like doing Maths I do the Maths.*

[T1 I3]

The learners in this Grade R class through this skill were able to describe the order of the numbers presented as part of the development of number concept.

#### 5.2.4 NUMBER CONCEPT DEVELOPMENT: Place Value

##### A. Place value (see 4.3.2.9)

CAPS states that place value is not applicable for Grade R. According to Charlesworth and Lind (2007) place value is one of the most difficult concepts to grasp: it pertains to the understanding of what position a number holds. In this Grade

R class place value occurred incidentally and the teacher saw this “golden moment” to introduce place value. The learners picked up objects and were asked to represent the number symbol of the collection they had. Some learners picked up more than 10 objects and had the challenge of presenting their number symbol for more than 10, the number range they are expected to work within Grade R. When this occurred, the teacher asked the learners to make a plan. Some of them knew instantly to put two numbers together. In the example of the 12 in lesson 2, this was in fact a visual plan, because it looked correct as a visual of 12, but in the place value of the number the learners were supposed to put a 10 and then add the single number 2 on the 0 because the value of the single 1 is 1, but the position of the 1 in the place value quantity of 12 is 10. This in effect can pose a challenge for learners when place value is being taught in higher grades; it is better if they do it the correct way from the start. In this class it was difficult because learners only had the number symbols 0-9 in their number containers. Because this was incidental learning and not planned, the learners and teacher came up with the best plan possible in that moment.

The researcher believes that place value has a role to play in a Grade R class and some learners are ready to acquire this skill. It must not be excluded from the learning plan of number concept development because it is not expected of teachers in Grade R to develop this skill; teachers should be open for this opportunity when it occurs as seen in this study.

### **5.2.5 SOLVE PROBLEMS IN CONTEXT**

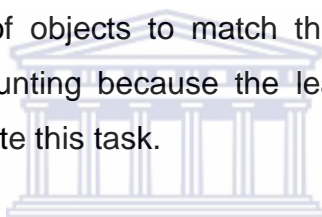
- 1. Use the following techniques up to 10: concrete apparatus e.g. physical number ladder*

[CAPS DoE, 2011]

#### *A. Object-based resultative counting (see 4.3.2.6.1)*

Van den Heuvel-Panhuizen et al. (2012) refer to resultative counting as when learners are able to answer the question of how many objects there are. This particular skill goes through many stages and object-resultative counting is the one that pertains to this classroom. It links to the above mentioned content area of the CAPS. Object-based resultative counting is demonstrated when learners are able to answer the how-manyness question when shown loose objects or pictures of objects.

In lesson 4 the learner played a game called “Is jy son of is jy maan” Two learners held hands, one being the sun and the other the moon. The rest of the class ran behind each other and when they passed through the hands of the 2 learners, one was caught. They sang a song asking the learner whether he/she wanted to be behind the sun or the moon. At the end when all the learners were caught, the teacher and the learners counted how many were on the moon side and how many were on the sun side. The sides with the most learners were the winners. The learners were the objects counted in this particular context. Similarly in lesson 1 the teacher asked certain learners how many objects they had collected, the learners counted their objects and were able to answer how many objects there were. During the interview the teacher was asked what kind of homework is given to the learners to extend number concept. The teacher explained how she involves the parents and asks learners to bring a certain number of objects to the class to fit the theme. She indicated she knows the learner understood the concept of the number when they bring the correct number of objects to match the number symbol. This refers to object-based resultative counting because the learners have to count the correct amount of objects to complete this task.



*Most of the times I will call in the parents, I will explain to them to do numbers with them at home, I will explain to them how important it is to do this with the child, when I cannot reach the parents, I will send a note with the child and a worksheet where they have to for example collect 7 leaves and bring it to school the next day. I know that they understand a number concept of 5 completely when I ask them to bring me for example 5 leaves or 5 bottle caps.*

(T1 I3)

The learners were thus able to solve these problems in a particular context by making use of object-based resultative counting.

II Solve word problems (story sums) in context and explain own solution to problems involving addition and subtraction with answers up to 10

[CAPS DoE, 2011]

*A. Emergent object-based counting and calculating (see 4.3.2.10)*

In this grade R class the teacher did not pose specific word problems for learners to solve but she used classroom situations to create word sums and solve problems. According to van den Heuvel-Panhuizen, emergent object-based counting and calculating takes place when learners use concrete apparatus to perform an element of calculating. This can be clearly seen in lesson 1 when the teacher calculates the absenteeism for the day. The learners count the number of learners present for the day which was 21 learners. They know there are 22 learners in the classroom and they immediately respond by saying 1 is absent. This number range is ahead of the number range of 1 to 10 used in Grade R but the learners are able to do it because the teacher has done this for the whole year every morning. Even though this is emergent counting and calculating the learners requires counting backwards without being aware of it. Similarly in lesson 9 the learners were asked to make 6 objects with the play dough. The teacher makes 3 big objects, divides it into 6 pieces but shows them only 3; she then asks them how many more objects she needs to get the required 6 objects. The learners responded she needs 3 more. So in both these situations, object-based counting and calculating took place without it being done in a specific lesson format. This responds to the CAPS requirement of learners being able to solve problems in context. During the interview the teacher was asked about her view on doing sums in grade R. The teacher feels that sums should be done through problem-solving informally in Grade R.

*I don't feel that a child is ready for that in Grade R. We do it but not formal, that they sit and do it on a piece of paper or in their books. But a child in Grade R must be able to tell you for example I have 2 sweets in my one pocket and 2 in my other pocket, I have 4 altogether. And that is a Mathematical sum, but they don't do it on a paper. So for me personally as you know, the children still struggle if I put a 5 there, they don't know what the quantity is of 5. So I would say I would rather do revision with them and practical with them for the whole year. And problem solving in an informal way.*

*(T1 I3)*

The teacher thus created different opportunities to teach the technique of solving problems. The CAPS document refers to a physical number ladder. This physical



number ladder is created when learners are able to move forward and backwards on the number ladder to do addition and subtraction. In the researchers' opinion, the teacher achieved this outcome as seen above.

