UNIVERSITY OF KWAZULU-NATAL

EXPLORING FOUNDATION PHASE TEACHERS' USE OF INSTRUCTIONAL STRATEGIES TO TEACH DATA HANDLING

By

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Dedication

This work is dedicated to

my daughters Awande and Wandile

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I thank my almighty God for making it possible for me to study and complete this degree.

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Declaration of originality

I declare that "Exploring foundation phase teachers' use of instructional strategies to teach data handling" is my own work and that all sources consulted and quoted have been indicated and acknowledged by means of complete references.

Signed……

Nokuphiwa D. Mkhabela

Statement by Supervisor

This dissertation is submitted with my approval.

Signed……

Dr J. Naidoo

Abbreviations and Acronyms

ANA	Annual National Assessment
CAPS	Curriculum and Assessment Policy Statement
DBE	Department of Basic Education
FET	Further Education and Training
KZN	KwaZulu-Natal
LO	Learning Outcome
LSEN	Learners with special education needs
NCTM	National Council of Teachers of Mathematics
PGCE	Postgraduate Certificate in Education
RNCS	Revised National Curriculum Statement
SA	South Africa
ZPD	Zone of Proximal Development

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ABSTRACT

Statistics plays a more prominent role within mathematics curricula globally it did a few years ago. Data handling is one of the sections in mathematics that is taught from the foundation phase up until the Further Education and Training (FET) phase. Data handling is considered as the easiest section, but the Annual National Assessment (ANA) (Department of Basic Education, 2012, 2014) reveals that learners are not performing well in it. This study therefore seeks to examine how data handling is taught in foundation phase classrooms. The purpose of this study was to explore foundation phase teachers' use of instructional strategies to teach data handling.

The theory of social constructivism informed this research study, which indicates the usefulness of this theoretical framework in collaboration and interaction while learners construct knowledge. Data on the instructional strategies used by foundation phase teachers to teach data handling were obtained using the case study approach. The analysis and the subsequent results were based largely on the participants' responses to a teacher questionnaire, lesson observation transcripts and transcribed interviews with eight participants from seven different primary schools.

The findings of this study were that the participants used different instructional strategies when teaching data handling and memorisation was the dominant strategy. The findings of this study may be of benefit to curriculum developers for professional development. This in turn may help learners to perform well in data handling; since data handling is part of mathematics, it may also improve results in this subject. If the results are improved then that may lead to economic growth of the country, because learners would be able to access those jobs that need mathematics skills. Since this research study focused on foundation phase, this study may be extended to instructional strategies used to teach data handling in other grades.

Chapter One

Introduction

1.1 Overview of this chapter

In this chapter the research process undertaken for this study is discussed. The study explored foundation phase teachers' use of instructional strategies when teaching data handling. This chapter firstly provides the background and purpose of this study. Secondly, the contribution this study makes to mathematics education is described; thirdly, the teaching and learning of data handling in the foundation phase as well as the key research questions that guided this study are discussed. Finally, a summary of the chapters is also provided.

1.2 Introduction

In South Africa (SA) as well as in other countries some of the mathematics teachers do not have a thorough background in statistics (North & Zewotir, 2006; North & Scheiber; Wessels, 2009). This undermines their capability and self-confidence in teaching topics in data handling. The poor results in mathematics in SA make research-based and efficient professional development in statistics for mathematics teachers necessary (Wessels & Nieuwoudt, 2011).

Machaba (2013) focused on teachers' challenges in the teaching of mathematics in the foundation phase. Her argument was that learners are not performing well in mathematics basic computations such as addition, subtraction, multiplication and division. She looked at the problems encountered by teachers when teaching mathematics in grade 3 classrooms. The problems included the fact that the classes had learners who speak different languages, and teachers could not speak some of the languages that were not the language of instruction of the school. Another challenge was that teachers had limited time to spend in the classroom and could

not give learners individual attention. The findings of Machaba's (2013) study were that teachers used the whole-class teaching strategy, which is not suggested since each learner learns differently. Therefore, exploring instructional strategies used by teachers in the foundation phase when teaching data handling is a necessity because the researcher has not come across such research. This is an area of concern in the field of mathematics, more so due to the Annual National Assessment (ANA) report (Department of Basic Education (DBE), 2012, 2014), which reveals that foundation phase learners do not perform well in data handling.

1.3 Background to the study

The notion of instructional strategies used by foundation phase teachers to teach data handling emerged from anecdotal experience and interest. The question of context becomes very important in studies that are focusing on instructional strategies that teachers employ (Vithal, 1998). In some contexts there is a wealth of resources and privilege and in others there is a lack of resources. Learning is viewed as a way of developing information within important contexts (Handal & Bobis, 2004). For a context to be important, learners within the context need to be able to relate to these contexts. Basically, social contexts that are favourable to learning need to be formed, because the procedure of learning is itself social (Putnam & Borko, 2000). Additionally, whilst learning is social, active participation and interaction of learners in the learning route is essential. Teachers, for example, need to realise the social and cultural aspects of mathematics teaching. Wessels (2009) argued that the low performance in mathematics calls for serious consideration of the way in which mathematics is taught. Hence it is the interest of this study in terms of what goes on in mathematics classrooms in relation to the strategies teachers use when teaching data handling.

1.4 The purpose of the study

The purpose of this study was to explore foundation phase teachers' use of instructional strategies to teach data handling. The issues of exclusion in terms of opportunities to effectively learn and teach data handling can be addressed through strategies that teachers use in teaching it.

The issue of exclusion is a social issue and needs to be addressed somehow, for example by retraining teachers who do not have ample knowledge or qualifications to teach data handling. This is because some teachers within the same country have the capacity to teach data handling given the ample availability of resources and facilities to teach it, while others do not, as well as the varying quality of teaching personnel. This makes it difficult for some teachers to teach data handling. It is therefore the purpose of this study to explore teaching strategies that are suggested by the literature in order to assist teachers to teach data handling effectively and efficiently, even though the conditions are not conducive to do so, in their respective contexts. This notion has largely influenced the carrying out of this research project.

1.5 The rationale for the study

The rationale for this study can be recognised by two aspects, which are: (1) addressing the gap in mathematics education; and also (2) the contribution of the study to mathematics education since data handling is one of the sections that is taught within the foundation phase mathematics curriculum.

1.5.1 Addressing the gap in mathematics education

Limited research studies have been done in teaching and learning within the foundation phase. For example, Lawrence (2011) conducted a study on the approaches that grade 3 teachers use to promote mathematical literacy in their learners. In addition, Motiswe (2012) focused on the instruction and learning strategies used in inclusive foundation phase classrooms. Moreover, Phajane (2012) examined first grade teachers' methods used in teaching beginning reading in Setswana. While these studies focused on the instructional strategies used in the foundation phase, they did not focus on the teaching of data handling.

Most of the research studies carried out in SA focus on developing and improving the instruction and learning of mathematics at secondary school level as well as tertiary level. For example, Ndlovu (2014) conducted a study in the University of KwaZulu-Natal, exploring pre-service teachers' mental constructions of learning matrix algebra. Pooran (2011) explored the instruction

and learning of mathematics word problems in grade 8 second language learners in English. Delport (2010) reported on the introduction of a learning approach that was intended to improve students' academic achievement in mathematics and statistics at the Central University of Technology in Free State. Pienaar's (2014) study focused on the function of fractions in the secondary school curriculum. Tsanwani's (2009) study examined the factors that assist in success of grade 12 mathematics learners in traditionally underprivileged schools in Limpopo Province. Thus, the above studies focused on secondary school mathematics. It seems that the body of research in the foundation phase with reference to teaching and learning of data handling is limited. Therefore this study will add new knowledge for the foundation phase mathematics community.

1.5.2 The contribution of this study to mathematics education

Literature on foundation phase teachers' use of instructional strategies to teach data handling will be reviewed in Chapter 2 and will show that this phenomenon has not been examined exhaustively within the South African classroom. The teaching of data handling using different instructional strategies recasts the connection between what teachers instruct and how they instruct. Teachers employ different instructional strategies to assist learners to construct meaning in data handling. When reviewing the literature it was revealed that the studies conducted in SA focused on different sections in mathematics and are limited in respect of data handling. More details on this will be discussed in the next chapter.

The ANA reports (2011, 2012 and 2014) revealed that foundation phase learners are not performing well in data handling, but this has not been the focus of most of the studies reviewed. Other researchers focus on mathematics computations (Machaba, 2013), while Luneta (2014) focused on geometry. Therefore this study explored instructional strategies employed by foundation phase teachers when teaching data handling. The findings of this study may be of benefit to mathematics curriculum developers and foundation phase mathematics teachers.

This study is qualitative in nature. The theoretical works of researchers within the field of social constructivism were also explored. This study also indicates the usefulness of social constructivism in collaboration and interaction of learners while they construct knowledge. The

data analysis will reveal that the participants used different instructional strategies when teaching data handling.

1.5.3 The role of statistics and data handling in the foundation phase

Some authors refer to data handling in schools as statistics (North & Ottaviani, 2002; North & Zewotir, 2006; Wessels, 2008; Chick & Pierce, 2008). Data handling is also referred to as statistical literacy (North & Zewotir, 2006). There are three main reasons for teaching data handling in schools: it is helpful for daily life, plays a part in other disciplines, and is essential in developing critical thinking (Chick & Pierce, 2008). Therefore the inclusion of the data handling section in the foundation phase is of benefit to the learners.

The statistics component within the data handling section of Curriculum 2005 (C2005) was initially developed by the DBE. In other words, data handling is part of statistics. In the past primary school statistics was reduced to activities and learners were given small prearranged data sets to represent in a graph and to answer questions (Wessels, 2008). In the Revised National Curriculum Statement (RNCS) data handling was a Learning Outcome (LO), and now in the Curriculum and Assessment Policy Statement (CAPS) it is a Content Area. Nevertheless there is no difference in what is expected from the learner as a skill. In the foundation phase the learner has to collect, sort out, present, analyse and interpret particular data (DBE, 2011). Therefore throughout the data handling section the problem-solving approach is used (North & Zewotir, 2006). North and Zewotir (2006) argue further that an attempt is made to teach statistical principles and encourage statistical reasoning. Therefore through data handling in the foundation phase statistical principles are taught and statistical reasoning is also developed.

1.6 Exploring mathematics in general

Research demonstrates that learners are exposed to mathematics on a daily basis in the form of counting, arranging and clarifying, (Mkhize & Nduna, 2010) and that mathematics is a pillar for any country's economic development (Mkhize & Nduna; Montague-Smith & Price, 2012; Vithal, 2012). Therefore mathematics is central to people's daily activities. It is recommended that the teaching of mathematics be done to assist learners see the importance of its contribution

to the economy of the country (BadaAbubakar, DagogoWokoma & OlajumokeAfebuame, 2012). In terms of understanding the role that mathematics plays in learners' lives, these studies are important, but they are silent in terms of data handling teaching and learning in the foundation phase.

1.7 The teaching and learning of data handling

While data handling is not new in the foundation phase in SA, it is a cause for concern in that learners are struggling to grasp this concept. The ANA (DBE, 2014) shows that foundation phase learners have a challenge in understanding data handling concepts. This concept is important as it appears throughout the curriculum, right up to and including the Further Education and Training (FET) phase curriculum in SA. Teachers need to gain learners' interest and sustain this interest through the schooling career. This is in line with what the Department of Basic Education (2011, p. 4) says when it states that a teacher must be adept at "…*equipping learners, irrespective of their socio-economic background, race, gender, physical ability or intellectual ability, with the knowledge, skills and values necessary for self-fulfilment and meaningful participation in society as citizens of a free country*..." Although teachers have been attending professional development workshops in statistics education, they still teach using traditional instructional strategies, rather than using innovative instructional strategies, and have a challenge in applying their knowledge of concepts found specifically in data handling (Wessels & Nieuwoudt, 2011).

The researcher also draws from Morrow's (2007) concept of organising systematic learning. Morrow (2007) suggested that teachers need to understand the theoretical and epistemological basis of the discipline, subjects or learning areas they teach. Teachers need to know the content of their disciplines so that they are able to understand the most appropriate way of scaffolding the learning process in order to stimulate understanding in learners. Groth (2007) stated that there is a difference between mathematical knowledge for teaching and statistical knowledge for teaching. Mathematical knowledge for teaching is the knowledge of mathematics that the teacher applies when teaching (Hill, Rowan & Ball, 2005). Thus mathematical content and statistics

content are different. Possessing mathematical knowledge does not mean that one can teach statistics or data handling. Groth (2007) argued that there is mathematical and non- mathematical knowledge for teaching statistics. Thus, mathematics teachers need to be trained in statistics in order to acquire non-mathematical knowledge for teaching statistics. This implies that having mathematical knowledge does not mean that one has statistical knowledge.

Within the context of this research study, teaching and learning of data handling includes not only the understanding of the content, but also knowledge of the strategies to activate learning. Shulman refers to this as pedagogical content knowledge (Shulman, 2004). According to Human, Van der Walt and Posthuma (2015), pedagogic content knowledge has three categories, which are acquaintance with content and learners; acquaintance with content and teaching; and knowledge of the curriculum. Pedagogic content knowledge necessitates the integration of content and pedagogy (Ball, Thames, & Phelps, 2008). This integration occurs as a device to understand how topics are represented with the intention of teaching these topics successfully. Furthermore, knowledge of subject matter and teaching refers to the knowledge the teacher employs to introduce the new concepts to learners of a specific age group (Ball, et al., 2008). Therefore the researcher argues that if teachers have content knowledge of what they teach, they may be able to choose the right instructional strategies to facilitate teaching and learning. So it is important to lay a good foundation for statistics in the foundation phase because statistical knowledge mastered in the foundation phase has a great impact on the learners' performance in secondary school and at institutions of higher education (Kieng-Kheng & Noraini, 2010). It is therefore the aim of this study to explore which instructional strategies teachers use to teach data handling in the foundation phase in selected schools in SA.

1.8 Introducing the critical research questions

As indicated previously, the purpose of this research study was to explore foundation phase teachers' use of instructional strategies to teach data handling. This study was informed by the theory of social constructivism and sought to answer three critical questions. The first question identifies which instructional strategies foundation phase teachers use to teach data handling. The second question explores how foundation phase teachers use instructional strategies to teach data handling. The third question interrogates why foundation phase teachers use instructional strategies when teaching data handling in the way that they do.

The instructional strategies used by foundation phase teachers within the sample were under focus in trying to answer the above research questions.

1.9 The scope of this study

This research study is limited to eight foundation phase teachers teaching within the Pinetown district in KwaZulu-Natal, SA. All participants were females and they were of diverse races and cultures. The participants' teaching experience was between 3 years and 23 years.

Table 1 shows a list of schools and research participants. Pseudonyms have been used to protect the schools' and participants' identities.

Table 1: Foundation phase teachers in this study

Teacher	Gender	Teaching experience (years)	Name of the school
Musa	Female	22	Green Primary
Qinisile	Female	10	Blackberry Primary
Honey	Female	23	Yellow Primary
Betty	Female	22	Reddy Primary
Charity	Female	15	Blueberry Primary
Jabu	Female	5	Pink Primary
Fiona	Female	9	Purple Primary
Vicky	Female	3	Purple Primary

1.10 Overview of this study

The following structure was used to determine the suitable approach to this study. The study comprises seven chapters, the references and the appendices. The chapters in this research study are outlined below.

Chapter One: Background and motivation of the study

This chapter provides a brief overview of the background of the study and also the motivation for the study. Chapter one also highlights the research approach to this study. Additionally; the research questions are introduced.

Chapter Two: Literature review

This chapter presents the relevant literature that will give strength to the theoretical basis of the study. The literature is based on research on mathematics, teachers, foundation phase mathematics, teaching and learning of data handling and instructional strategies.

Chapter Three: Theoretical framework

This chapter presents the theoretical framework. The theory of social constructivism informs this research study. The significance of social constructivism to this study is outlined in this chapter.

Chapter Four: Research methodology

This chapter discusses the research methodology and procedures undertaken to conduct this study. This chapter presents the design of the study and the research methods used. A discussion of the process of piloting the study, gaining access and sampling methods is also presented.