### **5.2.6 Perceptual subitizing (see 4.3.2.5)**

According to Charlesworth and Lind (2007) preschoolers subitize perceptually as a basis for later counting and cardinality to take place. Van den Heuvel Panhuizen et al. (2012) describe it as learners knowing the quantity of a number without counting it. This, to the researcher, is not a skill that can be plotted in a specific content area because this is valuable to all content areas. When learners are able to subitize they become independent of using concrete materials and are able to use numbers in different contexts to achieve a mathematical concept. For example in lesson 2 when the teacher was doing group work in the morning circle, she flashed dotted cards and the learners were able to name the collection without counting it. Some learners experienced difficulty with this skill but the teacher gave individual attention to this. In lesson 8 the teacher asked the learners how many pictures there were on the board; the learners responded 5 immediately without hesitation. This is an indication that certain learners in the classroom have mastered this skill. This was evident when the learners started to do independent educational play, the teacher placed different educational games after lessons 3, 5 and 7 so learners can play constructively while waiting for a table activity to become available. The learners had the opportunity to play the board game, snakes and ladders. When they threw the dice on the board to determine the number of blocks they were able to move they recognized the number on the dice without counting it. This to the researcher was a clear indication that perceptual subitizing was mastered.

### **5.3 Summary**

In this chapter the CAPS documents content area: number, operations and relationships were stated to identify the number skills the teacher used to achieve the development of number concept. The teacher's views of the skills used were included to substantiate her reasons for using these skills. In the next chapter the conclusions and recommendations for this study will be discussed.

# CHAPTER 6

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## Conclusion and Recommendations

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### 6.1 Introduction

The discussion in Chapter 5 underlined the number skills that the teacher applied in her class and how this influenced the development of number concept as expected by the Department of Basic Education's Curriculum and Assessment Policy Statement (CAPS). The purpose of this chapter is to give an overview of the study, to relate the major findings of the research, highlight the implications of this study and identify the limitations and recommendations for future study.

### 6.2 Overview of the chapters

#### 6.2.1 Chapter 1: Rationale for the study

This chapter provided a background on the current teaching in Early Childhood Development, and the teaching of Mathematics in Grade R. The research questions for this specific study emanated from a description of the research problem within the context of the school, current practices and limitations.

#### 6.2.2 Chapter 2: Literature review

This chapter reviewed relevant literature and aimed to provide a theoretical framework for the study. The constructivist views based on the theories of Piaget and Vygotsky and recent literature are presented to assist with the development of number concept. South African and International studies highlighted some of the research conducted on number concepts.

### **6.2.3 Chapter 3: Methodology**

This chapter provided a detailed description of the methodology employed to investigate the implementation of number concept at Grade R level. The data collection procedures, theoretical framework and data analysis used to answer the research question were described.

### **6.2.4 Chapter 4: Findings**

The purpose of this chapter was to report on the findings of the research. The findings were based on the data collected and the process of analysis incorporated in this study.

### **6.2.5 Chapter 5: Discussion**

The discussion chapter focused on the number skills the Grade R teacher used to respond to the demands of the CAPS document for Grade R.

### **6.2.6 Chapter 6: Conclusions and recommendations**

This chapter provided a summary of the study and highlighted the major findings, implication and limitations of the study. Recommendations for future study were also provided.

## **6.3 Major findings of the study**

### **6.3.1 Utilization of number skills to achieve the development of number concept as stated by the CAPS document**

The CAPS document (2011) as stated by the DBE identified different content areas that have to be developed for learners to make sense of basic building-blocks in Mathematics. In this particular study, number concept is a part of the content area: Numbers, Operations and Relationships was selected as an area of importance because it carries a weighting of 65% towards all the

content areas presented. The content areas each have a set of specific foci that need to be achieved by the learners in Grade R. It is therefore important that the teacher is sufficiently qualified and skilled to develop these content areas. Each content area states its specific skills clearly but teachers who do not have the knowledge and training may not know how to develop these skills. The CAPS document makes the following statement: “Grade R should not be a “watered down” Grade 1 class”. If the teacher does not have the knowledge to create a fun, spontaneous context in which these skills can be developed, mathematics can become intimidatingly formal and the informal play-based teaching of mathematics in the Grade R setting can be lost. In the researcher’s perspective, teachers need to know how to develop these specific foci in the content areas within the Grade R setting. The goal of this study was to try and narrow the gap between the specific focus of the content area and the number skills utilized to develop number concept.

The Grade R teacher used a specific set of skills to reach the outcome of the above mentioned content area. The first specific focus of this content area is number concept development: count with whole numbers. A number of skills emerged from the contexts the teacher created including distinguishing numerosity, imitating resultative counting, symbolizing by using fingers, one-to-one correspondence, object-based resultative counting, discovering different meanings of numbers, oral counting and rote counting. These skills were utilized throughout the daily programme thus executing the important method that CAPS emphasizes: integration within the Grade R classroom. These skills were planned as teacher-guided activities but emphasised a child-centered approach. The Grade R informal teaching method states that teaching should be formally planned but taught informally thus the learners are provided the opportunity for mathematics to emerge in a naturalistic learning environment. In the findings, learner’s responses showed how these skills linked directly to the main focus of counting in whole numbers. The learners counted in many different contexts and were able to count independently as well.

The second specific focus of number concept development is representing whole numbers. The strategies that the teacher used to develop this content area were representing and symbolizing numbers. In Grade R the rule of constructivism stating from concrete to abstract supports this specific focus because, through active involvement and many opportunities created, learners' understanding of the quantity of number grows. The learners are initially dependent on the use of concrete apparatus to do elementary calculations. The teacher, through these activities, facilitated the process of learners' transferring from the concrete apparatus to symbolizing the number and knowing the quantity represented by the symbol without having the physical objects. The class teacher referred to it as the child having to visualize the quantity to be able to represent number.

The third specific focus of number concept development is "Describe, compare and order whole numbers". The teacher introduced the skill of ordinality to achieve this specific focus. When a child is able to count forwards and backwards meaningfully, ordinality gives the reference of where a number or an object is standing in reference to another.

The fourth specific focus of number concept development is place value. Even though this is not applicable to grade R according to CAPS, place value emerged incidentally in the classroom and is introduced as a skill for further development in higher grades.

The fifth specific focus of number concept development is solving problems. The teacher used object-based resultative counting and emergent object-based counting and calculation to take learners to the level where they were able to solve classroom and mathematical problems that occur within the classroom context.

The above lay-out of the specific foci for each content area gives a clear indication of which skills can be used to reach the specific outcomes of the first content area: Numbers, Operations and Relationships.

### 6.3.2 Making mathematics fun

The specific aims of the Mathematics CAPS document states that learners should not fear Mathematics. A spirit of curiosity and a love of Mathematics should be engendered. The Grade R informal way of teaching adheres to this statement. Within this study it was evident that the teacher used the planned theme for the week to integrate all learning. The context created had fun-filled activities where the learners and the teacher were involved actively. The activities that the teacher planned made the learners enthusiastic: the teacher shared in their enthusiasm. For example, when in lesson 1, the learners had to role-play bird watchers, the teacher role-played first and then the learners role-played outside. They were enacting one-to-one correspondence: when seeing a bird they had to put one stone in the container. The learners enjoyed this and the excitement continued when they were symbolizing their objects with the number because it was like a competition especially between the boys in the class to see who had the most objects.

During the independent educational play after lesson 3, 5 and 7, learners were playing board games with a mathematical context. The learners enjoyed this activity and were excited about the selection of the winner. The teacher encouraged learners to participate in the games and was always motivating and creating new opportunities to develop their skills through play. The teacher was available to assist where help was needed and had an open policy in the classroom. For example in lesson 2 one of the learners was not able to subitize and the teacher called her for individual help and counted the dots with her. Similarly in Lesson 2 when one of the learners were struggling to represent the number for the number of objects collected the teacher assisted and counted the objects with him and helped him to represent the correct number. The researcher believes that the open relationship between the teacher and the learners reduced the fear of mathematics because learners knew that when they were finding something difficult the teacher or peers will assist. This situation opened the possibility to try again. The class allowed learners to feel that “I am allowed to make mistakes, and if I do I can try again and get it right.”

### **6.3.3 Golden moments**

The CAPS document emphasised on the use of incidental learning, often referred to as “golden moments”. It is evident that the teacher made use of naturalistic experiences to develop mathematics learning in this classroom. For example in lesson 3 the learners were playing educational games. The teacher intervened when they struggled and used this intervention as a golden moment to develop the concept of conservation of shape. This Grade R teacher was thus alert enough to spot golden moments and took these opportunities for learning to take place incidentally.

## **6.4 Implications of the study**

### **6.4.1 Preparation of pre-service Mathematics in Grade R**

The implication of this study is the significance of laying a sound foundation for basic numeracy skills within Grade R. The institution where the researcher is lecturing has gone through many changes over the past few years. The Faculty of Education has restructured the curriculum to change from the Teaching Diploma to the Bachelor's Degree and develop the knowledge of the practical to link to the theoretical depth. This study mirrors this transition from the practical experiences of teaching number skills to the theoretical depth that underpins Mathematics teaching and restructuring of the first year module of Mathematics in Education. The lecturer can use these number skills to underpin the demands of CAPS and teach directly to the theory to be used to develop number concept. Students can refer to this study as a useful guide to such pedagogic transitions and infrastructural development at various levels..

### **6.4.2 Utilization of number skills within practice teaching**

Mathematics teaching in Grade R has been integrated into the Daily Programme for many years. After the systemic evaluation results and the high demands of the new curriculum in Grade R, teachers expressed the need to develop number skills more specifically. Therefore a new concept of Mathematics Focus lessons was introduced to develop mathematical skills more specifically in the CAPS document. This Focus lesson has the tendency to become formal: teachers struggle to keep it informal and

still achieve their goals. This study helps teachers and students to see how these skills can be taught informally and still achieve the goal of developing mathematics skills. The Practice Teaching in the Foundation Phase expects students to teach a Mathematics Focus lesson to develop number concept informally but planned in a structured way. The number skills identified in this study can be used as a basis to develop these lessons according to the needs of the DBE. When students see the need to develop a certain focus area in practice teaching they can refer to this study to see the skills needed to develop the focus area and how they can do this in an informal play activity to encourage the love of Mathematics. This has a wider implication for Grade R teaching as when these students practice teach. The teachers of these classes can learn from the students and students can learn from the teachers how to develop these skills. Therefore this study may have implications for the wider teaching community that deals with Grade R. There is a general understanding that a large number of the current Grade R teachers have not gone through an official training course for teaching at this level.

#### **6.4.3 Development of the child holistically**

It is widely noted that the development of the child should not only occur in isolation through focusing on the cognitive aspects: the child should be developed holistically. This study addresses some important aspects of how a child can be developed holistically in developing number concept.

#### **6.4.4 Baseline study**

This study provided baseline data for the teaching of number concept at Grade R level which could be used to develop further studies to explore this understanding.

#### **6.5 Limitations of this study**

The limitations of this study are that only one school is used as a case study and only one teacher's method of teaching is being investigated. The period of investigation allowed by the school was 6 months and an extended period of investigation may have added greater value to the data collected and analyse



## 6.6 Recommendations for further study

It is recommended that further studies incorporate more schools and teachers to give a wider understanding of the development of the number concept at Grade R level. Future studies could explore how learners respond to a wider range of skills employed and compare the skills in terms of the impact they have on the learning environment in the Grade R classroom.



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## APPENDIX A

Die Spruit nr. 4  
Bain Street  
Wellington  
7654  
October 2010

The Principal / Governing Body

.....

Wellington

7654

Dear Madam

Re: Permission to conduct the research (case study)

I, Miss Lynn Le Grange, a post graduate student at the University of the Western Cape, hereby request permission to conduct a case study in one of the Grade R classes in your school. The teacher will be interviewed and classroom activities will video-recorded to identify the number skills used to develop number concept in a Grade R class.

The identities of the participants will remain private and the findings will be handed to the school management in a soft copy and hard copy for back up. The case study will be conducted without any pride or prejudice.

I hope my application will receive your endorsement.

Yours in education

-----

Lynn Le Grange

email address: legrangel@cput.ac.za



## APPENDIX B

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FACULTY OF EDUCATION

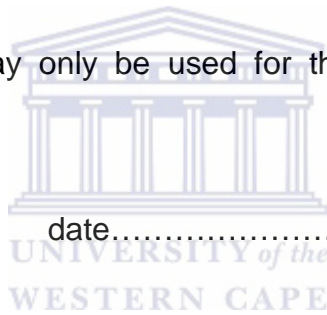
### The consent form for the participating teacher

Note well: **This consent form should be kept in a secure place by the researcher**

I....., hereby, give permission for Lynn Le Grange who is a student at the University of the Western Cape to conduct a research study where my daily activities will be video- recorded. I give consent that interviews may be conducted about the daily activity. My participation is personal and voluntary.

These video-recordings may only be used for the purpose of the study and for lecturing purposes.

Signature ..... date.....



## APPENDIX C

UNIVERSITY OF THE WESTERN CAPE  
FACULTY OF EDUCATION

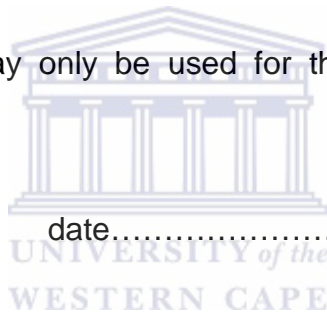
### The consent form for the parents of participating learners

Note well: **This consent form should kept in a secure place by the researcher**

I..... , parent of .....hereby, give permission for Lynn Le Grange who is a student at the University of the Western Cape to conduct a research study where my child will be video-recorded during class activities.