Chapter Five: Data analysis

Chapter Five focuses on analysing data that were collected. Each foundation phase teacher is introduced, with a discussion revolving around the instructional strategies each participant used.

Chapter Six: Discussion and findings

This chapter discusses the results and implications of this study. Moreover, this chapter aims to answer the critical questions of the study. In this chapter the questions that were asked in the teacher questionnaire, lesson observations and interviews are also discussed.

Chapter Seven: Recommendations and limitations

This chapter is the concluding chapter of this study. The conclusions that were drawn based on the data generated and analysed are presented. The recommendations as well as limitations of the study are also discussed in this chapter.

1.11 Conclusion

This chapter has outlined the purpose, rationale and scope of the study. The chapter's conclusion was the summary of the study with a brief overview of each chapter. The next chapter discusses the review of the literature.

Chapter Two

Literature review

2.1 Prelude

The previous chapter presented the background, purpose, rationale and overview of the study. Additionally, literature on mathematics in general, the teaching and learning of data handling, as well as the role of statistics and foundation phase data handling were elaborated and discussed. The literature informing this research study and the implications of this literature are discussed in this chapter.

2.2 Mathematics in SA

When considering contextual issues in terms of public schooling in SA, some learners are not doing well in mathematics. Public schools are those schools that are aided by the State and private schools are those that are independent (Immelman & Roberts-Lombard, 2015). However, SA is not the only country that experiences low performance in mathematics (Reddy, 2005); low performance in mathematics is a global problem. Although other countries do not perform well in mathematics, SA achieves low results when compared with other countries (Mutodi & Ngirande, 2014).

South African schools need to develop effective instructional strategies for teaching mathematics to solve the problem of poor performance (Moila, 2006; Kriek & Grayson, 2009). As far as the issues of context are concerned, this study proposes that learners should engage in authentic tasks. Authentic tasks focus on real-world problems and their solutions (Lombardi, 2007). This is because research points out that using real-life learning contexts enhances the chances that learners will engage in problem-solving enquiry (Friesen & Scott, 2013; Fullan & Langworthy, 2014), which is part of data handling. In other words, mathematical tasks that learners engage in must have a sense of being authentic, with the learners' answers being implementable in real-life situations. Nevertheless, in order for schools to engage in such tasks, the availability of facilities

including libraries, textbooks, computers and access to the internet is required. However, a number of public schools in SA do not have such facilities (Hart, 2004; Paton-Ash & Wilmot, 2015).

Mgqwashu (2008) states that the current learning and teaching in most public schools in SA lacks the quality it deserves because of the unavailability of or limited resources in such schools. For example, the resources these schools lack include television sets, tape recorders and computers. Mgqwashu (2009) further reveals that in 2003 the Gauteng Province Education Ministry articulated its concerns about a huge immigration of learners from South Western Township (Soweto) schools to former Model C schools. The reason for that might be because the township schools lack resources (Mampane & Bouwer, 2011; Masitsa, 2011). Based on the above postulations, the issue of context is pertinent in this study.

The argument is made that the availability of these facilities are vital in mathematics curriculum delivery. According to research done in SA, learners perform poorly in mathematics in most public schools (Mkhize & Nduna, 2010). Research by Mbugua, Kibet, Muthaa and Nkonke (2012) concludes that factors contributing to low performance include understaffing and inadequate teaching or learning materials. There has been an outcry over the years about the low achievement in mathematics coupled with little intervention in the subject. Mkhize and Nduna (2010) argue that such interventions have not brought clarification to the issue of low achievement in schools; hence the focus of this study on instructional strategies teachers use in teaching data handling is essential.

Low performance in mathematics is also a problem in the foundation phase (Hugo, 2010). This low achievement in mathematics is not only taking place in high schools, but it starts in primary schools. A research study with grade 6 learners found that they were unable to perform mathematics tasks expected of learners at grade 3 level (Reeves & Muller, 2005). This highlights that there is a challenge with the teaching and learning of numeracy. Data handling is one of the concepts that seems to be challenging for foundation phase learners, and that is why this study seeks to understand how data handling is taught in foundation phase classrooms.

There is a scarcity of artisans and technicians in SA because of low performance in mathematics (Vithal, 2012; Siyepu, 2013). Mathematics contributes to the economic growth of the country since most of the high-paying professional jobs require mathematical skills. The basic entry requirement to the prestigious courses like medicine, engineering and other degree programmes is a high mark in mathematics (Mbugua et al., 2012). Mathematics skills are critical for one's future educational attainment and labour market success (Kim, Kim, Desjardins & McCall 2015). Research indicates that learners who pass mathematics well at high school are expected to follow higher education and to have higher salaries later in life (Altonji, 1995; Rose & Belts, 2004). For the above reasons this study seeks to explore the instructional strategies teachers use when teaching data handling in the foundation phase, because that will help other teachers to use the same strategies and can also be used for professional development. This in turn may help to improve mathematics results or the teaching of data handling.

In 2009 the Department of Education reviewed the functioning of the National Curriculum Statement grades R to 12 (DBE, 2011). After the review, recommendations were made and one of them was "*regular external systematic assessment of Mathematics, Home language and English first additional language*" (DBE, 2011, p. 4). Subsequently the ANA was conducted by the DBE in February 2011 in literacy/language and numeracy/mathematics. A qualitative analysis of the results demonstrated that the overall achievement of learners was low, with average scores of 30% and less in languages and mathematics. There were also instances where some learners did not respond to a single item in some tests (DBE, 2012).

These findings confirmed what Hugo (2010) alluded to: that young learners in the foundation phase were not performing well in mathematics and in language skills. Thus, while many education policies were introduced in the years after the demise of the apartheid era, the quality of primary education and the impact on learner performance had been minimal (Chisholm, 2004).

According to Mji and Makgato (2006), instructional strategies contribute to low performance in mathematics. In other words, if a teacher uses teaching strategies that are not effective in the classroom, learners may not perform well. Therefore there is a relationship between learners' achievement and instructional strategies (Moss, & Brookhart, 2012).

2.3 Teaching mathematics within the South African context

Learners in different social contexts receive school knowledge which is not the same (Hoadley, 2007; Carter, 2010). The way knowledge is relayed to learners in different contexts needs to be considered. The reason for different results might be because teachers use different instructional strategies, since one of the factors that adds to low performance in mathematics is the instructional strategies used by teachers (Mji & Makgato, 2006). Another contributing factor to different results in different social contexts is mathematical knowledge for teaching (Groth, 2007). For example, learners in rural areas receive low-quality education since few teachers are qualified and they also lack material resources compared to schools in urban areas (Mulkeen, 2006). A teacher with mathematical knowledge is expected to be interpreting someone else's errors and developing alternative explanations because of the misconceptions of some of the mathematics teachers (Ball, Hill & Bass, 2005). The above involves choosing and employing different types of instructional strategies. Therefore learners in different social contexts do not have access to the same quality of education, in this case in mathematics (Wood, Levinson, Postlethwaite & Black, 2011).

2.4 Mathematics in the foundation phase

The foundation phase refers to the first phase of the General Education and Training band. The term foundation phase refers to grades R, 1, 2, and 3, including learners beginning from six to nine years of age. It is a phase of four years. Learners in the foundation phase are required to learn all subjects in their vernacular language (Van Laren & Goba, 2013). The Department of Basic Education (2011, pp. 8-9) lists the following mathematics skills that foundation phase learners need to develop:

- Expand the accurate use of language of mathematics;
- Learn to listen, speak, think, reason logically and apply the mathematical information gained;
- Learn to ask and solve problems; and

Learners who have not established a strong foundation in mathematics may have a problem learning higher-order mathematics (Mutodi & Ngirande, 2014). According to Ensor, Hoadley, Jacklin, Kuhne and Schmitt (2008), confirmation from international, national and local assessments points out that the most of the children in SA are not proficient in numeracy at the end of primary school. However, the Department of Basic Education (2014) reports an improvement since implementation of the ANA in 2011. Although an improvement in the results of foundation phase mathematics is reported in the ANA of 2014, it was revealed that foundation phase learners were still not performing well in data handling. Spaull (2013) also states that although there has been an improvement in mathematics results since 2011, SA is still the lowest in mathematics performance when compared with other countries.

The mathematics curriculum in the foundation phase is divided into five sections known as content areas (DBE, 2011):

- Numbers, operations and relationships
- Patterns, functions and algebra
- Spaces and shapes
- Measurement
- Data handling.

Given the above content areas, grades 1 and 2 found 'Spaces and shapes' easy during the 2014 assessment, while grade 3 learners found 'Patterns, functions and algebra' easy. However, data handling is not mentioned as a section that learners found easy. Ensor et al. (2008) point out that learners who do not perform well in mathematics are those that have a poor background since they attend under-resourced schools in townships and in rural areas.

Learners have a challenge in following the curriculum in the higher grades because of the learning challenge they acquire in the foundation phase (Spaull, 2013). Early intervention is essential to improve mathematics results not only in the lower grades but also in the higher grades. Few mathematical studies have been conducted in the foundation phase in SA (Machaba & Lenyai, 2014). Dawker and Boyd (2009); Boyd, et al (2014); and Machaba and Lenyai (2014) argue that if mathematical difficulties are not solved early, learners may have a problem with

mathematics for the rest of their lives. Therefore a strong foundation needs to be laid in the early years of schooling.

Many studies have been done in SA but the focus has been on high schools (Fricke, Horak, Meyer & Lingen, 2008); hence this study focuses on the foundation phase. Machaba and Lenyai (2014) maintain that few studies on mathematical issues have been conducted in underprivileged foundation phase schools in SA. Thus this study focuses on exploring foundation phase teachers' use of instructional strategies to teach data handling. By exploring the instructional strategies used to teach data handling in the foundation phase other teachers might benefit and use such strategies in their teaching, and that may improve results in the data handling section. When foundation phase learners were assessed in data handling in the 2014 ANA, it is reported that they displayed a lack of understanding of how to read and interpret data represented. Moreover learners were unable to make comparisons of data. Therefore exploring foundation phase teachers' use of instructional strategies to teach data handling is essential.

2.5 Data handling in the foundation phase

Data handling is a section of mathematics which uses mathematical tools to collect, sort out, represent and interpret mathematical data in order to solve problems, make sense of situations and/or make predictions about the future (Montague-Smith & Price, 2012). Therefore the introduction of this section in the mathematics curriculum was to make sure that every learner or school leaver is statistically literate.

Data handling is a very unique and imperative section of statistics (Makina & Wessels, 2009), and the aim of statistics is to respond to real-world questions (Mvududu & Kanyongo, 2011). Thus statistics, in this case data handling, relates to real-life situation. Nevertheless, learners are not performing well in the data handling section (Ijeh & Onwu, 2013). The DBE (2012) revealed that since the introduction of data handling in the South African mathematics curriculum, performance has not been encouraging.

Therefore during the teaching and learning process, data handling may be presented in real-world problems. This is what Vygotsky (1978) suggested – that learners be given authentic problems to

solve collaboratively. This was further reiterated by Davies (2011), that censuses at school and experiments be used to improve collaborative teaching and learning of statistical thinking. Censuses at school and experiments are all real-life situations that learners are familiar with. In this way teachers would be using real-world examples to teach the abstract concepts of data handling.

Data handling has turned out to be one of the fundamental sections of mathematics at all grade levels in SA, and also an essential part of mathematics curricula for primary and high schools in most countries (Makina & Wessels, 2009). Statistics invades all aspects of modern life (Hand, 2009). In other words, data handling plays a fundamental role in life. Therefore the introduction of data handling in the foundation phase and the low performance in mathematics calls for serious concern about how it is taught to learners (Makina & Wessels, 2009).

The Sciences Research Council in SA conducted research in 1998 under the sponsorship of the International Association for the Evaluation of Educational Achievement (North, 2010). According to this study the South African learners' marks were comparatively low in every mathematics topic. This shows that something needs to be done to help improve the results of mathematics, starting from the foundation phase. Ijeh and Onwu (2013) suggested that teachers need to make sure that learners clearly understand data handling concepts by employing instructional strategies that would enhance learners' achievement. Therefore this study intends to understand how teachers teach data handling in the foundation phase.

2.6 Teaching and learning of data handling internationally

Data handling (statistics) is important and is not taught only in SA: "Statistics is both the science of uncertainty and the technology of extracting information from data" (Hand, 2009, p. 288). Paparistodemou and Meletiou-Mavroutheris (2008) define data handling as the science of learning from data. Data handling plays a vital role in many countries. For effective governance all developed countries have an Office for National Statistics to monitor the changing economy and other issues related to society (Hand, 2009). This means that statistics plays a fundamental

role in the economy of every country. Therefore it is important that data handling is taught in a way that will benefit learners in schools, so that learners will be statistically literate.

There are different teaching strategies that are used when teaching data handling. Basturk (2008), Garfield and Ben-Zvi (2007) emphasised active learning as effective in teaching data handling. Active learning includes working in pairs or working in groups. Garfield and Ben-Zvi (2007) continue to say that groups could also be used as an instructional strategy to work on projects outside of class. Piaget (1977) also argued that the learner is able to grasp what is learnt when there are actions involved. Davies (2011) proposes that censuses at school and experiments with school projects be used to teach data handling, since that is genuine information. He also argued that learners are taught well from genuine information; for example, in the experiments at school the information is produced by learners from work they do in the laboratory or classroom or on the computer. Teaching data handling using the information that learners have generated or are familiar with is effective.

Garfield and Ben-Zvi (2007) refer to a Japanese study where teachers conducted their personal classroom research by investigating some problems in their class and experimented with activities to develop learners' learning. The above study indicates that formal statistical data can be developed from informal data. This implies that by conducting research in class some proper data handling ideas can be developed that can enhance learners' understanding of the topic. Another effective teaching strategy in data handling is the use of technological tools like computers, graphing calculators, software and the internet (Barsturk, 2005; Garfield & Ben-Zvi, 2007; Paparistodemou & Meletiou-Mavrotheris, 2008). According to Aguinis and Branstetter (2007) visual tools are also effective when teaching data handling. There are different effective teaching strategies that may be used when teaching data handling.

2.7 Mathematics teachers in SA

Most teachers in SA are facing challenges, especially primary school teachers. In the study conducted by O'Connor and Geiger (2009) on primary school teachers' challenges in the Western Cape, they found that teachers were frustrated by the workload and large classes. Some teachers share the same class; in other words, they teach two classes in one room. In any

circumstances it is the work of the teachers to make sure that learners understand what is taught. Besides the overcrowding in classes, most of the schools lack the material resources to help the teachers to do their work effectively.

Any teaching needs to take account of the learners for whom it is intended (Morrow, 2007). Teachers are expected to use effective instructional strategies when teaching to ensure that learners understand, especially in primary school where learners are young. Mji and Makgato (2006) and Luneta (2014) argue that instructional strategies have a direct influence on the performance of learners. In other words, the way a teacher teaches will determine the achievement of learners. The teacher who was taught in an unskilled manner will have learnt bad application and is likely to use such in teaching others (Mji & Makgato, 2006).

Data handling or statistics is sometimes taught by teachers who do not have enough training in statistics (North & Zewotir, 2006). This makes it difficult for learners to perform at the expected level. Teachers need to possess the appropriate knowledge of the subject matter in order to teach effectively (Groth, 2007). Some teachers might have taken mathematics at school and also at tertiary institutions, but their experience with statistics might have been limited (Pereira-Mendoza, 2002). This implies that some foundation phase teachers have a challenge in teaching data handling because of little or no professional development in this section.

Nzama (2012) reported that some teachers, when asked questions about the work they teach, could not come up with the answers. This implies that some teachers have a problem with subject content. Spaull (2013) stated that the SACMEQ111 (Southern and Eastern Consortium for Monitoring Educational Quality) (2007) tested grade 6 teachers, and most of them could not answer the questions aimed at their learners. FET teachers were also tested in the study conducted by Bansilal (2015) to determine teachers' competence in mathematics. The study exposed low competency levels of practising FET teachers, who have to teach learners who will be writing the same examination as that used in that study. These findings might be the cause for learners not achieving higher results in mathematics.

If teachers have a challenge mastering mathematical concepts, then they cannot teach what they do not know. Nzama (2012) also pointed out that mastery of mathematics concepts in the lower

grades is of critical importance, because it influences the subject choices that learners make in the FET phase.

Reasoning with data requires different skills from mathematical reasoning (Groth, 2007). Thus having learnt mathematics does not imply that a teacher is in a position to teach data handling, because he or she does not possess the skill of statistical reasoning. This has implications on how learners are taught, and may have an impact on how learners perform in data handling. Pereira-Mendoza (2002) argued that primary school teachers do not have statistical knowledge to teach statistics in primary school. Therefore one cannot expect teachers to have ideas that they have not been taught or to teach what they do not know (Taylor, 2008). Thus content knowledge and effective teaching strategies are a challenge in South African schools (Taylor, 2008; Mji & Madgato, 2006). Most of the teachers who have a challenge with content knowledge are those that serve poor and rural communities (Spaull, 2013).

The ineffective instructional strategies and poor subject knowledge contribute to the low quality of teaching and learning (Hightower, Delgado, Lloyd, Wittenstein, Sellers & Swanson, 2011). Furthermore, Spaull (2013) pointed out that South African schools fail to impart foundational knowledge and skills to learners that they should be acquiring at school. The factors contributing to ineffective teaching and learning are the fundamental training teachers receive, lack of curriculum understanding, insufficient resources, poor infrastructure and overcrowding (Makeleni & Sethusha, 2014). Therefore effective instruction in mathematics requires teachers to develop sound instructional strategies and knowledge of useful sources and activities (Luneta, 2014).

Mathematics teachers need to create an environment where students can relate and interact with each other; this may help establish a sense of community (Boaler, 1999). Teachers have to link resources and questions to the learners' prior knowledge (Baviskar, Hartle & Whitney, 2009). Prior information can be elicited in various ways, and this includes asking easy questions, formal short tests, or giving learners tasks such as concept mapping that require general knowledge to be applied. Good teaching must always be associated with a well-defined learning goal (Ermeling, Hiebert & Gallimore, 2015). Grant (2012) maintained that without specifying learning goals, there is no way to sort out which instructional strategies are better than others. Different learning goals require different instructional strategies.

2.8 The use of different instructional strategies

Instructional strategies or teaching strategies are the styles or approaches that teachers use to deliver information or knowledge to learners. Alternatively, instructional strategies refer to smaller teaching patterns that can be applied across models for a variety of purposes with different content (Rosenshine, 2012). The instructional strategies teachers use during teaching and learning have the potential to influence learners' achievement (Firmender, Gavin & Mc Coach, 2014). Therefore, the instructional strategies used in the classroom have an impact on the learners' understanding of what is taught. These instructional strategies involve engaging learners in appropriate tasks to expand mathematical concepts through the use of classroom communication, technology and relations to prior knowledge (NCTM, 1991).

Young learners should be actively involved in a curriculum that is demanding and deep and that allows them to examine mathematical content (Firmender et al., 2014). Most of these instructional strategies are grounded in the theory of Vygotsky that views the acquiring of knowledge as taking place through social relations. Salako, Eze and Adu (2013) suggest that academic achievement of learners is likely to improve when cooperative instructional strategies are employed. Learner-centred instructional strategies are considered more effective in motivating and encouraging learners to realise their actual potential (Qamar, Almad & Niaz 2015). Those strategies include group discussion. The instructional strategies which need cooperation and interaction assist learners to support each other's learning, and that is of great benefit to learners (Reuy, 2010). Therefore good teaching is characterised by proper instructional strategies (Rahman, Khalil, Jumani, Ajmal, Malik & Sharif, 2011). There is a variety of such strategies, but for the purposes of this research study the researcher will refer to those outlined below as they are also informed by the theoretical framework of this study.

2.8.1 Scaffolding in the classroom

Scaffolding refers to breaking a procedure into parts suitable for the learner, with the aim of supporting learners whilst guiding them towards independent learning (Rosenshine, 2012). Scaffolding involves the notion of learners in need of assistance as they function in the zone of

proximal development (ZPD) until they are independent (Lee & Smagorinsky, 2000; Vygotsky, 1978). Vygotsky (1978, p. 86) define the ZPD as the:

> distance between the actual development level as determined by independent problem solving and the level of potential development as determined by through problem solving under adult guidance or in collaboration with more capable peer.

Scaffolding has been discovered to be an effective instructional strategy (Cole, 2006 and Pawan, 2008) because the learner receives guidance until he/she is able to do certain tasks without assistance. Murphy and Messer (2000) conducted a study of the effects of scaffolding on the performance of learners who were 5–7 years of age. The children either received scaffolding or worked without scaffolding. The findings were that learners who received scaffolding advanced in their level of performance more than those who worked without scaffolding. Therefore the above study maintains the claim that the use of scaffolding is effective.

2.8.2 Think, pair, share strategies

These are the cooperative learning strategies (Sampsel, 2013). The aim of think, pair, share strategies is to increase learner involvement through learners sharing information in non-threatening environments. When the problem is given to learners to be solved, they are given an opportunity to think about that particular problem individually, after that they share that in pairs. The teacher decides on an issue, for example the teacher may give learners a graph with data and learners could answer questions using data on the graph. Learners then discuss ideas in a whole-class sharing session. There are benefits of using think, pair, share strategies in the classroom (Charney, 2008; Barniro, 2015; Ndebele & Maphosa, 2013), which include:

- Providing an opportunity for high-order thinking;
- Reinforcing listening to others and providing an opportunity for immediate feedback and change of thought; and
- Assisting students to increase their assurance in their mathematics capabilities and skills so that they can contribute to class discussions.

2.8.3 *Group work*

Group discussion can be narrowed down to an instructional tool or strategy (Mishra, 2015). Group activities offer important opportunities to learners to construct meaning for themselves during talk, that is not found in the whole-class approach (Mercer & Sams, 2006). This strategy encourages active participation in learners while using language to communicate. By so doing learners better understand data handling concepts and are also to relate them to their environment. Dividing the class into small groups produces many benefits; for example, learners receive individual attention and there is more interaction between learners and teachers (Qamar et al., 2015). According to Vygotsky (1978) language is an important psychological and cultural device. He further argued that social involvement in problem solving constituted an important factor for individual development.

For social constructivists people construct their knowledge based on communication and relations amongst members rather than basing it on individual construction or being dictated to by authorities (Baviskar et al., 2009). Group work promotes collaborative learning. When learners work collaboratively, they share ideas in small groups and discuss a problem, task or other instructional objective whilst teachers are guiding them (Lie, 2008; Williams, 2007). Thus new ideas are shared within groups because of the different background knowledge. Teaching and learning refers to the process where learners construct meanings together through interaction and sharing of ideas as they solve problems (Mishra, 2015).

2.8.4 Using questioning as an instructional strategy

Question and answer instructional strategy is central to learning, which is sense-making during the teaching and learning process (Paul & Elder, 2006). Therefore it seems rational that the type of questions asked and answered, as well as how these questions are asked and answered, will have a significant effect on the quality of learning. Research in SA points out that the most frequently used questioning strategy in classrooms is the IRE (initiation-response-evaluation) strategy (Jina & Brodie, 2008 and Stoffels, 2005). In this strategy teachers pose a question, learners respond, and the teacher evaluates the response. In this way there is interaction between the teacher and the learners in the classroom. However, when using the questioning strategy

learners are also expected to take part in asking questions and evaluation, with the evaluation probably being more than just a simple conclusion of being right or wrong. These strategies are viewed as pertinent in this study because of the understanding that knowledge is constructed and interpretive, depending on the context.

2.9 Issues of social justice and mathematics in SA

Social justice refers to access to opportunities and resources without discriminating against any person within society (Lesser & Pearl, 2008) and Gonzalez, 2009). South African people come from a history where unequal power relations were exercised, and a philosophy of inclusion and exclusion existed (Miles & Brown, 2003). There was a construction of ideas which encouraged unequal relations of power in SA. Kubota and Lin (2009, p.5) refer to that situation of inequality as 'inferiorisation', meaning the "discourse supported by a specific power dynamic that excludes certain radical groups as the inferior other while maintaining the status quo of the self".

The harsh inequalities of the outcomes of education in SA can be noticed along a number of related dimensions, including affluence, school setting, language and environment (Spaull, 2013). Spaull (2013) further argues that learners who speak the language of instruction and those who have parents with grade 12 qualifications perform well at school. By engaging learners in authentic problem-solving enquiry tasks, learners from an early age would be in a position to realise such social problems and the need not to repeat them for future generations. Therefore social exclusion in terms of mathematics is a social issue.

Children have a right to education, in this case mathematics, since it is needed by learners and adults as members of society (Atweh & Brady, 2009). This idea is supported by Gonzalez (2009) when he argues that all learners deserve a strong foundation in mathematics. Teachers need to understand how learners' culture and context influence their lives and learning (Bartell, 2011). If teachers understand their learners' culture and social context, they will be able to use instructional strategies that will help learners comprehend what they are taught (in this case mathematics).

Furthermore, according to Hoadley (2012 mathematical knowledge is not the same in different social contexts. This implies that some learners have a strong foundation in mathematics while others do not, with resultant low performance in mathematics. In the context of this study it is argued that this is a social concern which has to be addressed, and one way of addressing it is exploring teachers' instructional strategies when teaching mathematical aspects like data handling.

When learners' performance is analysed, it is reflected that learners in former White schools have higher marks whereas those from African schools have lower scores (Siyepu, 2013). What leads to South African learners performing poorly includes lack of appropriate learner support materials and poor subject knowledge of the teachers (Ndlovu, 2011; Van der Walt, Maree & Ellis, 2008). Mji and Makgato (2006) assert that overcrowding in the classroom as well as lack of resources contributes to low achievement. The issue of overcrowding and lack of resources is evident in rural and township schools (Mampane & Bouwer, 2011; Sedibe, 2011; Murtin, 2013).

In addition, learner performance at school is influenced by household characteristics (socio-economic status, level of education of parents, health) as well as personal, community and school level variables (Kainuwa & Yusuf, 2013). School level performance in SA has been influenced by school level and community level inputs; more advantaged schools provide inputs that include better-skilled teachers, support programmes, strong parent-teacher bodies and community support (Lam, et al., 2011). These inputs in turn have been fundamentally affected by historical legacies such as the dual education system (Sartorius & Sartorius, 2013), which sees government schools in many townships continue to underperform compared to the more advantaged models that were originally developed for White learners only (Van der Berg, 2007).

Timaeus, et al. (2012) conducted a study on inequalities in school attainment in SA, which showed that poor African learners remain disadvantaged because of the continuing low performance of former African schools. The way in which teachers teach within different social contexts has an effect on the way that learners perform in mathematics (Hoadley, 2012). Thus the quality of education or mathematical knowledge is not the same for all learners, since the quality of rural teachers' work is sometimes poor (Mulkeen, 2006). According to Mulkeen (2006) the reason for poor quality of work is that in some cases rural teachers have difficulty in accessing books and other learning materials. Therefore poor quality of work by rural teachers

implies that rural learners receive poor quality of education. Social inequality in SA is reinforced by the poor performance in schools, and this leads to the situation where learners inherit the social status of their parents (Spaull, 2013, Timaeus et al., 2012). In this way learners in different social contexts do not receive the same quality of mathematics instruction, and this is a social justice issue.

2.10 The implications of literature reviewed

The above information suggests that there are diverse styles of instructional strategies that teachers use when they deliver information to learners. Some teachers "mainly lecture, while others spend their time on demonstrations or activities, some focus on principles and others on applications, some emphasise theory and others understanding" (Felder & Brent, 2005, p. 57). It is important to consider the understanding of learners when teaching, and that is why this study seeks to explore instructional strategies used by foundation phase teachers.

Naidoo (2011) explored the use of visual instruments in mathematics classrooms, but her focus was on the FET phase. Her argument was that the use of visuals enhances learners' understanding, and she (2012) further highlighted that the use of visualisation within mathematics classrooms could be explored.

As indicated in the previous section, there are different types of instructional strategies and teachers use different strategies in different subjects. Khourey-Bowers (2011) mentions 10 different strategies that help learners to understand what they learn better. Some of those strategies are having children collect data for an extended period, using discrepant events to awaken curiosity, using unique examples to explore concepts, and 'saying it with flowers' (Khourey-Bowers 2011, p. 41). The latter refers to visual strategies as part of teaching strategies, in other words tools that can be seen and are interesting to the learners.

Machaba (2013) conducted research in the foundation phase, and her focus was the strategies teachers use to teach basic mathematics computation. Her study emanated from realising that grade 3 learners are not performing well in mathematics computation. Makeleni and Sethusha (2014) also conducted a study in the foundation phase, but focused on teachers' experiences

concerning implementing the curriculum in rural schools and how their understanding influences the curriculum.

Research conducted by Luneta (2014) focused on foundation phase first-year students, and was about student teachers' conceptual understanding of shapes. The Van Hiele level of geometric thought model was employed as a lens to determine and understand students' comprehension of geometry. Van Laren and Goba (2015) conducted a study focusing on Postgraduate Certificate in Education (PGCE) pre-service teachers who had completed the foundation phase numeracy education module in IsiZulu.

Although these studies mentioned above were conducted in the foundation phase, they did not focus on teachers' use of instructional strategies when teaching data handling. Ijeh and Onwu (2013) conducted a study on instructional skills which competent teachers use to teach statistics. This study was not done in the foundation phase since it focused on the performance of learners in the Senior Certificate examination. This research revealed that learners are not performing well in data handling in the Senior Certificate examinations because of teachers who have limited pedagogic content knowledge in statistics.

Konrad (2014) explored how the productive pedagogy framework can be considered a potential supportive mechanism for foundation phase third-year student teachers. This study focused on how student teachers deal pedagogically with issues of learner diversity in foundation phase classrooms.

Marais and Meier (2010) focused on disturbing behaviour in the foundation phase of schooling. This study identified which types of behaviour cause disruption which occurs most often in the foundation phase, with the aim of providing strategies for the teachers to manage this kind of behaviour.

Imenda (2012) investigated ways in which foundation phase teachers in Empangeni (KwaZulu-Natal) promoted indoor and outdoor play for their learners. This study examined the play activities that foundation phase teachers valued the most and the educational benefits the teachers associated with these play activities.

Another study conducted by Mudzielwana (2014) focused on teachers' perceptions of foundation phase learners' low reading performance. This research study was carried out in four schools in Limpopo province.

The above are some of the research studies that the researcher has come across, but none focused on the instructional strategies used to teach data handling in the foundation phase. Although some of the above studies focused on the foundation phase, they did not explore instructional strategies which teachers use when teaching data handling.

2.11 Conclusion

In conclusion, this study seeks to explore the instructional strategies used by foundation phase teachers when teaching data handling. The findings of this study may be of benefit to curriculum developers and foundation phase mathematics teachers. This in turn may help learners to perform well in data handling, and since data handling is part of mathematics it may also improve mathematics results. If the results are improved, then that may lead to an improvement in the economic growth of the country, because learners would be able to access higher-paying and more lucrative career paths. Based on the literature that was reviewed in this chapter, it is evident that research on instructional strategies used to teach data handling is limited.

The focus of Chapter Three is on the theoretical framework of this study.

Chapter Three

Theoretical Framework

3.1 Prelude

This study explored foundation phase teachers' use of instructional strategies to teach data handling. A review of literature informing the study was introduced and discussed in the previous chapter. The intention of this chapter is to ascertain the theoretical framework that guides this study. The theory that is described in this chapter will be used to inform the methodology and data analysis. In this chapter social constructivism is discussed as the framework for this study. The concept of scaffolding as discussed by Anghileri (2006) is also used to frame this study.

3.2 Social constructivism

Within the classroom context, when talking about the use of instructional strategies to teach data handling, social constructivism based on Vygotsky's (1978) theory is applicable. Vygotsky's theory claims that knowledge construction is socially oriented (Weinberger, Ertl, Fischer & Mandl, 2005), meaning that knowledge is produced when the learner interacts with the social environment. For social constructivists knowledge construction is consistent with a social activity (Ndlovu, 2013).

It is imperative that learners receive guidance and direction to discuss their views with each other and also with the teacher (Von Glasersfeld, 1995). Von Glasersfeld (1995) emphasised that talking about what one is doing is a confirmation that one is exploring what one is doing. During observations at the participating schools some of the teachers were encouraging learners to talk in class, for example discussing in small groups and reporting back to the whole class. Therefore the participants observed did use different instructional strategies to teach data handling in the foundation phase.