These video-recordings may only be used for the purpose of the study and for lecturing purposes.

Signature ..... date.....



## APPENDIX D

**Day 1** Interview with teacher about the integration of Mathematics in the Grade R classroom:

Researcher : Tell me a bit more about yourself, the qualifications that you have and your Grade R experience?

Class teacher : My name is AD, I am married with children, I live in Wellington and I've been a teacher for more than 20 years. I was teaching in Atlantis for almost 13 years and I have experience with Grade 1, then I moved to Grade R. I do not have formal Grade R qualifications, but I attended all the Courses that they gave here in Wellington. I have been a Grade R teacher for 7 years now, at Dwergiebos. I have a formal Teaching Diploma.

Researcher : How did you learn how to do your formal planning for Grade R, seeing that you're not a qualified Grade R teacher?

Class teacher : It is basically the same as Grade 1 and I learned a lot from the teachers at this school. We sit together and plan our lessons. Everything I know up until now, I've learned from the teachers here.

Researcher : What resources do you use when you plan? I know that you plan together as a group, but do you have a specific resource that you use as a set programme for Grade R or what do you use?

Class teacher : What we normally do is, we have research at school because Grade R is very informal and we normally use whatever we have and we collect from our homes. We also make use of the public

library and whatever resources we use, is normally the real thing/real experience.

Researcher : Do you use the NCS (National Curriculum Statement) as a guideline for Grade R?

Class teacher : Yes, we do. We are a private school, but we use that and work according to that. And we also attend all the meetings that there is about it.

Researcher : So you have the learning programmes set out with the Grade 1, 2 and 3, and you have the work schedule and you work out your daily lessons?

Class teacher : Yes, we do it according to that.

Researcher : Do you write out your daily lessons or do you go according with your work schedule and then decide what to do everyday?

Class teacher : No, we write it out, every Tuesday we work it out together. But sometimes, as you know, the lessons don't always go the way you planned it, so personally it works better for me when I write it daily, so I write out my own lesson for the day.

Researcher : When we take it back to Mathematics. In your experience in the daily classroom, what I have seen today is that you really integrated Mathematics all over, and I really enjoyed that, thank you very much. In your experience, what would you say would be the important about Numeracy in Grade R, why is numeracy so important and what aspects of Numeracy is important to you?

Class teacher : I won't say that the formal way of doing Numeracy, I don't believe at this stage that it is so important. I believe that

Numeracy should always be play criteria. I always talk to my parents about that and tell them that instead of taking your child and say sit down, now we are going to do homework, we are gonna do Maths and I am going to teach you now about numbers. That is a no-no in Grade R. I always believe that Numeracy starts at the beginning of class and it ends when the children leave, because Numeracy is always there, the whole day. Even when you say good afternoon to your teacher, its a skill or a Mathematic aspect that you teach the child about the concept of time then, in the morning you say good morning, so it starts from the beginning of the day till the child leaves.

Researcher : I also see that you integrate different kinds of Mathematics. If you look at colours, if you look at length, the little board they had on the ground with colours that you used, and you used time and I can see that you truly use Mathematics through your whole day programme. All learners don't develop at the same level, how do you differentiate?

Class teacher : Yes it is obviously always like that. You never get children that are all on the same level. So, I must always make sure that there will be work for a slower learner. Some of them, I've got 3 or 4 in the class that are not at the same level as the others. And what I always do, I try to challenge the stronger ones because if I don't do that, they will definitely get bored and I try to encourage the ones that are slower and I make sure that they don't feel embarrassed in front of the other learners. I also find that sometimes a child can learn from another child more than they can learn from the teacher, by sometimes just asking the child next to him/her just to help them with a number or so, its sometimes much better than I teach a child.

Researcher : As we have said before, the NCS (National Curriculum Statement) has different assessment standards for Mathematics.

How do you assess if you have gone through all the assessment standards for the year, how do you do your assessment?

Class teacher : The way we do it at school is, that there is never only one way to assess a child, for instance we want to assess a child if he knows his colours, we can't just call the child and the child must say the colours on a specific day, and then it is finished and over with. Inside and maybe outside we find that some children, if i can make an example, of skipping, I noticed when I asked them to skip inside, and when a child struggles, I would rather stay outside. You must always be there, but when the child is outside the child can skip without even knowing that I am assessing that specific child, then I will do assessments like that. So we try to use different methods to assess the children.

Researcher : Do you tick it off on a grid?

Class teacher : I have three formal ones that I use every day. Whenever they work, while they're busy working, for instance how they keep their pencils and I write it down on formal papers and I also write it down on their class lists.

Researcher : What I saw today, while you were busy. When you flashed the number cards today. When do you really start flashing numbers that they must recognize? In the end, or now in term 4? How did you start with numbers bringing it up to where they are now able to recognize the numbers when you flash it?

Class teacher : Whenever I start with the numbers, I introduce the number as well as the cards, for example number 2 with the card with the 2 dots next to it. So they know the first time that they see the number, I show them the number. I don't emphasize it that much. Only in term 3 where they start with formal numbers, recognizing it, they should be able to know like that's a 5 or a 4. But right at

the beginning it's more play-play.

Researcher : And like this morning when they did their outdoor play and they came back with their stones and they counted out their stones. Do they only do that in their first term and then they put the number with in the 3rd term.

Class teacher : No, I do it right from the beginning and up to 5. So they are used to doing that. Even if they do it with the play dough, sometimes I would ask them to make 5 balls with the play dough, I noticed that the moment the child can feel the number, in the dough they feel the 5 and I write it with my finger on their backs. That is the first and the second term they do it like that and the 3rd term they have it on a card.

Researcher : Thank you very much for the day today. I really enjoyed being in your classroom. Is there anything that you would like to add to what you did today?

Class teacher : Not really at this specific moment. It's just that, as I said before it's very important, I can't emphasize it enough, that numeracy should be part of the child's daily programme. Not only a certain time for Maths, like I tell my parents also that it should be part of life, everyday. For example when the child goes to the toilet, there can be a long or a short piece of toilet paper. When the child bath you can emphasize if it is a full or a empty bath. Numeracy is a live thing and it never stops.

Researcher : Thank you very much and I will see you next week.