3.2.1 Vygotsky's theory of social constructivism

Vygotsky (1978) argued that learners are social people who grow and learn through their contacts with teachers and parents. The social environment in which learners acquire data handling will influence their progress. The major implication of Vygotsky's theory is that learners require opportunities to learn with the teacher and their peers (Turuk, 2008). This theory supports the notion that foundation phase teachers need to use instructional strategies that enhance learners' understanding of data handling. Moreover, Vygotsky (1978) maintained that the social and cultural context strongly influences the way that learners learn.

3.2.2 The role of language in the social construction of knowledge

Language plays an important role in the social construction of knowledge (Vygotsky, 1978). Vygotsky was of the opinion that speech is not only for communication but is for the purpose of directing active learning. Mercer and Sams (2006) argued that language is an essential instrument that learners use for communication in mathematics. To promote communication in the classroom, teachers need to use group discussion and pair enquiry as instructional strategies. Expanding on the above, language is an important tool for interacting in the classroom for understanding, irrespective of the subject that is taught. In the primary schools where the researcher observed data handling lessons, teachers were using the learners' vernacular language when teaching. During the process of teaching and learning learners had to construct knowledge and interact with the teacher and other peers using their home language. The reason for teaching in the vernacular language is that learners think in their language of instruction (Barnett-Clarke & Ramirez, 2004 and McLeman, 2012).

3.2.3 Social interaction and collaborative opportunities for learning

Given that the intention of this study was to explore foundation phase teachers' use of instructional strategies to teach data handling, the central concerns of the researcher are to understand which instructional strategies foundation phase teachers use when teaching data handling, how foundation phase teachers use instructional strategies when teaching data

handling, and why foundation phase teachers use instructional strategies in the way that they do. Thus, while this study is basically interpretive in its purpose, it attempts to understand the way teachers convey information to learners, and therefore social constructivism is used to frame this study. Therefore teachers in the foundation phase need to provide learners with opportunities that assist in discovering new concepts that would help learners to understand data handling.

Stevens, et al. (1991) suggested that creating an opportunity for cooperative learning not only increases learners' achievements but also improves the learners' self-concept and social skills. Research shows that learners who are in cooperative learning groups attain more than those in traditional groups (Felder & Brent, 2007; Wichadee & Orawiwatnakul, 2012). When learners interact and engage in instructional conversations with other learners and teachers about their learning activities, they construct knowledge collaboratively from a particular activity (Perez, 2004).

Since learners require expansion of their own understanding of what is being taught, the central goal of the social constructivist teachers should be to encourage critical thinking in learners. This could be done by establishing that the learners take responsibility for their own learning through interactive activities. Since people have diverse ideas of situations, to reach a common meaning they need to be involved in an argument or discussion concerning those ideas (Jaworski, 1996). It is important that the teacher makes sure that learners have understood; to have that assurance the learner should answer in a way that is well-matched with the teacher's understanding, rather than being able to repeat what the textbook says.

The work of Vygotsky has shaped the basis of social constructivism in the setting of education (Jones & Brader-Araje, 2002). Social constructivist practices are generally applied in schools through the use of interactive instructional strategies such as group work and questions and answers. These instructional strategies emphasise having learners work collaboratively while sharing views and questioning each other's points of view (Zach & Agosto, 2009; Jones & Brader-Araje, 2002). From a social constructivist viewpoint based on Vygotsky's (1978) theory, interaction is considered the most important source of the cognitive constructions raised by people in order to understand the world (Lyle, 2008; Woo & Reeves, 2007).

Ernest (1991, p 42) argued that "social constructivism views mathematics as social construction". This implies that for learners to construct knowledge from problems in data handling, they have to engage themselves in social discussions. Learners construct knowledge when they work together to solve problems (Innes, 2006). This implies that the social constructivist approach is learner-centred and that knowledge can be gained through active involvement of the learner. By implication, this means that the learner needs to take ownership of his/her knowledge acquisition (Von Glasersfeld, 1995 and Ernest, 1991).

Social constructivism suggests a number of things (Ernest, 1991), and one of them is how social contact expands the mind of the learner, and its input to the learners' understanding and classroom activities. This suggests that social interaction plays a significant part in the development of the mind of the learner. Radford (2008) suggested that learning may take place as a result of the active and discursive interaction between the learner and the teacher, whilst both the teacher and the learners collaboratively solve problems. Thus when learners are actively engaged with peers and the teacher, concepts are formed in the learner's mind. Additionally, the instructional strategies which promote critical thinking and which are learner-centred are employed to motivate learners to be more responsible in the learning process.

Moreover, studies have revealed that learners who work together in groups have a tendency to achieve better or at a higher level than learners who work individually (Webb, 2009; Ndlovu, 2011). This explains the implication of social participation during the learning progression of a learner. Based on the above argument one can conclude that the teacher has to plan the type of learning process considering the learning goal. It is essential therefore that mathematics work is structured by the teacher in a way that gives learners an opportunity to interact in order to improve in learning, particularly in data handling.

Social constructivists are of the idea that truth is constructed during a person's action (Kim, 2010). For the social constructivist truth cannot be revealed; it is nonexistent prior to its social discovery. People construct meaning during their contacts as they communicate and work together in the setting where they live (Kukla, 2000). For social constructivists learning is a social practice. Significant learning takes place when people are involved in social actions. Social constructivists are of the view that the environments that learners take to their learning milieu are vital (Kim, 2010). For example, in the data handling classroom setting learners are

from different contexts. The main focal point of social constructivism is to expose the ways in which people engage themselves in the construction of their social truth. Social constructivism suggests that the best learning milieu is one where there is a lively interaction among teachers, learners and activities. This learning environment gives learners the opportunity to construct their own reality due to the contact with other people and the surroundings.

Social constructivist theory has its basis in detailed assumptions about reality, knowledge and learning. Social constructivists suggest that knowledge is invented by humans, and is collectively and culturally constructed (Gredler, 1997; Swan, 2005; Gergen, 2011). As people interact, they create meaning. Reuy (2010) argued that for the theory of social constructivism information is socially located and created through manifestation on one's views and what people experience, as well as other learners' thoughts. Thus knowledge is constructed through the learners' experiences with the assistance of other learners.

In a social constructivist learning milieu there is an expectation of learners' involvement in learning, for example discussion, argument, and exchanging of ideas and collaboratively solving some problems. Teachers plan and make available the learning context and assist in learning activities (Richards, 2005). During data handling lessons the teachers need to provide learners with the opportunity to engage themselves in problem solving as a group. By so doing learners may be able to assist and support each other if some members of the group have a problem with data handling concepts.

Vygotsky (1978) pointed out that learning does not occur in cognitive remoteness, but takes place in the context of actions and social contacts being informed by cultural environments. In social constructivism learning occurs better in a socially active milieu formed by the teacher as well as learners (Lauzon, 1999; Duschl & Hamilton, 1998). In that social scenario more knowledgeable others will influence proficient learning in the learners' immediate setting. Among the more knowledgeable others, the teacher or other learners in the learning environment are included. In addition, the level of participation by learners and of becoming engaged will be different since learners have different capabilities and backgrounds (Stears, 2009). Therefore foundation phase teachers need to take into consideration the learners' abilities when employing the instructional strategies to accommodate all learners in the classroom. For example; they can use different instructional strategies in one lesson so that even those learners who are slow to

grasp may benefit. The involvement of learners encourages improved attention to the subject matter and likewise improves learning.

Social constructivism is consistent with the social contacts of learners in the classroom being involved in critical reasoning (Powell & Kalina, 2006), and teachers being involved to provide guidance. By implication this means that learners are responsible for the construction of meaning and information, and teachers are learning facilitators not instructors (Adams, 2006). This theory (social constructivism) values the probe or the question and answer instructional strategy (Powell & Kalina, 2006). Nonetheless the question and answer approach is another type of instructional strategy where there is interaction between the teacher and the learners. This is what happens when a teacher is teaching data handling in the classroom, a question is posed and learners gather data and analyse the information in order to answer the question. Therefore, based on the above explanation, that is a social constructivist setting.

From a social constructivist viewpoint, "the guidance provided by a teacher should enable a learner(s) to link whatever knowledge and skills they are expected to acquire to their existing schema" (McCown & Biehler, 2009, p. 240). Powell and Kalina (2009) suggested that social constructivism is an effective instructional strategy that every learner can gain from, since cooperation and social interaction are incorporated.

A social constructivist teacher is required to be capable of planning the social environment of the classroom such that learners argue, reflect (Naidoo, 2011) and engage in data handling activities. Foundation phase teachers need to know how learners think about the particular data handling topics they teach, and to strive to recognise their learners' thinking at a deeper level (Mvududu, 2005). Thus, if teachers have studied how learners think about a particular subject matter, they would be able to choose the instructional strategies that would help learners understand without any difficulty.

According to Jegede and Aikenhead (1999) social constructivism stresses that all learning is influenced by culture and occurs in the social environment, and that previous knowledge is of importance in accomplishing production of knowledge in a new setting. For social constructivist teachers it is imperative to consider the environment and cultural background of the learner during the learning progression (Govender, 2009). The reality is that in South African

classrooms learners have diverse cultural backgrounds and teachers will have to identify these differences and understand the learners' views of the truth, and accept that various truths exist. In a few participating schools the classrooms had learners from different cultural environments. Therefore the participants needed to take cultural diversity into consideration when teaching.

A study of whether teaching using social interaction was effective was conducted by Gaile (1991) on two groups of kindergarten learners. One group was given activities to discuss and to organise different viewpoints relating to how to spell words. The second group was engaged in the same activities as the first group, but working individually with the teacher showing the correct spellings. The results revealed that children who were involved in social interaction benefitted a lot compared to those who were doing their work as individuals with teacher modelling. Therefore social contact is of benefit to learners during the learning process – even to those at kindergarten level. According to Callison and Preddy (2006), since there is collaboration, argument, sharing and genuine learning in the social constructivist method, it is not easy to forget what is learnt. Moreover, what is learnt using the social constructivist method is transferred to the real-life situation (Ultanir, 2012). Therefore, social constructivism is relevant to this study.

Vygotsky (1962, 1978) was of the opinion that learners are active meaning makers achieving learning through collaborative interaction and operation as teachers assist and guide them to construct their own knowledge (Pappas, 2008). Bruner (1978) described the teacher's role as *scaffolding*, Halliday (1975) referred to it as *tracking*, Vygotsky (1978) talked about working in the learner's *zone of proximal development* and Clay (1985) suggested the importance of *sensitive observation* accompanying each stage of teaching. These researchers used different concepts, suggesting that teachers use temporary support to enable the learner to work beyond what the learner could do independently. By so doing the learner moves from one level of knowledge to another.

Two main concepts constitute social constructivist theory: the zone of proximal development and scaffolding (Turuk, 2008 and Thompson, 2013).

3.3 The zone of proximal development

Vygotsky (1978) came up with the concept of the zone of proximal development (ZPD). The ZPD "defines those functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but currently in an embryonic state" (Vygotsky, 1978, p. 89). Therefore, Vygotsky (1978) is of the view that what a child can currently do with the support, she will be capable to do by herself in the future. Actually learning very frequently starts at the point where the learner is unable to progress on his/her own and needs the dynamic intervention of the teacher (Radford, 2008). The teacher then helps and guides the learner in his/her ZPD to understand the work or concepts and also be in a position to do her work independently. This guidance and assistance offered is also called scaffolding (Vygotsky, 1978).

In scaffolding teaching, a more well-informed person provides assistance to facilitate learners' progress (Van der Stuyf, 2002). Scaffolds may also refer to different teaching strategies. Scaffolds may refer to models, clues, incomplete solutions and direct teaching (Van der Stuyf, 2002). Additionally, scaffolds may be used in data handling research projects, where learners have to gather, analyse, summarise and come to a conclusion based on data collected. This research work is part of what is taught in data handling lessons.

The constant interaction between an individual and other people is referred to by Vygotsky (1978) as the ZPD. Vygotsky emphasised the significance of the ZPD because it gives an idea of the potential capacity of the intellect of a person rather than the achievement of a person. In the ZPD learners actively carry out actions that would be ahead of their rank of capability when performing alone (Nelson, 2002). To assist children to achieve higher levels of thoughts and eloquence, the more knowledgeable elder can give explanations, show and work together with children to make possible new learning (Siyepu, 2013). The more competent and knowledgeable grown-up could be the teacher. The teacher may use examples or manipulatives that the learners are familiar with when teaching data handling (for example, containers of juice or milk with measurements). This is in line with what the CAPS (DBE, 2011) states, in that examples used when teaching learners should come from their own surroundings.

Vygotsky (1978) was of the belief that teachers need to supply learners with problems and teaching that give opportunities to work out problems, given that this may lead to a higher rank

of thought and learning. This by implication means that critical reasoning needs to be promoted by the teachers during their data handling lessons. In the ZPD learners are at first independently capable of using some skills when solving problems, and that Vygotsky (1978, p.86) calls the "actual developmental level"; this is implicitly the same as the prior knowledge of the learners, whilst also at this stage they are not capable of using other skills without being assisted. The significance of a ZPD for Vygotsky is that it indicates a gap in potential or understanding, then having identified the gap the teacher may be able to assist learners so that they will enhance their skills and knowledge. Having received assistance, the learners may be able to carry out the tasks independently. Then, from the above description of the teacher's liability, one can define teaching as the support of an individual by a teacher or a more competent other through the ZPD (Tharp & Gallimore, 1988).

Roosevelt (2008) maintained that the main objective of education from Vygotsky's view is to maintain the learners in their ZPDs as frequently as possible, by providing them with problem-solving activities that are a little bit more difficult than what learners can do alone. The aim is that after completing the task collaboratively with other peers, the learner may be able to finish a similar task alone next time. For that particular task the learner's ZPD would be raised. Figure 1 (Campbell, 2008, p. 3) illustrates this concept.

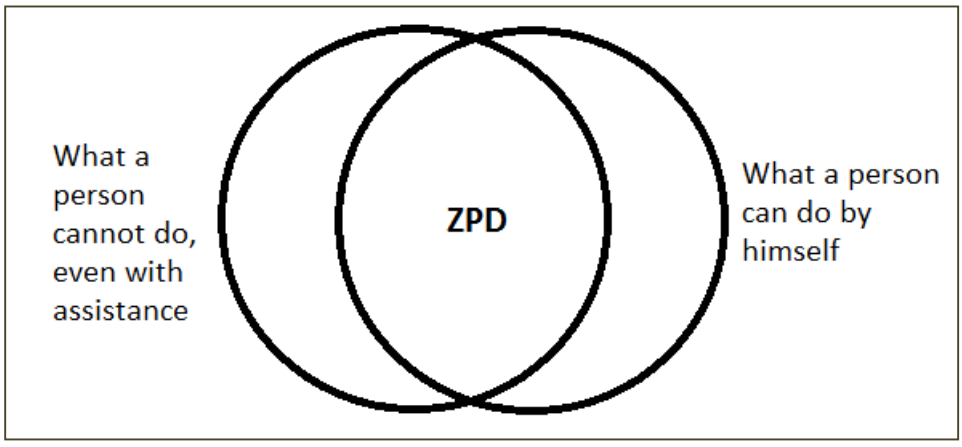


Figure 1: The ZPD, adapted from Campbell (2008, p. 3).

When the learner completes the task, the gap between what the learner can do on her own and what she can do with the assistance becomes narrower. This narrowing of the ZPD is illustrated in Figure 2.

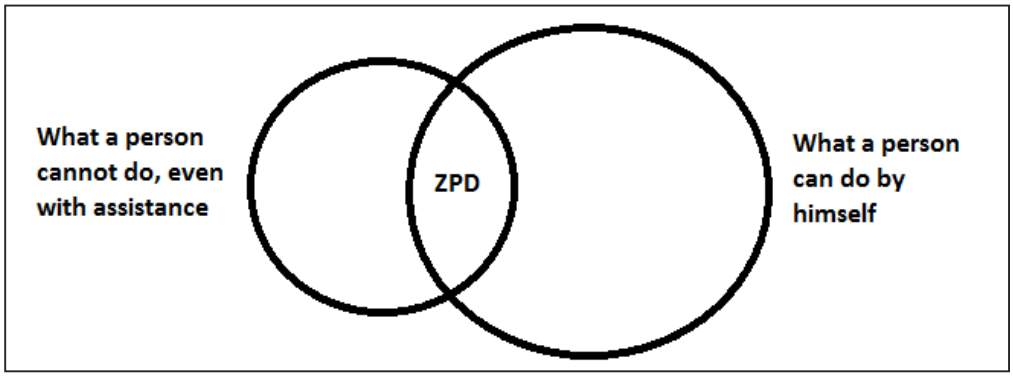


Figure 2: The ZPD after teaching has taken place, adapted from Campbell (2008, p. 3).

If the districts of the schools provide curriculum material resources which comprise constructivist tasks, teachers might feel it appropriate to incorporate these in their teaching (Beck, Czerniak & Lumpe, 2000). Thus, if the resource materials are designed well for carrying out the curriculum, those materials may support teachers to have the courage to employ social constructivism when teaching. In most of the participating schools teachers were giving learners Department of Education workbooks to use when giving them class activities. This made it easier for learners to read instructions for themselves. This study is also framed on the metaphorical concept of scaffolding as it was mentioned in the introduction section.

3.4 Scaffolding the instruction

Historically the concept of 'scaffolding' stemmed from scaffolds or the boards which builders stand on when building (Naidoo, 2011). Thus the concept scaffolding is used metaphorically in education. Wood, et al. (1976) came up with the term. Scaffolding refers to the support provided by a more competent person during interactions (Sherin, et al., 2004). Scaffolding can be defined

as the instructional strategy of guiding and supporting learners at the proper time, at the proper level of complexity, and in a proper manner to meet the needs of an individual (Pritchard, 2007, p. 6).

Scaffolding instruction is another alternative to the traditional style of educational teaching. Increasing numbers of teachers and researchers have employed the scaffolding concept as a metaphor to depict and describe the responsibility of teachers in supporting learners' learning during teaching and learning (Verenikina & Chinnappan, 2006). Scaffolding refers to the smallest support that the learners receive to do the particular activities. It also refers to the assistance that the learner is provided with to accomplish the given activity on their own (Bruner, 1986). Cumming-Potvin (2007) stated that researchers developed the concept of scaffolding from the theory of social constructivism to explain how grown-ups guide learners by offering assistance.

Categorising two developmental levels to explain the learners' learning and abilities, Vygotsky (1978) explained the metaphor of scaffolding during his seminal work. The first developmental level specifies a child's level of intellectual operation on an independent task; the second level measures the learner's achievements with the assistance of others. Vygotsky argued that the ZPD is the difference between the learner's independent and prospective levels of functioning, the last being triggered by scaffolding. Scaffolding and the idea of the ZPD are completely consistent with the framework of Vygotsky's (1978) social constructivism theory (Nordlof, 2014).

Scaffolding may take place in different scenarios, and that includes research projects, giving clues and hints whilst learners are solving a problem, giving an example, an unprompted question as learners are continuing with an activity, categorising a problem into small steps, demonstrating, feedback, using probes by asking questions, and whatever promotes learners' growth and independence (Slavin, 1997; Pritchard, 2007; Snowman, McCown & Biehler, 2009; Naidoo, 2011). Foundation phase teachers are expected to provide scaffolds when teaching data handling. This may be done by asking questions when introducing the data handling concepts and also while learners are working in groups.

Scaffolds are therefore viewed as techniques which help learners to reach an advanced level of understanding by promoting diverse and creative reasoning (Brush & Saye, 2001; McCosker &

Diezmann, 2009). In a number of situations the exchange of ideas among learners contributes to their experiences and they scaffold each other's opinions; occasionally the ideas of learners are questioned by the teacher. It is in this manner that learners are assisted to think at an advanced level. It would not be possible to reach this advanced level of thought if learners worked without such assistance. Based on the above, it could be concluded that scaffolding methods provide learners with assistance and guidance to be able to do tasks that they would not be able to without the assistance.

When using tools teachers find it easy to supply their learners with strategies that are essential for learning. With reference to data handling lessons, those strategies could include the use of visual tools, demonstrations and graphs. Jacobs (2001) stated that once learners are capable of doing more work without assistance, the teacher should slowly withdraw the support.

The process of scaffolding instruction is fundamental to the notion of the ZPD. As construction workers use scaffolds to maintain their building labours, teachers can likewise use scaffolds to assist learners to develop towards their higher limit of the ZPD and accomplish the required objective (Naidoo, 2011). Moreover, Pritchard (2007) suggested that in preparation of the activities for learners a teacher needs to consider the present situation of the learners in question, and plan properly in view of that. Pritchard pointed out that in normal circumstances this could imply preparing for individuals, but in reality this is not naturally achievable because the majority of schools have large class sizes. This circumstance was witnessed in the participating schools, because most of them had large class sizes and as a result teachers could not plan according to individual differences.

The concept of scaffolding is very suitable for teaching and learning progression (Donald, Lazarus & Lolwana, 2010). Metaphorically, this is what takes place when teachers scaffold key information structures and instructional strategies for their learners.

Mayaba (2008, p. 92) suggested that there are four types of scaffolding:

- Precise modelling. Foundation phase teachers need to supply concrete examples by doing whilst clarifying concepts step by step. In addition, the teacher can use material objects when describing data handling concepts.

- Direct explanation and re-explanation might be of benefit to the learners who are struggling to grasp some data handling concepts.
- Invitations to contribute to a discussion – for example, foundation phase teachers can encourage learners to participate actively in a discussion, perhaps in a group or in a class discussion.
- Verifying and clarifying whether the learner understands. Foundation phase teachers need to make sure that learners' work is well done; if it isn't then the teacher needs to clarify.

The above types of scaffolding are some of the instructional strategies which foundation phase teachers may use to teach data handling.

3.4.1 Scaffolding in the learning of data handling

The foundation phase teachers in this study employed different instructional strategies to teach data handling. Based on the lesson observations and the interviews with teachers, the results showed that as teachers use different instructional strategies they also included scaffolding strategies to guide their learners' progress in data handling.

3.4.2 The different levels of scaffolding

The three levels of scaffolding were introduced by Anghileri (2006), and constitute a variety of useful instructional strategies that may be obvious in the classroom. These instructional strategies are discussed in more detail in the subsections that follow.

3.4.2.1 Level 1: Exploring the learning environment

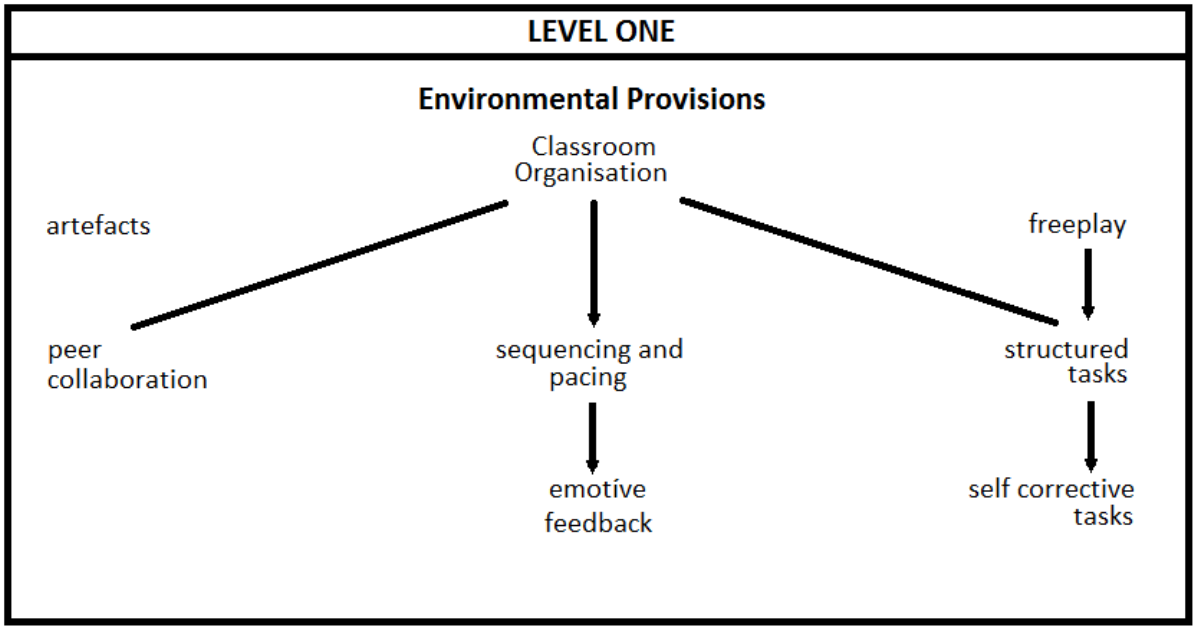


Figure 3: Instructional strategies for scaffolding in the classroom at level 1 (adapted from Anghileri, 2006, p. 39).

Level 1 includes environment stipulation. Prior to teaching learners, teachers scaffold the instruction by the surroundings and impressions they create in the classroom. Environmental requirements include the preparation and encouragement presented in the classroom situation (Siemon & Virgona, 2003 and Naidoo, 2011). Level 1 scaffolding speaks about the style, relating to the way the teacher arranges his/her mathematics classroom. The arrangement may include colourful charts and pictures displayed on the walls. The reflective teacher uses displays in his/her classroom, to encourage active learning (Preen, 2007). This was observed in all the participating schools, although the teachers did not refer to the wall displays when teaching data handling.

Moreover, the teacher may also arrange learners to sit according to their level of capabilities in groups to encourage peer collaboration. This is what the social constructivist approach also encourages. To encourage peer cooperation learners might be given an opportunity to work on engaging data handling tasks, which also encourages critical thinking. This cooperation, when joint with efficient progression and timing, is of assistance in the teaching and learning of data

handling. Progression and timing relate to the way in which the teacher progresses from one notion to the subsequent one during the data handling lesson. Basically the teacher times instruction to make the utmost use of teaching time.

In addition, the teacher needs to encourage emotive feedback (Naidoo, 2011). Emotive feedback includes the support and reinforcement the teacher gives to learners while they are actively involved in activities. Constructive and motivating responses create a suitable environment for successful teaching and learning. Different types of prearranged activities also positively influence the classroom environment. Prearranged activities could refer to worksheets or classroom tasks. While doing these tasks the learner is given guidance and the teacher's assistance through the lesson or the tasks. During environmental manipulation the participants formed an appealing and encouraging atmosphere inside the classroom. For example, as learners were working in groups the teachers gave them different activities to do, and also gave them assistance when they needed it.

3.4.2.2 Level 2: Exploring the teacher-learner interaction

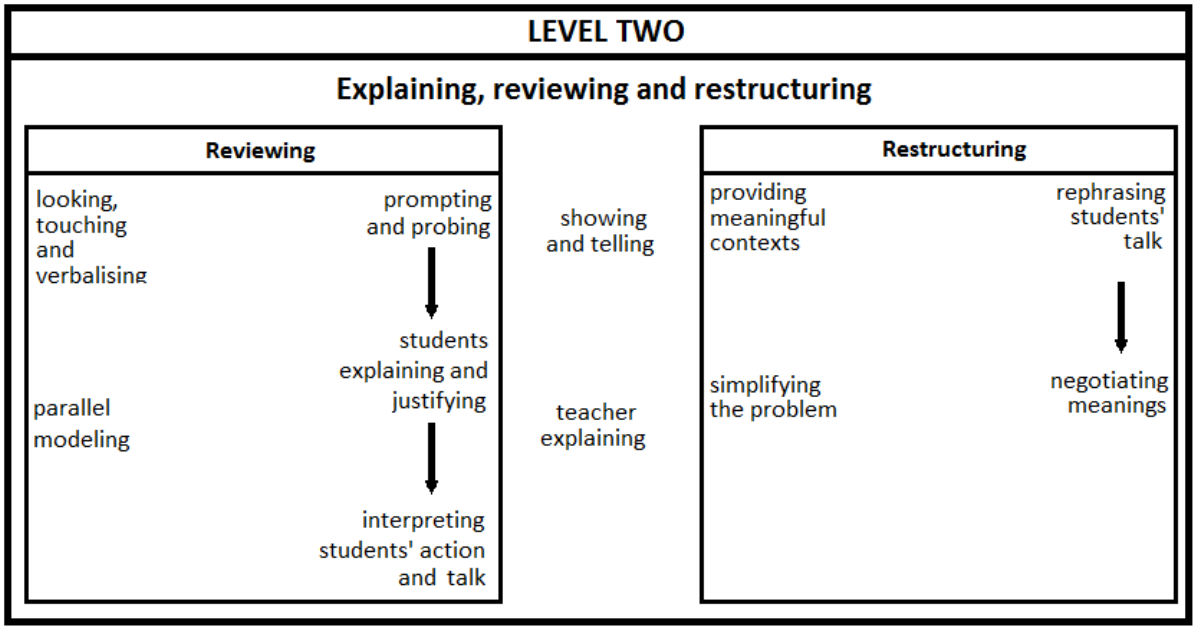


Figure 4: Instructional strategies for scaffolding in the classroom at level 2 (adapted from Anghileri, 2006, p. 39).

Interaction between teachers and learners is necessary and cooperation is a necessity among all members in the learning .environment. Level 2 scaffolding incorporates various levels of contact between the teacher and the learner. This kind of contact depends on teachers' reviewing and reorganising what is experienced in the classroom.

Throughout the period of reviewing, learners have to be motivated to communicate what they notice and think. There is a need for learners to be encouraged to explain and confirm their performance and remarks. Through understanding learners' remarks, planning and asking enquiring questions, teachers may recognise if the learner has misunderstood some of the data handling concepts. This may lead to equivalent modelling, whereby the teacher plans and solves problems in collaboration with the learners and also solves the problems related to the learners' identified problem based on their misconceptions.

In the restructuring of tasks the teacher rephrases the learners' remarks, seeking to negotiate meanings and create more understanding. Important contexts are formed to make abstract situations more accessible to the learners. All participants in the study incorporated level 2 scaffolding to different levels. The interactions between the participants and learners were based on particular tasks. Rather than convincing learners to be engaged in data handling tasks individually, the teachers recognised and discussed different methods for solving problems and motivated their learners to interact and communicate in the classroom. The participants used probes by questioning learners, and in that way they were encouraging learners to present their significant explanations (McCosker & Diezmann, 2009 and Naidoo, 2011). The above mentioned strategies have the features of level 2 scaffolding.

Brown, et al., (1989) asserted that learning using real-life situations can be seen from social constructivism's view; this can take place when learners are involved in practical activities within their real life and with reference to their cultural background related to the real environment. Scaffolding is not limited to contact among people – artefacts, material resources, and social context are also employed as scaffolds (Puntambekar & Hubscher, 2005; Naidoo, 2011). The concept of scaffolding is related to Vygotsky's (1978) work; he pointed out that learning first takes place at the social stage and emphasised that social interaction plays a significant role in cognitive growth. Scaffolding instruction incorporates planning and arranging

concrete and social constructions for interaction, giving problems to be solved and providing assistance and developing critical reasoning (Anghileri, 2006).

Thus, whilst the teachers were facilitating teaching and learning progression as occurs in traditional approaches, they also engaged their learners in the argument. They reviewed and restructured activities taking into consideration their learners' requirements. Demonstration, support and interactive sense making (Siemon & Virgona, 2003) were ensured. This by implication means that teachers used both traditional and social constructivist instructional strategies when teaching data handling.