## APPENDIX E

### Mathematics concepts (colour coding used)

Number	:	yellow
Shape	:	red
Size	:	green
Colour	:	blue
Time	:	pink

### Narrative – Day one

When I arrived at the school all the activities for the day was ready and a learning atmosphere was evident. Next to the painting table there was a painting tray with each learners name on, so they knew where to store their paintings for it to dry. This set a platform for them to recognize their names. The fantasy corner was set with household apparatus; the class had a big carpet for group activities and the morning circle. The wooden blocks and mathematics corner was ready. Displays of the learners work was on the wall and a space to pack their collage activities also with their names so recognizing of names could also take place. The discussion table was set out with the week's theme which was birds. Tables for educational play with a birthday chart which had the months, the dates and the learner's names. A Tidying up chart was ready for the week so every learner knew where to tidy up and responsibility was given to every learner.

### Lesson 1: Structured Outdoor Play

The children lined up in front of the classroom and sat on the porch. The learner counted with the teacher touching every learners head up to 21. She asked how many children were absent and the learners replied:

*“One learner”*



The teacher then asked them to line up in front of the classroom door. The teacher asked the children to fetch their binoculars. I suspected they made it the previous week. The learners got up from the carpet and fetched the binoculars and then returned to the carpet. The teacher told the learners they were going outside to do bird watching with their binoculars and on their way out they had to take with their margarine containers with the numbers in their locker. The teacher asked if any of them knew what bird watching was.

One learner responded and said:

*"It's watching for birds"*

She then asked where they would find birds.

*"On the ground? In the toilet? Where on the school ground?"*

A learner responded:



UNIVERSITY of the

*"On the stripes in the road".*

A learner responded on the trees and the teacher agreed. She demonstrated how to look for a bird using one eye and the binoculars. She furthered the instruction and then told them when they see a bird they must put a **tiny stone** in the container, and when she blew the whistle they will come back to the classroom. She instructed the bottom locker girls to fetch their containers first; these learners stood up and fetched it. Top locker girls, top locker boys and then bottom locker boys. Now all the learners left the classroom together.

The teacher blew the whistle and the learners started walking around looking for birds, she joined them to assist.



(D1, L1, P1)

While walking, one learner said:

*"Teacher I see a bird".*

Teacher replied:

*"What must you do if you see a bird? Pick up one tiny stone".*

The teacher encouraged them to walk all around the playground. The children started walking around, some in groups and others individually. The teacher reminded them to pick up a **small stone, a tiny one**. She asked one learner if she had found a bird yet. The learner just shook her head. She then asked if she had a stone in her container. I think the teacher was making sure everybody understood the task given. One learner screamed at the teacher in excitement:

*"Teacher I see one!"*

The teacher replied:

*"What must you do now?"*

Learner replied:

*"Get a stone"*

The learners wandered around looking for birds; I noticed some of them were picking up stones without seeing a bird. Some of the girls walked together looking for birds. The teacher reminded all the learners:

***"one bird, one stone".***

One learner told the teacher I have seen **two birds**. The teacher replied:

*"Then you must have two stones, do you have two stones?"*

The learner did not respond. The teacher asked another learner if he had seen a bird. The learner just shook his head. The teacher assisted him to where she saw a bird and guided him to pick up a stone. **The same learner then sat on the ground and counted the stones in his container.**



(D1, L1, P2)

I wondered if he really didn't see any birds. Or just picked up stones? One learner told the other:

*"Let's go there; there is a lot of stones!"*

Did they see the bird in order to pick up the stone? One boy ran around screaming:

*"I found one, I found one"*

He didn't have his container in his hand. Did he store it somewhere and puts in the stones afterwards? The teacher asked a learner **how many stones he had. He replied**

**"two"**

**The teacher checked and then told him to put in one more stone because they just saw one more.**



(D1, L1, P3)

The teacher then blew the whistle and asked the learners to come closer. She told them to go back to the classroom with their binoculars in the one hand, the container in the other, wave their arms and walk on their toes like they were birds. The learners followed the teacher back to the classroom.



## APPENDIX F

### Mathematics concepts (colour coding used)

Number	:	yellow
Shape	:	red
Size	:	green
Colour	:	blue
Time	:	pink

### Lesson 2: Morning Circle

The learners entered the classroom and sat on the carpet. The teacher prayed and the children repeated the prayer after her. The teacher told them the story of David and the harp and the learners listened attentively. The teacher and the learners sang bible songs in Afrikaans and English.

They turned to the chart with the days of the week.



(D1, L2, P1)

The teacher asked:

*"What day it is today?"*

A learner replied:

*"It's Monday"*

The same learner changed the marker to Monday on the chart.



(D1, L2, P2)

One of the learners said that there are 2 days we don't come to school. The teacher repeated it and said:

*"That's the weekend its, Saturday and Sunday".*

She asked what day it was yesterday.

One learner responded it was Sunday. The teacher asked:

*"What day is it going to be tomorrow?"*

A learner responded it will be Tuesday. She then asked them to sing the days of the week. The learners responded by singing the days of the week. She then asked them how many days in a week? A learner responded seven and she asked them to double check and the learners counted the days together, with the teacher pointing to the days on the chart. She asked the students:

*"Do we come to school 7days?"*

The learners responded by saying:

*"No, 5 days"*

The teacher then said:

*"Two days they stay at home because it's weekend".*

She then asked:

*"How many months in a year?"*

A learner responded:

*"twelve"*.

The teacher and the learners said the months of the year in English and then sang an Afrikaans song repeating the months of the year. The teacher then asked them about the seasons and reminded them about the clothes we wear during seasons and when the flowers started blooming.

She asked:

*"It is summer?"*

A learner responded:

*"It's autumn"*.

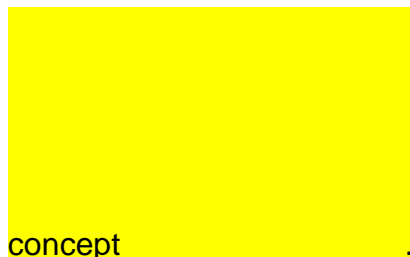
She reminded them about the leaves falling down in autumn and that season is finished for the year. She told them it is spring now, all the flowers are coming out. She asked them to show her 10 fingers and then 9, then 5 and put them in their lap. The teacher showed number symbols and the learner's answered individually.

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(D1, L2, P3)

Then the teacher showed a number symbol to all the boys, then all the girls and some individually. One of the learners didn't respond correctly so the teacher asked her again to assess her. The teacher then used dotted cards and followed the same



concept



(D1, L2, P4)

One of the learners didn't know the number of the dotted card and the teacher asked her to count the dots to make sure.