3.4.2.3 Level 3: Using representational tools

Level 3

Developing conceptual reasoning

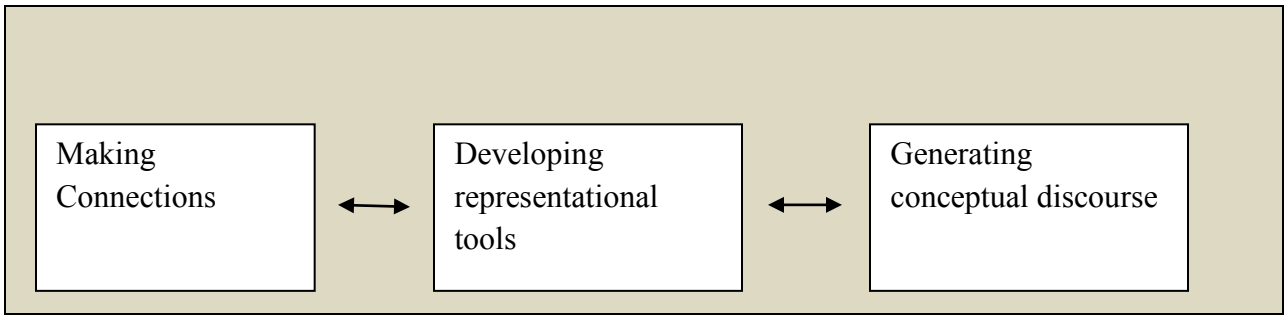


Figure 5: Instructional strategies for scaffolding in the classroom at level 3 (adapted from Anghileri, 2006, p. 39).

In level 3 scaffolding the use of symbolic tools is emphasised so that conceptual arguments will be produced within the learner (Verenikina & Chinnappan, 2006). The participants employed scaffolding to formulate connections between the learners' prior knowledge and the information that needed to be incorporated.

The teachers used concrete materials to make abstract data handling concepts more understandable to learners. The participants' concrete materials included graphs, coloured chalk, bottles to demonstrate measurement and diagrams. Thus, although scaffolding has turned out to be valuable to teachers (Holton & Clarke, 2006), the intention of scaffolding is to ensure that learners have a teacher to assist them in their learning process. This means that when learners have observed and heard the teacher demonstrating a particular data handling concept, learners are then expected to carry out the task without the assistance. Therefore, when the 'building' is complete, the scaffolding is taken away (Frederick, et al., 2014).

Therefore there is a link between social constructivism and scaffolding, because for social constructivists knowledge is socially constructed. Since scaffolding is the assistance offered by the teacher to learners while they are working collaboratively, scaffolding therefore works hand in hand with social constructivism. Knowledge is constructed while there is interaction between learners and the teacher. The teacher supports and guides learners during the learning process, and that is referred to as scaffolding. Scaffolding is also one of the instructional strategies that teachers may use to teach data handling. Thus social constructivism is an appropriate framework for the study since it focuses on foundation phase teachers' use of instructional strategies to teach data handling. Moreover scaffolding is also relevant to this study since the notion of scaffolding instruction is related to Vygotsky's theory of social constructivism (Pritchard, 2007). The theory of social constructivism will assist this study to understand how teachers use instructional strategies to assist learners to construct knowledge.

3.5 Conclusion

This chapter discussed the theoretical and conceptual frameworks of the study and also reviewed the related literature. The framework of this study is Vygotsky's social constructivism theory of teaching and learning. The study is also framed on the concept of scaffolding as discussed by Aghileri (2006). Scaffolding was discussed in connection with social constructivism and participants' teaching during the data handling lessons. In the context of this study, instructional strategies used in the foundation phase to teach data handling were explored. The viewpoint that the researcher adopts in this study is that teachers need to produce an environment that is

conducive for learners to construct knowledge and also to work together solving problems or sharing ideas. This is in line with social constructivism as learners work collaboratively in groups discussing data handling problems, they construct new knowledge.

Since the theory that informs this study has been discussed, the next chapter will focus on the research methodology used.

Chapter Four
Research Methodology

4.1 Prelude

The focus of this chapter is the methodology followed to produce empirical data to address the research questions in this study. The paradigm within which this study is located is outlined as well as the approach, design and methods selected. Furthermore sampling measures followed in collecting data are discussed. Measures for ethical clearance are also discussed. In addition, this chapter discusses measures taken to ensure a sound degree of reliability and validity in respect of the findings of this study. Finally, some of the design limitations are discussed.

Figure 6 overleaf shows the research design and methodology adopted for this study.

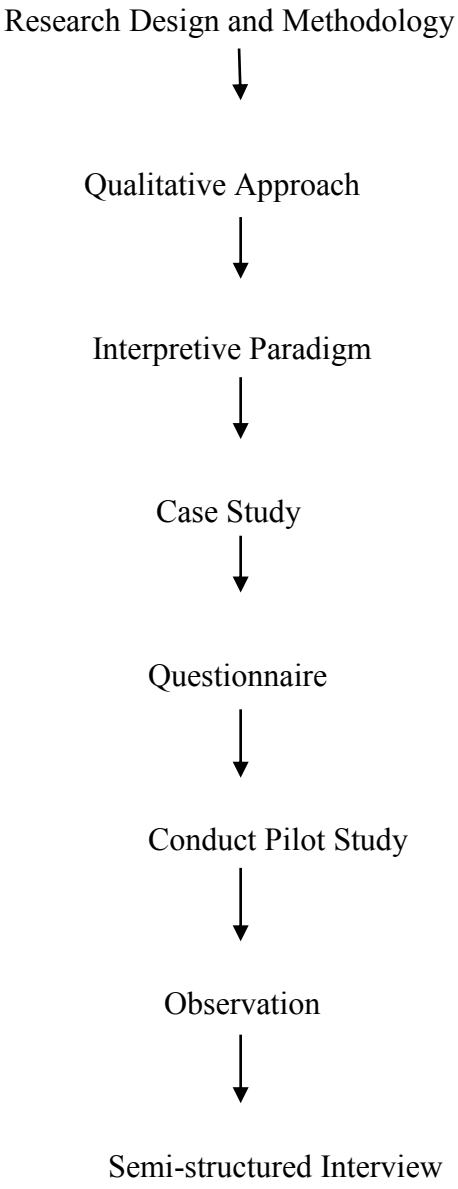


Figure 6: Research design and methodology flow chart adapted from http://www.statpac.com/surveys

4.2 Qualitative approach

This interpretative study focused on exploring foundation phase teachers' use of instructional strategies to teach data handling. An interpretive approach is used to understand the subjective world of human experience (Cohen, Manion & Morrison, 2007). Furthermore, interpretive researchers examine situations through the eyes of the participants rather than those of the

researcher (Cohen, Manion & Morrison, 2011). A qualitative approach is suitable for this study since it researches the actual practice of foundation phase teachers when teaching data handling. Rule and John (2011) point out those qualitative researchers are interested in studying the social situations as they are, in their natural context, and also want to make sense of opinions and practices as they happen in the real environment. This research has drawn meaning from what transpired in the classroom setting and also what participants said. Quantitative research uses a large sample that is selected at random and works under unnatural conditions (Johnson & Christensen, 2008); hence it was not be suitable for this study. Quantitative data take the structure of numbers, while qualitative data take the structure of words and visual descriptions (Denscombe, 2010). Creswell (2009) views qualitative research as comprising a number of techniques relating to interpretive naturalistic approaches towards its subject matter. As the number of teachers that participated in this study was small, it allowed the researcher to study their use of instructional strategies when teaching data handling in depth.

Qualitative research emphasises the lived practices of the participants (Bell, 2006). This is consistent with the researcher's attempts to understand the participants' world; this is described as understanding the living practices of people. Qualitative research is different from quantitative research in that quantitative research's main concern is to test the hypothesis, while qualitative research focuses on understanding and implication. Through a qualitative research design the researcher was able to explore foundation phase teachers' use of instructional strategies when teaching data handling.

A qualitative research approach allows the researcher to examine, understand and draw a conclusion based on the participants' responses towards a phenomenon under deliberation in a given normal setting, like a natural mathematics classroom (Denzin & Lincoln, 2005). Thus individual people or groups are the focus in qualitative research. Qualitative research focuses on exploring, understanding, determining significance and describing a particular phenomenon through the practices and viewpoints of the participants, predominantly within areas of educational thinking and training (McMillan & Schumacher, 2010). Flick (2007, p. ix) points out that one could understand, make sense, give explanation and depict social occurrence "from the inside" in three plausible ways:

> Analysing experiences of individuals or groups… By analysing interactions in the making…by analysing documents(texts, images, films or music) or similar traces of experiences of interactions.

In this research, through questionnaires, observations and semi-structured interviews, the researcher has attempted to conduct a detailed account of foundation phase teachers' use of instructional strategies. Hence through using a qualitative approach, which is a case study that is located within interpretive paradigm, the researcher attempted to capture and report on the instructional strategies which foundation phase teachers use to teach data handling.

4.3 Working within the interpretive paradigm

Paradigms are "all encompassing systems of interrelated practices and thinking that define for researchers the nature of their enquiry along three dimensions" (Terre Blanche & Durrheim, 2006 p. 6). These three dimensions that Terre Blanche and Durrheim (2006) refer to include ontology, epistemology and methodology. They maintain that ontology focuses on the nature of reality that is studied and epistemology is concerned with the nature of the connection between the researcher and that what could be known. Thus epistemology refers to what led people to know what they know. Lastly, methodology involves the process demonstrating how the researcher has come to comprehend a phenomenon (Henning, Van Rensburg & Smit, 2004).

Paradigms are views that people bring to the research and that contribute to how they plan and carry out their projects (Creswell & Clark, 2007). Drawing from the above explanation, paradigms are ideologies about the nature of the world. A number of paradigms are positivism, post-positivism, critical theories and interpretivism (where the researcher is responsible for exposing objective authenticity and demonstrating it using practical means) (Wiersma & Jurs, 2009). Additionally, Neuman (1997, p. 69-70) argued that positivists believe that people share the "same meaning system and that we all experience the world in the same way". In the positivist researcher's study surveys, measurement, observation and numbers would be included. Therefore the methodology used by the positivist researcher is described as quantitative. From the above mentioned description, positivism does not consider how people make meaning.

Neuman (1997) argued that positivism has been criticised for equating individuals to numbers and its concern for statistical data, which is unrelated to the actual lives of people. For the above reasons the positivist paradigm was not suitable for this study.

This study is located within an interpretive paradigm because knowledge is constructed not only by visible phenomena but also by descriptions of the way people make meaning (Henning, 2004). Interpretivism is related to hermeneutics, a theory of meaning that emphasises a detailed reading or examination of text (Neuman, 1997). This suggests that the researcher tries to find meanings within a text through a comprehensive study. In contrast to positivism, the interpretive researcher focuses on the participants' interpretations of the situation. After lesson observations the researcher conducted interviews with the participants to find out why they used particular instructional strategies to teach data handling. This was done to understand the participants' interpretation of the instructional strategies used to teach data handling in the foundation phase. This approach calls for an in-depth understanding of the subject and deep immersion in the environment of the subject (Thomas, 2011). Basically, the aim for the interpretive researcher is to understand from the participants' view. Therefore using an interpretive approach provides opportunities to uncover more meaningful understanding and data collected are more appropriate to describe real world issues rationally.

Thus, the findings of this study will provide knowledge of the instructional strategies used in the foundation phase to teach data handling and how these instructional strategies are used. The interpretive paradigm strives to understand the participants in their world and how they define their social reality (Cohen et al., 2007). The interpretation of their reality, according to Cohen et al. (2007), includes the meaning given to data from the views of people being studied. This is in contrast with the positivist paradigm which maintains that there is an objective reality that exists apart from the perceptions of those who observe it (Krauss, 2005). Thus, as this study wishes to understand the foundation phase teachers' use of instructional strategies, the use of the interpretive paradigm is appropriate.

For interpretivists the purpose of social and education research is to understand the meaning which informs human behaviour (Bertram & Christiansen, 2014). Similarly, Bertram and Christiansen (2014, p. 26) propose that "It makes sense that meaning can only be understood in

interaction between researcher and respondents". The participants in this study are from different contexts; in the interpretivist paradigm context is important because the meaning that the participants make is influenced by the context (Henning et al., 2004). Some participants are from rural schools, some from township schools and others are from urban schools. The researcher wanted to explore foundation phase teachers' use of instructional strategies to teach data handling, making the interpretive paradigm most suitable to use because this approach calls for deep understanding of the subject and its environment (Thomas, 2011), and this study looks at the instructional strategies used and participants from diverse environments.

Working in an interpretive paradigm requires the gathering of data that will enable the researcher to understand the world from the perspective of the participants. As it was crucial in this study to explore which instructional strategies foundation phase teachers use to teach data handling and how they use these strategies to teach data handling, as an interpretivist researcher lesson observations were carried out. The data handling lessons were video recorded and all discussions with the participants were audio recorded.

Video was used to capture information and lesson observations were triangulated with the data from interviews exploring the reason for using instructional strategies in the way that they did. Furthermore, Walsham (1993) argued that the most suitable method of conducting experiential research in the interpretive tradition is the in-depth case study. Taking into consideration the nature of this study, as described by the purpose and the research questions, the researcher resolved to use the case study approach, as discussed in the following section.

4.4 The case study

The case study approach is appropriate for this study because it helped in examining in depth the foundation phase teachers' use of instructional strategies when teaching data handling. According to Babbie (2007) a case study is an in-depth examination of a single instance of some social phenomenon. It is a systematic and in-depth investigation of a particular instance in its context in order to generate knowledge (Rule & John, 2011). A case study is "qualitative research that examines a bounded system (i.e. a case) over time in detail, employing multiple sources of data found in the setting" (McMillan & Schumacher, 2010, p. 485). The case may be a person, a group

of people, a school, a community or an organisation (Bertram & Christiansen, 2014). This study is a case study of foundation phase teachers in Pinetown district. A case study approach is used since it can be used to address exploratory research questions (Johnson & Christensen, 2008; Rule & John, 2011). This approach assisted the researcher to examine foundation phase teachers' use of instructional strategies to teach data handling. According to Cohen et al. (2007) case studies call for deep investigation.

There are three reasons for the use of a case study referred to by Yin (2009). Firstly, 'how' or 'why' research questions that seek to explain present situations justify the use of a case study. The third research question in this study, focused on how foundation phase teachers used the instructional strategies when teaching data handling, makes the choice of a case study approach relevant. Secondly, the case study is a chosen approach when the researcher has little control over the events related to the phenomena. The third reason is that it focuses on a contemporary phenomenon within a real-life situation. Hence the case study approach was relevant to this study because the research was done with the foundation phase teachers in their environment (schools).

Case studies also allow the researcher to understand deeply the dynamics of the environment (Maree, 2007). The characteristics of a case study are that it strives towards a comprehensive understanding of how participants make meaning of a phenomenon under study (Maree, 2007). The concern of the researcher in this study was to understand the instructional strategies foundation phase teachers use to teach data handling. Case studies aim to "describe what it is like to be in any situation, so they are generally descriptive in nature, however they can also be used to generate claims for further verification" (Bertram & Christiansen (2014, p. 42). Therefore this approach is more relevant because it provided for deep investigation through individual engagement with participants in terms of classroom observations as well as semi-structured interviews. The case in this study focuses on Pinetown district foundation phase teachers that teach mathematics. In this study the research is located in 7 different primary schools.

In this research an exploratory case study has been used. An exploratory case study regularly studies a phenomenon that has not been researched previously, and it can lay the foundation for further research (Rule & John, 2011). The researcher has not come across another study that

explored foundation phase teachers' use of instructional strategies to teach data handling. Most of the existing studies focus on the FET phase. The exploratory case study was chosen because this study wanted to understand how foundation phase teachers use instructional strategies when teaching data handling. The case study approach was used in this study supported by questionnaires, observations and interviews to explore in depth the foundation phase teachers' use of instructional strategies when teaching data handling.

The use of the case study approach enables a researcher to get very close to the research participants by means of observations and interviews, and to construct an intensive, in-depth analysis of a case under study (Cohen et al., 2007 and McMillan & Schumacher, 2010). Furthermore, through using various data collection measures, such as questionnaires, observations and interviews, it is likely that the researcher could get close to subjective factors such as participants' cognition, emotions and expressions (Cohen et al., 2007). Since the researcher was using the case study approach supported by questionnaires, observations that were video-taped and interviews, the researcher was able to explore foundation phase teachers' use of instructional strategies when teaching data handling. Thus through the use of a case study approach a researcher can capture most important features of the research activity, that could help to make sense of the phenomenon under investigation (Cohen et al., 2007). Given the explorative nature of this study and the research questions, the following procedures for data collection were followed:

- Questionnaires were prepared in order to gather biographical information on the participants;
- Observation schedules were created and video recordings of data handling lessons were made;
- Observation notes were made during data handling lessons; and
- A semi-structured interview plan was constructed to assist in the one-on-one interview.

4.5 The ethical issues addressed

The moral aspects of any research must be respected (Charles & Mertler, 2008). Confidentiality was maintained at all costs. The participants' names were kept anonymous, as were the names of

the schools. Cohen et al. (2007, p. 64) argue that "the essence of anonymity is that information provided by participants should in no way reveal their identity".

It is imperative to draw attention to ethical issues in respect of qualitative research; an important aspect is the confidentiality of what the research found and the conclusion of the study, and protection of the identity of participants. A letter was written to the Department of Education asking for consent to conduct research in Pinetown District Primary Schools (Appendix A ii). Letters were also written to principals of the schools asking for permission to conduct research in their schools (Appendix A iii). Another letter was written to parents, asking them to give the researcher consent to conduct research involving their children, since the research was done in primary schools (Appendix A v). Observations were recorded. The last letter was written to the teachers asking, them to be participants in this research study (Appendix A iv). This letter explained to the teachers the details of the study, so that they could give consent to participate. In doing so the purpose of the study was described to the foundation phase teachers, as well as the research questions and the methodology that was planned to be used in this study. Furthermore all the participants were informed about their role in this study and that their anonymity would be respected, and thus no participant would be referred to by the name in the research report and pseudonyms would be used.

The participants were also given the assurance that any information collected from them would be kept confidential, and they were also informed that the data collected from them would only be used for the purposes of the study only. The participants were also informed that participation was voluntary and they could withdraw at any stage if they wished to do so. After receiving the necessary consent from the participants that were willing to participate in the study, an application for ethical clearance from the University of KwaZulu-Natal (UKZN) was submitted. After receiving an ethical clearance number from UKZN, appointments were made with the participants to give them questionnaires to fill in and also to discuss the days and times for observing them teaching data handling. All video tapes and audio tapes will be kept in a secure place (in a locked filing cabinet in my supervisor's office) for a period of five years, as required by UKZN policy. Thereafter the video recordings, transcripts of observations and interviews, and field notes will be shredded and disposed of via the waste centre.

To deal with these issues letters of consent were obtained and permission to observe and interview participants was also obtained, with commitment to destroy the audio tapes after gleaning the data, in order to protect the participants. In order to protect the participants' rights to privacy the researcher had to promise them the confidentiality of the information they would give (Cohen et al., 2007), so that the public would not know who provided information. The entire data set collected were used with the informed permission of the participants. The research did not disturb the daily operation of the schools.

4.6 Obtaining consent for the study

Letters were submitted to various stakeholders prior to data collection. The first letter was to the education officer in Pinetown district, the second to the principals of the schools, and the third to the parents of grade 3 learners asking them to allow their children to participate in the study. The last letter was written to the participants. The nature of the study was explained in detail to the participants and they were given consent forms to fill in to ensure that they agreed to participate in the research project. They were assured that their identity would not be revealed when writing the report.

4.7 Sampling

Sampling entails decision making about which individuals, locations, proceedings or activities to incorporate in the research study (Bertram & Christiansen, 2014, p. 58). Flick (2007) added that sampling is a vital phase in planning qualitative research and also when the researcher decreases the huge number of possible subjects and cases for study to a controllable number of cases and subjects. Twenty teachers were selected from different primary schools within Pinetown district. These 20 primary schools were selected by using a map, since the researcher was not sure about schools that fall under Pinetown district. The map showed the names of the schools and where they were located. Selection of the schools for inclusion was done on the basis of convenience, since it was going to be easy to travel to those schools. From these 20 teachers 10 were selected for the main study and two participated in the pilot study. Convenience sampling means deciding

on a sample which is simple for a researcher to arrive at (Bertram & Christiansen, 2014). This selection was thus based on the accessibility of the school, and the availability of the teachers and their responses on the teacher questionnaire.

The schools selected to be used for the main study were from different contexts. Two schools were in a rural area, four were in townships and one was an ex-Model C school. Two teachers in the ex-Model C school participated in this study. Although eight schools were selected for the main study, seven schools participated. This study ended up having eight participants because two grade 3 teachers at the ex-Model C school wanted to participate in the study. The participants were all females, because at all of the participating schools all of the foundation phase teachers were females.

The map illustrates the places where the research was conducted in Pinetown district primary schools, and the table shows the different participants, their schools and the places where their schools are based (indicated by arrows on the map).

Table 2: The participants and their schools.

Name[1]	**School**[2]	**Place**
Musa	Green Primary	Hillcrest
Qinisile	Blackberry Primary	Mpumalanga Township
Honey	Yellow Primary	Mpumalanga Township
Betty	Reddy Primary	Mpumalanga Township
Charity	Blueberry Primary	Cato Ridge
Jabu	Pink Primary	Mpumalanga Township
Fiona	Purple Primary	Waterfall
Vicky	Purple Primary	Waterfall

[1] Pseudonyms were used to protect the identity of each participant.
[2] Pseudonyms were used to protect the identity of each school.

Figure 7: Map of the research sites (retrieved March 20, 2015, from http://www.sa-venues.com/maps/kwazulunatal_durban.htm)

4.8 Data collection methods

Data refers to the information collected by a researcher from which interpretations and conclusions are drawn with respect to a particular incident under study (McMillan & Schumacher, 2010). An important part of methodology is gathering data that are both reliable and valid, which could in this instance only be realised through the use of appropriate and purposively structured instruments that would contribute to answering the research questions of the study (Maxwell, 2005). The data collection instruments included a teacher questionnaire, an observation schedule and a semi-structured interview schedule. The questionnaire assisted in gaining biographical information on the teachers and also addressed whether or not they attended any courses or professional development workshops. Each of the 20 participants initially selected were asked to complete a questionnaire. The responses on the questionnaire assisted in selecting the sample for

the main study. These completed questionnaires also assisted in developing both the observation schedule and interview schedule.

Subsequent to the administration of the questionnaire, lesson observations were scheduled. By observing the lessons, the researcher had an opportunity to record information as it occurred in the classroom. Therefore these lessons were video recorded. The observation schedule and video recordings of lessons were used to examine how foundation phase teachers teach data handling .instructional strategies they used and how they used them. Lastly, each participant in the study was interviewed one on one to find out why she was teaching in the way she taught. The aim of conducting interviews was to get rich explanatory data that would assist in understanding how participant construct knowledge and social authenticity. Therefore interviewing participants assisted in gaining rich information of why they teach in the way they do.

The following data collection plan was used. Different data collection methods were used to answer different research questions.

Table 3: Data collection plan.

Critical research questions	**Participant**	**Method**
1. What instructional strategies do foundation phase teachers use to teach data handling?	Teacher	• Teacher questionnaire • Classroom observation • Video recording of data handling lessons
2. How do foundation phase teachers use these instructional strategies to teach data handling?	Teacher	• Classroom observations • Video recordings of data handling lessons • Interviews with foundation phase teachers
3. Why do foundation phase teachers use these instructional strategies to teach data handling?	Teacher	• Interviews with foundation phase teachers

In the next section the methods of collecting data (questionnaires, observations and interviews) are explored. Questionnaires, observations and interviews were used to answer the critical questions.

4.8.1 Questionnaire

A questionnaire is a form that is given to participants for research purposes, to complete and return to the researcher (Creswell, 2012). It is a list of questions which the participants answer (Bertram & Christiansen, 2014). In this study a questionnaire was used to gain biographical information on the teachers. The questionnaires asked about the school profile and the participant's profile. Questionnaires are not always linked to the statistical analysis (Mellenberg, 2008). The questionnaire was used in a pilot study to ensure that it would be trustworthy and suitable for use in the main study. Since the participants complete the questionnaire in privacy, it increases the likelihood of them answering the questions sincerely (Newby, 2010). The disadvantage of using a questionnaire is that some people might not complete and return it (Charles & Mertler, 2008). This challenge is normally encountered in large surveys, but in this study all of the participants returned their completed questionnaires, although some did not answer all of the questions. The advantage of using a questionnaire, as stated by Kidder and Judd (1986), is that participants answer questions in a relaxed environment, taking their time, and thus this leads to well thought out answers. The questionnaires were collected at the participants' schools after a week.

The questionnaire had three sections comprising 29 questions. The first section focused on the school profile, including the number of teachers on the staff, the number of mathematics teachers and the learner/teacher ratio. This information was going to assist the researcher to get a picture of each research site. Since this study explored the instructional strategies that foundation phase teachers used to teach data handling, the second section focused on the school infrastructure. This information was going to highlight the conditions under which the teachers worked. The last section sought information about the teacher, including their qualifications, teaching experience, instructional strategies used when teaching data handling, and professional development workshops attended. The questionnaires were piloted to ensure that the questions were clear and not ambiguous. The researcher made sure that the questionnaire covered all of the domains it was intended to cover (see Appendix B i).

4.8.2 The observations

Another technique that was used to gather data was observation. Observation is a procedure of collecting unrestricted, actual information by observing individuals and the location at a research site (Creswell, 2012; Bertram & Christiansen, 2014). Observation is an everyday activity whereby one uses one's senses and intuition to gather data (Maree, 2007). Hence the researcher was able to explore which instructional strategies foundation phase teachers used and also how they used those instructional strategies to teach data handling. Grade 3 data handling lessons were observed in seven schools and eight foundation phase teachers participated (in one school two teachers were observed). Two lessons in each school were observed and those lessons were video recorded.

According to Maree (2007) the most important part in the observation is the recording of the data. The advantage of observation is that one gets a chance to record information as it takes place in a location and to study real behaviour (Creswell, 2012). Therefore the researcher was able to see for herself the foundation phase teachers' use of instructional strategies when teaching data handling. The researcher had a research assistant to record data handling lessons using a video recorder and she (the researcher) took notes. This gave the researcher an opportunity to focus on observing the lessons and she was able to take notes without any disturbance. This helped in reducing the risk of omitting essential data, which may have happened if the researcher wrote down the details at a later stage. The aim of observing was to see which instructional strategies foundation phase teachers use when teaching data handling and how they use these instructional strategies to teach data handling. According to Cohen et al. (2007) the distinguishing quality of observation as a research procedure is that it provides a researcher with the chance to collect 'live' data from actual, happening social situations. The researcher observed the participants teaching their classes.

From lesson observations the researcher compiled the interview questions. The different ways in which the foundation phase teachers taught data handling required explanation, and it is for this reason that interviews were conducted. Corbin and Strauss (2008) maintain that combining

observations with interviews to confirm interpretations with the participants is always an advantage. The discussion that follows focuses on interviews as they were used to capture data.

4.8.3 The semi-structured interviews

A qualitative interview takes place when researchers ask one or more participant/s common, unrestricted questions and record their responses (Creswell, 2012). Santiago (2009) mentioned the three types of interview which are the structured, semi-structured and unstructured. She pointed out that structured interviews are incredibly formal and are employed to gain particular information in quantitative research. Unstructured interviews, according to Bell (2006), can generate valuable information but those who use it need to be cautious since this type of interview needs much expertise. Structured interviews were not appropriate for this study since they are likely to be inflexible and could have restricted the data collected. Thus semi-structured interviews were the most appropriate for this study.

This study used semi-structured one-on-one interviews, since they "allow the probing and clarification of answers" (Maree, 2007, p. 87); thus the researcher was able to ask the participant to clarify if she did not understand the response. Interviews are considered as the joint production of accounts of experiences, identity, knowledge, and so on (Seal, Gobo, Gubrium & Silverman, 2004), and the interview questions were based on what transpired during the data handling lesson presentations. The foundation phase teachers explained why they taught in the way they did. This method allowed the researcher to follow up on interesting avenues that arose during the interview (De Vos, Strydom, Fouche & Delport, 2005). It also gave the researcher and the participant flexibility in that the participant could also introduce an issue that the researcher had not thought of (Terre Blanche, Durrheim & Painter, 2006; De Vos et al., 2006). The advantage of semi-structured interviews is that a researcher can ask more questions to obtain more detailed information if the participant does not give sufficient detail initially (Bertram & Christiansen, 2014).

These interviews were conducted after school hours at the schools where the different participants teach. This was convenient for the teachers and ensured privacy (De Vos et al., 2005). Moreover, in an interview context one has to ensure that one is not unduly disturbed

(Terre Blanche, Durrheim & Painter, 2006). There was no disturbance in the afternoons when interviews were conducted because learners and other teachers had left the school. With privacy assured, the participants were free to talk since the environment was non-threatening. Fontana and Frey (2000) argue that the above needs to be taken into account before conducting interviews. To address the issue of bias, a common interview schedule was prepared. This also avoided vagueness and ensured that there was some structure in terms of uniformity, succession and phrasing of the key questions.

The interview comprised four main questions. The first question focused on the instructional strategies that are effective in the foundation phase teachers' teaching of data handling. The second question focused on the concepts covered using the instructional strategies that they mentioned. The participants were also asked about the benefits of using the instructional strategies that they mentioned in response to the third question. The fourth question was about the responses of learners to the instructional strategies used. Then the foundation phase teachers were asked why they used the instructional strategies that they used in class when they were observed. The following questions were asked during the interview:

- Question 1: Which instructional strategies are effective in your teaching of data handling?
- Question 2: Which concepts did you cover using those instructional strategies that you mentioned?
- Question 3: How do those instructional strategies help learners in understanding data handling?
- Question 4: What can you say about the response of learners to the instructional strategies used?

Interviews were conducted after school hours twice a week and were 25 minutes in duration. These interviews were audio recorded with the consent of the participants, since the researcher believed that this was the best way of capturing the exact words of the interviewees. It also allowed the researcher to concentrate on the responses of the interviewees without being disturbed by taking notes, as well as making sure that all the responses were captured. McMillan and Schumacher (2006) point out that audio-recording the interview gives substance for checking reliability. Silverman (2005) also claims that audio recordings permit tapes to be replayed and transcriptions to be enhanced. So audio recording the interviews meant the

researcher did not have to depend on written notes and recalling information, either which could have been faulty or not complete.

The researcher transcribed the data after the interviews were conducted. While transcribing, the researcher became familiar with the data. Henning et al. (2004, p. 105) state that when the researcher knows the data better, he/she will be more competent "in labelling units of meaning". Therefore as transcription was in progress the researcher was immersing herself in the data. After transcription the drafts were given to the participants to check whether their responses were correctly captured and that important issues were not omitted. Participants were allowed to delete or add to the text to clarify their responses in the transcripts. After the edited transcripts were reviewed for accuracy, they were then ready to be analysed.

The following section discusses issues of validity and reliability.

4.9 Validity and reliability

The skill in methodology, being considerate and sincerity of the researcher determine validity and reliability in qualitative data (Zohrabi, 2013). The sections that follow focus on issues of validity and reliability.

According to McMillan and Schumacher (2006, p. 324), validity refers to "the degree of congruence between the explanations of the phenomena and realities of the world". Drawing from the above, validity refers to how honest the data are. Bush (2007) claimed that there is internal and external validity; internal validity refers to the extent to which research findings exactly represent the phenomenon being examined, and external validity refers to the level that results may be generalised to the people represented by the sample, or to another related environment. As mentioned earlier, given the sample of eight participants the results of this research study cannot be generalised as representing all foundation phase teachers teaching data handling in SA. Nonetheless, some parts of the results may be applicable and may be transferred to related characteristics. McMillan and Schumacher (2006) recommend different strategies to add to the validity of the design, and this study used some relevant strategies to improve the validity (Table 4).

Table 4: Different strategies adding to the validity of the design (adapted from Singh, 2011, p. 54).

Strategy	Relationship to the study
Multi-method	This study used three data collection strategies: questionnaires, observations and interviews
Participant language and verbatim accounts	The interviewees were advised to be free to express themselves in IsiZulu if they wanted to, especially those who were not English first language speakers
Mechanically recorded data	With permission from participants a video recorder was used for observations and a voice recorder was also used for interviews
Participants' review	The participants were asked to check the transcripts to ensure that their answers were recorded correctly

Using more than one technique of data generation in research is referred to as triangulation (Cohen et al., 2007). This helps to check the "validity of an interpretation based on a single source of data" (Bergman, 2008, p. 23). This study used three methods of collecting data, as previously mentioned.