(D1, L2, P5)

The teacher then asked the learners to fetch their containers with the numbers and stones and to put it down in front of them. The teacher and the learners recited a rhyme from a book together, then the girls together with the teacher and then the boys together with the teacher. The discussion ring then started talking about the different birds and the kind of feathers. The teacher asked them about their previous discussion on feathers and how many different kinds of feathers a bird has. The learners responded naming tail feathers, wing feathers and body feathers. The teacher and the learners responded the wing feather to fly with, the body feathers to keep them warm and the tail feathers to keep them in the air. The teacher asked about the skeleton of the bird. One of the learners said:

*"It's hollow".*

The teacher asked the rest of the class what was meant by the word "hollow". They responded:

*"There is nothing inside".*

She wanted to know why the skeleton is hollow. A learner responded:

*"It must be light, because the bird must be able to fly."*

The teacher told the learners that she has brought a surprise to school today. The teacher had an unopened box on her lap. She told them there is something inside which is very delicate. She asked the learners if they knew the meaning of the word



delicate and then told them it is something that breaks easily, something you must handle with care. One learner asked if it's like a glass. The learners got the opportunity to guess what is in the box and the teacher gave them a clue saying it starts the letter "e". One learner responded saying it's an egg. She gave them another clue and said it's round. One learner responded by saying it's an ostrich egg. She furthered the discussion and said it's oval and it had a cream colour. She described cream and said it's almost white. The teacher said it's not alive and started opening the box. The teacher then took out the egg slowly and the learner responded:

*"I was right!"*

The teacher repeated the word delicate and asked the learners to clap the word in syllables. The learners clapped and the teacher responded saying:

*"That's three"*

Meaning three syllables. The teacher told the students the egg is very precious, it is more than 7 years old and it is oval almost like a rugby ball. One of the learners asked if there is something in the egg. The teacher focused their attention on the hole in the egg and asked why they think there is a hole? A learner responded to it by saying so that the ostrich could come out. The teacher asked what they thought was in the egg. One learner responded:

*"An ostrich"!*

The teacher told them there was an egg in it like the egg we eat and took a normal chicken egg out the box. She told them that because the egg is so old she had to take out the insides otherwise it'll become rotten if we don't eat it. But she kept the shell and she will be very sad if it broke. Everybody got the chance to feel the egg and the teacher told them it's very delicate, they must handle it very carefully. The teacher asked the learners why she would bring an egg if they are talking about birds. One of the learners responded and said birds like eggs. She asked them again, why an ostrich egg? She told the learners that an ostrich is also a bird, the biggest bird there is. One learner responded and said it's a big black bird.

All the learners wanted to tell her their own bird story and the teacher said a rhyme to quiet them down.

The teacher asked the learners to make a circle and take their container with them. The teacher asked the learners to pack out the stones they collected earlier. Some learners packed out a lot of stones and she asked some of the learners if they really saw that many birds?The learners assured her they did.

Some learners had big stones and the teacher specifically told them to use small stones.



(D1, L2, P6)

She asked them to take out the number card from their containers that matched the amount of stones they had. She said: “Count them, so you know what number you must take out”



(D1, L2, P7)

Some learners were not sure of the number they must take out. The teacher assisted and said:

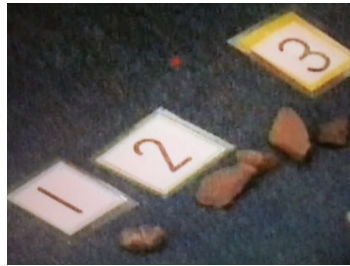
*“Count with me. Put your finger on the stone”.*

The learner counted with the teacher using his finger. He had five stones and took

out the number eight. The teacher asked him to count it again. She asked him what number he must take out. He said five. She responded by saying:

*“Yes, the man with the fat tummy”.*

Another learner packed out the numbers above every stone from 1 – 3.



(D1, L2, P8)

The teacher asked:

*“How many stones do you have?”*

The learner responded and said 5. The teacher asked her to look for the number 5. One of the other learners had a lot of stones and the teacher asked if he saw that many birds?



(D1, L2, P9)

The learner answered

*“No”.*

The teacher said:

*“Yes you were only looking for stones and not birds”.*

The learners with more than 10 stones had a problem. In the container they only had the numbers 1-10. One learner had 27 stones, and the teacher helped him with putting a 2 and a 7 together. I think this confuses the child because 27 are a 20 and a 7, not the two singles together. Another learner had only 7 stones and put out an 8. The teacher then counted with her making sure she touches every stone.



(D1, L2, P10)

This learner was older than the other learners but seemed to struggle. The teacher asked one of the other learners to help her look for the number.



(D1, L2, P11)

The teacher checked every child's number and stones individually. The teacher went back to the older learner and wrote the number in the air to show her again.

Another learner didn't have his number yet. The teacher asked him to count the stones. He counted very softly and she asked him to count louder so she can hear him. I think she was making sure that the rote counting<sup>1</sup> is in line with him touching the stones. He had 12 stones. I think that's why he didn't have the number ready because he didn't know how to make the twelve knowing he only had up to the number 10 in his container. The teacher helped him taking the 1 and the 2, not taking the 10 and putting the 2 on top of it.

---

<sup>1</sup>Memorizing and reciting the numbers in order without associating a number with a group of objects is defined as rote counting. (Bastian, 2011)



(D1, L2, P12)

One of the learners had 23 stones. He already put out his 2 and 3 together. This was the same learner who ran around on the playground without his container, picking up stones everywhere. Another learner had 7 stones but put out a 2.



(D1, L2, P13)

Could this learner be struggling with visual discrimination<sup>2</sup> seeing that the 2 and 7 has some similarities?



(D1, L2, P14)

Many of the learners counted the stones correctly and had the right number. One learner then counted the stones but started on the right side. The teacher then stood behind the learner and assisted her to count from left to right. This is also the writing direction. Does this learner know her left from her right? She had 12 stones and had

<sup>2</sup> Visual discrimination is the ability to see differences and similarities. A child with poor visual discrimination cannot see the difference between for example b and d, p and d or 6 and 9 and will read was for saw, stop for pots, and so forth. (Grove & Hauptfleisch 1981: 1)

her 1 and 2 ready to put out to make 12 but she puts it the other way around and made 21.



(D1, L2, P15)

An indication that this child might have a laterality<sup>3</sup> problem.



(D1, L2, P16)

The teacher now put a big container in the middle of the circle and asked the learners to put their stones in the container in the order of the letter their name begins with. The teacher uses the programme "Letter land" with this class during Language enrichment, so she called out the letter name as in the stories of the programme:

*"If your name starts with an "e" Ellie Elephant put your stones in the container"*

The teacher ended of the lesson asking the learners to make groups with the number symbol she was showing. She showed the 3 first and they physically made groups of 3.

---

<sup>3</sup> A sense of laterality enables a child to be aware of the two sides of the body, to know which side is moving and when it is moving. A child must also have a clear concept of his own body and of body movements outside the body. Only when a child has acquired an inner feeling of left and right will he be able to detect left and right outside of himself. (Grove & Hauptfleisch 1981: 2)



(D1, L2, P17)

Some of them ran from group to group realizing they were 4 and looking for another group. It was interesting to see how happy they were when they realized their group had the right amount of learners, and how unhappy they were when they were not. They almost shove the extra one out of the group, or call another to complete the group. The last number she showed is an one and then they are all individual again.



# APPENDIX G

## Mathematics concepts (colour coding used)

Number	:	yellow
Shape	:	red
Size	:	green
Colour	:	blue
Time	:	pink

### Lesson 3: Indoor Play

Four Tables were set out for this activity. The first table was a drawing table, here they had three tasks. They had to draw a bird, something a bird likes and they had to colour it in. Table two was the collage activity; they had to draw an owl. They had to tear paper and paste only the wings of the owl. Table three was the painting table; they were given an outline of a guinea fowl. They had to paint it black and make white spots with an ear bud and white paint. The fourth table was the dough table, here they had set cards. Every card had an instruction for example: picture of a bird, nest and a number 5. They had to make a bird and a nest with 5 eggs. Every card had a different number on it.

The teacher prepared a place for every learner to start a certain activity. The learners now rotated to finish all the activities at every table. The learners started with their activities. At one of the tables the learners all start the activity differently. Some stuck the glue first and then they tore and pasted, others tore first and then put glue on to the paper.



(D1, L3, P1)

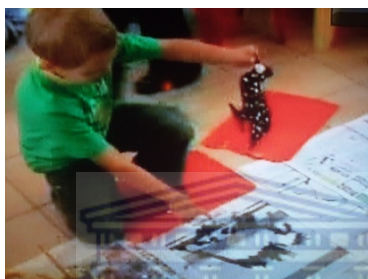


Table 2 some learners did not paint the whole outline and the teacher assisted them.



(D1, L3, P2)

One learner painted over the sides on the newspaper and was fascinated by the outline of black left when he lifted his painting to put it in the painting tray to dry.



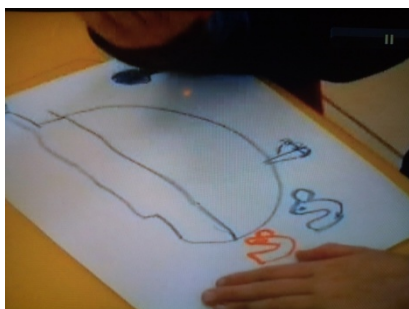
(D1, L3, P3)

He told the learner next to him that it's shadow. He looked for his name and then stored it. At the dough table the learners started with the bird first, doing it in the reading direction. Fine motor skills<sup>4</sup> were practiced here and the teacher assisted a learner in rolling the dough between her hands to make the dough more workable. She told the learners to remember to call her when they had finished their eggs so that she can check if it's the right amount.

At table four, the learners drew their birds and the teacher asked what a bird likes to assure they understood the task.

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<sup>4</sup> These are the small muscle movements of the body. A child's normal everyday activities – especially those in the classroom – make tremendous demands on fine motor co-ordination. A child is expected to perform a large number of accurate movements with his fingers and hands when he draws, colours pictures, copies or writes. A child whose fine motor development is inadequate will find it difficult to fasten buttons, tie bows, draw, colour in, write, or perform any of the tasks that require the use of fingers. (Grove & Hauptfleisch 1981: 2)



(D1, L3, P4)

Back at the dough table one learner had to make 5 eggs for the nest. He didn't make the bird yet. Did he understand the reading direction of the card? He made a very small nest and the teacher asked him if he thought the nest was big enough for 5 eggs and where is his bird? The teacher showed him the card again pointing to the bird and asked him if he shouldn't make the bird first before starting with the nest. He agreed and started again.

One learner made her 5 eggs and checked if she is correct by counting every egg with her finger.



(D1, L3, P5)

Another learner made his nest first and then the eggs. He took out the 6 eggs and started making another nest, also without a bird.



(D1, L3, P6)

He finished his task and he also made the number symbol "6" with the dough.



(D1, L3, P7)

At the drawing table a learner did not know what else to draw of the bird. The teacher then assisted and said:

*“What does he eat? Where does he live?”*

The same learner who struggled with the dotted cards in the previous lesson, struggled at the dough table to make the right amount of eggs, she made 3 and not 7 eggs. The teacher counted with her and asked how many more she must make? They counted to seven and the teacher left her to figure it out. This same learner also struggled with the right number for the amount of stones. Interesting enough the learner who helped her to look for the right number card was sitting next to her again. One of the boys previously struggling with his amount of stones, only used a black crayon at the drawing table, the teacher told him to use other colours as well. At the dough table the teacher assessed those that were finished and when they were finished she asked them to make a ball again. This related to Piaget's process of conservation<sup>5</sup>, to take the child back to the beginning. At the drawing table one of the learners asked the teacher if a bird's body is an oval shape like the rugby ball? The teacher agreed. The learner who only used black crayons now showed the teacher his drawing and she motivated him and said it looks much better. He now sat on the carpet alone looking at the other children working. The teacher asked him if he had done the dough table and he shook his head. She then told him to finish that activity. At the dough table one learner showed the other he had 8 eggs as asked for and counted it with his finger touching every egg. The teacher assisted the boy who

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<sup>5</sup>The understanding that something stays the same in quantity even though its appearance changes. To be more technical (but you don't have to be) **conservation** is the ability to understand that redistributing material does not affect its mass, number or volume. (McLeod, 2010)

painted with only black crayons, he had the card with the 5 eggs he struggled with earlier and the teacher reminded him ,it's the man with the fat tummy.

The teacher also packed out educational play so when the learners are finished with their four activities or waiting for a table with an open seat they could do educational play. Two learners started with puzzles whilst there is a space open at the drawing table. At the drawing table two learners were discussing the use of colour. One of the learners asked the teacher for a different activity because he couldn't find a space. She gave him a board in a triangle shape with red on the one side and blue on the other.



(D1, L2, P8)

He now has to fit the sticks to match the size and the colour. He started by fitting the sticks in the right length but didn't concentrate on the colours as much.



(D1, L3, P9)

He told the teacher one of the sticks doesn't fit. She helped him and she realized that he didn't concentrate on the colours, she focused his attention on the colours and he tried again.



(D1, L3, P10)

He showed the box once finished and I showed him there were more ones that didn't fit the colour He got very upset and threw out everything and started again. In the meantime some of the other learners started playing a game similar to snakes and ladders but with dinosaurs.

They understood the use of the dice and played it very efficiently.



(D1, L3, P11)

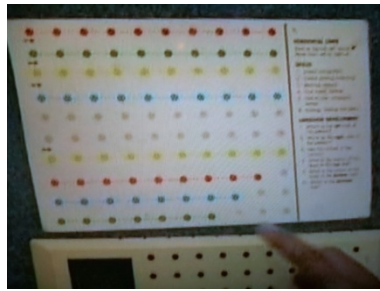
Some of them knew the amount to play without counting the dots and others counted the dots on the dice and then moved their counter on the board.



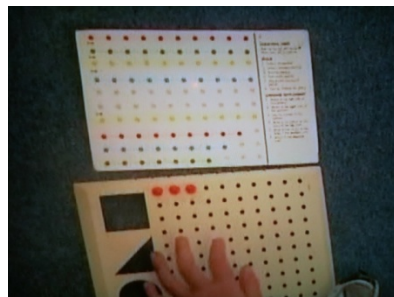
(D1, L3, P12)

One of the learners now opened the pegboard game. She just started by putting in the pegs without using the pattern on the card. The teacher saw this and looked for an easier card and explained in detail how she must look for the colours.

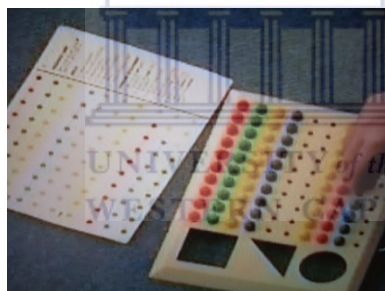
This card had one colour per row.



(D1, L3, P13)



(D1, L3, P14)



(D1, L3, P15)

She experienced some success.

Other learners opened a game called laces. There's a card with shapes that matched (shapes ex. Triangles, half a circle) and at the back there was a shoe that showed they had done it correctly. The teacher saw them struggling and explained to them that they should start where the arrow is and then match it to the shape to complete the shoe at the back.



(D1, L3, P16)



(D1, L3, P17)



(D1, L3, P18)

They experienced success.

I asked one of the learners at the dough table if he had the right amount of eggs and he counted it with his fingers correctly. One of the other learners also tried the triangle box with the colours; she struggled too but soon experienced success. The teacher now called the learners attention to the tidying up card and read out the names who should tidy up at which table and the learners started to tidy up. She told them in which colour containers crayons must be stored and paint brushes needed to be put and the sorted.

WESTERN CAPE

The children now started with snack time. The teacher talked about healthy food and the shapes of their sandwiches and the colour of their lunch boxes. She also encouraged them to share with one another.

# APPENDIX H

## Curriculum and Assessment Policy Statement 2011

### Mathematics

### Reception Year

### Content area 1

The Curriculum Policy has five different content areas:

- 1- Numbers, Operations and Relationships
1. Patterns, Functions and Algebra
2. Space and Shape (Geomertry)
3. Measurement
4. Data Handling

### Content area 1: NUMBERS, OPERATIONS AND RELATIONSHIPS

Progression in Numbers, Operations and Relationships

- The main progression in Numbers, Operations and Relationships happens in three stages:
- The number range increases
- Different kinds of numbers are introduced
- The calculation strategies change.
- As the number range for doing calculations increases up to Grade 3, learners should develop more efficient strategies for calculations
- Contextual problems should take account of the number range for the grade as well as the calculation competencies of learners.

*Numbering as used in the CAPS document*

### NUMBER CONCEPT DEVELOPMENT: Count with whole numbers

#### 1.1 Count objects

##### Count concrete objects

- Estimate and count to at least 10 everyday objects reliably



## **1.2 Count forwards and backwards**

- Count forwards and backwards in ones from 1 to 10
- Use number rhymes and songs
- Say and use number names in familiar context.

## **NUMBER CONCEPT DEVELOPMENT: Represent whole numbers**

### **1.3 Number symbols and number names**

#### **Recognise, identify and read numbers**

- Recognise, identify and read number symbols 1 to 10
- Recognise, identify and read number names 1 to 10

## **NUMBER CONCEPT DEVELOPMENT: Describe, compare and order whole numbers**

### **1.4 Describe, compare and order numbers**

#### **Describe, compare and order collection of objects up to 10**

- Describe whole numbers up to 10
- Compare which of two given collections of objects is big, small, smaller than, bigger than, more than, less than, is equal to, most, least, fewer up to 10
- Order more than two given collections of objects from smallest to biggest up to 10
- Use ordinal numbers to show order, place or position
- Develop an awareness of ordinal numbers first, second, third up to sixth and last

## **NUMBER CONCEPT DEVELOPMENT: Place Value**

### **1.5 Place value**

Not applicable for Grade R

## **SOLVE PROBLEMS IN CONTEXT**

### **1.6 Problem solving techniques**

Use the following techniques up to 10:

- concrete apparatus e.g. counters
- physical number ladder

### **1.7 Addition and subtraction**

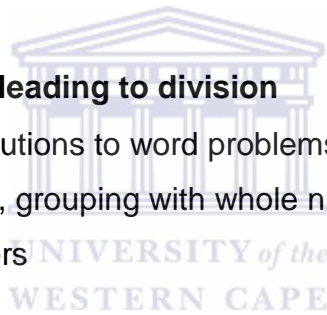
- Solve word problems (story sums) in context and explain own solution to problems involving addition and subtraction with answers up to 10

### **1.8 Repeated addition leading to multiplication**

Not applicable for Grade R

### **1.9 Grouping and sharing leading to division**

- Solve and explain solutions to word problems in context (story sums) that involve equal sharing, grouping with whole numbers up to 10 and answers that can include remainders



### **1.10 Sharing leading to fractions**

Not applicable for Grade R

### **1.11 Money**

- Develop an awareness of South African coins and bank notes.

## **CONTEXT-FREE CALCULATIONS**

### **1.12 Techniques(methods or strategies)**

Not applicable for Grade R

### **1.13 Addition and subtraction**

Solve verbally stated addition and subtraction problems with solutions up to 10

### **1.14 Repeated addition leading to multiplication**

Not applicable for Grade R

### **1.15 Division**

Not applicable for Grade R

### **1.16 Mental mathematics**

Number concept: Range 10

- Each activity commences with mental maths:
- Counting everyday objects
- Counting forwards and backwards
- Ordinal counting
- Clap hands many/few times
- Which claps are most/least/more/fewer
- Which number comes before/after/between

### **1.17 Fractions**

Not applicable for Grade R