Figure 8 shows triangulation with the data collection techniques used in this study to ensure validity.

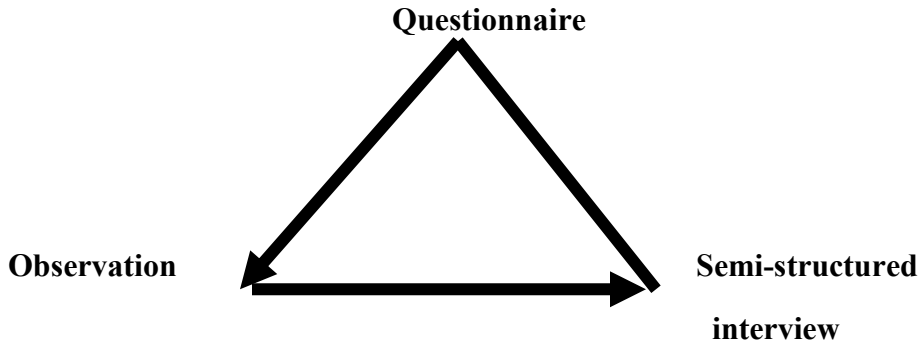


Figure 8: Triangulation with reference to the data collection instruments used in this study.

Wiersma and Jurs (2009, p. 9) claim that there is internal and external reliability. They refer to internal reliability as the "extent that data collection, analysis, and interpretations are consistent given the same conditions" (Wiersma & Jurs, 2009, p. 9). External reliability refers to the duplication of studies in related situations, and whether the outcomes are consistent. Video recording observations and audio recording interviews helped with checking reliability. Silverman (2005, p. 222) points out that when actions are recorded and transcribed, reliability might be undermined by ignoring minor but often significant "pauses and overlaps" when transcribing. When transcribing this was taken into consideration, so that even trivial expressions by participants were transcribed.

A pilot study was conducted to ensure validity and reliability of the research instruments. Validity is "an attempt to check out whether the meaning of and interpretation of an event are sound or whether a particular measure is an accurate reflection of what you intend to find out" (Vithal & Jansen, 1997, p. 32). Therefore validity was ensured through triangulation (Creswell, 2009), which is using two or more methods to collect data (Cohen et al., 2007). The researcher used different sources for data (questionnaires, interviews and observations), that will add to the validity of the study. According to Maree (2007), when qualitative researchers speak of research validity and reliability they are referring to research that is truthful. After the pilot study the instruments were amended to ensure that they assisted in data collection pertaining to the use of instructional strategies of data handling in the foundation phase.

The transcripts were checked to make sure that there were no mistakes when they were transcribed, and this was done to ensure reliability. The researcher asked PhD student to "cross-check" (Creswell, 2009, p. 191) her codes or categories in the data analysis section. This was done to check whether another person would use the same code that the researcher used for the same text. Interview transcripts were also given back to the participants to check and comment on whether they thought they were an accurate reflection of what they said (Bertram & Christiansen, 2014). At the end of the research study the researcher will hold a workshop with the participants and discuss all the findings.

4.10 The pilot study

A pilot study is a small study that is conducted prior the main research study (Arain, Campbell, Cooper & Lancaster, 2010). In other words a pilot study is a pre-test of the instruments for collecting data. Yin (2009) points out that a pilot case study helps in improving plans for data generation. He (Yin, 2009) added that pilot case studies have to give details of lessons learnt for both the research plan and field events. For the pilot case one primary school close to where the researcher is teaching was selected, because it was convenient for the researcher to arrange to meet with the participants. Two foundation phase teachers in that school were given questionnaires and the researcher also met with them individually for interviews. What the researcher learnt was that the interview questions were not well phrased, because the participants kept on asking for clarification. Those questions were rephrased in preparation for the main study. This also helped in reducing fear about the approach and communication when conducting interviews.

4.11 Limitations of the study

One limitation of this study revolves around the research design. Since this study involved eight foundation phase teachers in Pinetown district, the findings cannot be generalised to all primary schools in Pinetown or in the country. In response to the above limitation, Rule and John (2011) argue that some parts of the findings might be relevant and can be transferable to related circumstances, locations or contexts because of similar characteristics. Therefore, by exploring foundation phase teachers' use of instructional strategies to teach data handling, findings may be of relevance to other primary schools.

4.12 Conclusion

In this chapter the research methodology and design of the study were discussed in detail. The interpretive paradigm with emphasis on qualitative research was also discussed. Sampling, data collection techniques as well as strategies undertaken to increase the trustworthiness of the study

were also outlined. Finally, details with regard to the pilot study and the limitations were provided.

The analysis of the data is discussed in detail in Chapter Five.

Chapter Five

Data analysis

5.1 Prelude

In this chapter a discussion of the data analysis is presented. Eight foundation phase teachers participated in the main study. The participants were invited to complete a questionnaire. When all questionnaires were returned, coding was done in order to generate themes, since in qualitative approach the researcher analyses the data for themes (Creswell, 2009). The participants were also observed and interviewed after they had completed the questionnaire.

Data collection, analysis of data and writing a report are not disconnected stages when conducting research; these procedures are consistent and take place concurrently (Creswell, 2007; Wiersma & Jurs, 2009). Clarifying the above, Henning, et al. (2004) and Daley (2004) explain that the data analysis procedure in qualitative research studies is an ongoing process. Therefore a researcher may go back and forth from collecting data to analysing data. Creswell (2012) claimed that there is a three-step strategy to qualitative data analysis: the first step refers to preparing and organising data for analysis, then themes surface during a process of coding, and lastly data are represented in images, tables or text.

5.2 Coding of the teacher questionnaire

Coding was used to assist in analysing the data obtained from the questionnaire, observations and interview schedules. Coding is the paraphrasing of the responses of the participants and their information in specific categories with the intention of analysing them (Kerlinger, 1970). Coding refers to conveying relevant identifiers to different segments of the data (Daley, 2004). The teacher questionnaire was organised by using pseudonyms to replace the participants' names and those of their schools to ensure confidentiality (Table 5). The coding process involved identifying a significant instant and encoding it before the process of interpretation. Encoding information sorts out the data to discover and build up themes from them (Fereday & Muir-

Cochrane, 2006). Therefore, the coding process led to thematic analysis. Thematic analysis is the process of identifying patterns within the data, where surfacing themes turn into categories for analysis (Boyatzis, 1998).

Table 5: Pseudonyms and coding used for the participants and their schools

Name of school	**Teacher name**	**Code**
Green Primary	Musa	A
Blackberry Primary	Qinisile	B
Yellow Primary	Honey	C
Reddy Primary	Betty	D
Blueberry Primary	Charity	E
Pink Primary	Jabu	F
Purple Primary	Fiona	G
Purple Primary	Vicky	H

5.2.1 School profile

The next table summarises the profiles of the participating schools. It includes the number of teachers, number of mathematics teachers and the learner/teacher ratio. What could be noticed in most of the schools was that the class sizes were large. In some classes three learners were sharing a desk which was meant for two learners. This table is included to show the human resources per school. The participants' responses to questions with regard to school profile are also coded and given in Table 6.

Table 6: Coding used to establish school profile

Code	A	B	C	D	E	F	G
No. of staff	16	13	14	17	20	30	28
No. of Maths teachers	16	13	14	5	15	18	28
L/T ratio	1:40	1:40	1:50	1:60	1:55	1:50	1:25
Girls	360	284	338	490	570	795	299
Boys	290	317	362	530	530	705	201

L/T = learner/teacher.

5.2.2 School resources

In this section of the questionnaire the researcher needed information regarding the availability of electricity, the library, internet and computers in the schools where the research was conducted. This was included to determine whether the school resources contributed to the instructional strategies used by the participants when teaching data handling. Most of the schools did not have a functional library, computers or the internet. Out of the seven schools that were the research sites, only three had a library and computers. Two participating schools had internet access.

Table 7 illustrates the resources of the participating schools, and is included to provide the reader with more information regarding the participating schools.

Table 7: Coding used to establish the participating schools' resources

Access to:	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Electricity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Library	No	Yes	No	No	Yes	No	Yes
Internet	No	No	No	No	Yes	No	Yes
Computer	No	No	No	No	Yes	Yes	Yes

5.2.3 The participants' profiles

Table 8 provides information about each participant. This includes age group, qualifications and whether they attended professional development workshops or not. Participants were also asked about their years of experience and whether they have a statistics qualification or course under their belt. Most of the participants indicated that they did not do any form of statistics or data handling in their higher level of education. Only one participant did statistics during her degree. Only two participants indicated that attended professional development workshops.

Table 8: Coding used to establish participants' profile

	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Gender	Female	Female	Female	Female	Female	Female	Female	Female
Age group	41-50	41-50	51-65	51-65	51-65	51-65	41-50	20-30
Qualific-ation	M.Ed.	Teachers' diploma	Teachers' diploma	Teachers' diploma	B.Ed.	Teachers' diploma	B.Ed.	B.Ed.
Subjects	Maths, English, IsiZulu, Life Skills	Maths, IsiZulu, English, Life Skills	All subjects	All Subjects	Maths, IsiZulu, English, Life Skills	Maths, IsiZulu, Life Skills	Maths, English, Life Skills, Physical Education	Maths, English, Afrik-aans, Life Skills
Teacher experi-ence	22 yrs	10 yrs	23 yrs	22 yrs	15 yrs	5 yrs	9 yrs	3 yrs
Statistics course in the Degree/ Certificate	Yes	No	No	No	No	No	No	Yes
Profess-ional develop-ment work-shops	Yes	No	Yes	No	No	No	No	Yes

5.3 The participants' stories

All of the participants were female since in all of the participating schools all of the foundation phase teachers were female.

5.3.1 Fiona (G)

Fiona teaches at Purple Primary School. Purple Primary is situated in a primarily White neighbourhood. Despite this, the learners at Purple Primary are of diverse races. This primary school is a former Model C school. The Model C schools are those which catered for Whites only during the apartheid era. During apartheid in SA there was racial segregation into groups labelled Whites (Europeans), Indians (people from South Asia), Coloureds (mixed race), and Blacks (Africans) (Seekings, 2010). Therefore this resulted in the division of towns into White, Coloured, Indian and Black areas. South Africans classified as White lived in relatively affluent neighbourhoods, with high-quality municipal infrastructure (Western, 1981). South Africans referred to as Coloured and Indian were located in less-serviced neighbourhoods which were poverty stricken. For the Black people townships were the temporary residence, because they were located in the rural areas (Christopher, 1994). Townships were provided with minimal infrastructure. Hence the former Model C schools are still located in predominantly White suburbs.

Purple Primary has small class sizes and excellent resources. It is one of the wealthy schools and has a good reputation when it comes to discipline. This school belongs to Quintile 5. State funding in SA is organised into quintiles, where schools are separated into categories considering the poverty ranking in the neighbourhoods they serve. Thus schools are divided into five quintiles: Quintile 1 to Quintile 5, where Quintile 1 represents the most underprivileged schools and Quintile 5 the more affluent schools (Mestry & Ndhlovu, 2014).

The wealthy schools receive less State funding. Even though the State funding for the affluent schools has been reduced, they are able to acquire physical and human resources through various fundraising initiatives and the collection of school fees from parents (Hall & Giese, 2008). Additional funds are allocated to the most underprivileged schools and less money is allocated to the more affluent schools. The decisive factors to determine the quintile that schools fit into are the national census data for the school catchment area (Naidoo, 2011), with three main aspects: earning level, unemployment level and level of education (Kanjee & Chudgar, 2009; Naidoo, 2011). Poorer schools have high government subsidies and low fees, and wealthier schools have low government subsidies and high fees. In the poorest schools parents are totally not liable for paying school fees and these are referred to as 'no fee schools' (Mestry & Ndhlovu, 2014). Three schools in this study belonged to this category.

Purple Primary has high school fees since it was one of the wealthier schools. The school has excellent sporting facilities and a well-functioning library. Additionally, learners at this school have access to the computers, as well as the school's own workbooks designed by the school. Well-designed teaching materials may assist teachers in successful implementation of constructivism in the classroom (Beck et al., 2000). Since each learner had his or her own workbook, the teacher was able to give them different activities according to their capabilities, and assisted them individually, and that is what Wood et al. (1976) refer to as scaffolding. In Purple Primary each learner had all the equipment he/she needed in the classroom, for example a pencil case with pens, pencils, a pair of scissor and glue.

There are 26 teachers on the staff and at present the learner enrolment is 500 and the learner/teacher ratio is 20:1. Fiona has a teacher qualification, a Bachelor of Education degree in the Foundation Phase. Fiona has taught in the foundation phase for 9 years. She considers as important to update her educational content and professional knowledge by going to the workshops organised by private organisations as well as those arranged by the KZN Department of Education. Fiona believes that the visual tools in data handling are important. Her belief is captured in the following statement: "… important to take into consideration whether a learner is a visual or an audio learner…".

Fiona also involves learners when teaching by reading the instructions and also asking them to write answers on the chalkboard. During her interview she expressed the importance of reading an instruction as follows:

> … it is important for everyone to read instructions in order to succeed d in life…it is also important for holistic development. Moreover these learners have to write ANA paper and are expected to understand the instruction without being assisted …

Fiona believes that reading or following an instruction not only helps learners in the classroom but also in life in general. She also demonstrated what Vygotsky (1978) claims – that learners learn better when they are actively involved.

5.3.2 Honey (C)

Honey teaches grade 3 at Yellow Primary which is situated in a rural area that caters for the Black population. Her classroom is overcrowded with 50 learners, and there 14 teachers in her entire school. The number of learners at the school is 700. The school lacks resources for teaching and infrastructure. Some of the learners were sitting three at one desk which was meant for two learners. This implied that there was a shortage of furniture in the classrooms. At this school the Department of Education's workbooks are used. Most of the learners do not have pens to write with. When they are given work to write, they go to the teacher to borrow one; because of this the teacher has many pens on her table that she gives to learners when it is time for

written work. In the foundation phase vernacular language is used when teaching and even the learners' workbooks are written in isiZulu. Nevertheless, Honey code switched between IsiZulu and English when teaching (used both isiZulu and English during her lessons) and gave the following reason for doing so:

> …the worst part is that of teaching in IsiZulu…they do not talk like that in their homes, even when they count they do not count in IsiZulu even when it comes to fruit and vegetables, they do not say 'izaqathi' [carrot]…

She articulated her apprehension about the learners she was teaching – that they were from poor families and some had sick parents and they (learners) were also sick. She expressed her concern as follows: "… these learners have problems, they have parents who are sick and they are also sick … at the end of the day these kids must pass…".

Honey has 23 years' teaching experience and has a teaching diploma. Honey believes in using colours when she teaches data handling, and said colours catch the learners' attention. When writing on the chalkboard she used different colours of chalk. She also provided her own resources when teaching measurement, for example a 750 ml bottle of cooking oil, 2 l bottle of wine, etc. When she was observed teaching a data handling lesson she was also demonstrating. For example, she called learners to the front to explain the meaning of comparison. She called a boy and a girl and asked learners to compare them, asking learners to mention any differences they saw. Honey argued that in everything she was teaching, she was preparing the learners for the ANA paper.

5.3.3 Musa (A)

Musa is a teacher at Green Primary. She is highly qualified, with a Master of Education degree and 22 years of experience teaching in the foundation phase. Musa's primary school is located in a rural area. Her school lacks resources (materials) and also does not have a library or computers. Considering the human resources, there 16 teachers at the school, 650 learners enrolled, and the learner/teacher ratio is about 41:1.

Musa uses the Department of Education workbooks when teaching. She uses different instructional strategies when teaching data handling. Musa used colours, demonstration, reading, recitation and reading in her data handling lesson. When interviewed on how the instructional strategies help learners in understanding data handling, she responded as follows:

> … the instructional strategies that I use in most cases accommodate all different learners' learning abilities … those that might show that they are struggling, they will be further accommodated by means of using different strategies …

Therefore Musa uses different instructional strategies to make sure all learners understand what she teaches. She also uses what she learnt in her Master's degree when teaching data handling, as she believes that learners have to be actively involved:

> … my teaching philosophy is influenced by the constructivism theory. This theory is in line with the instructional strategies I use in teaching grade 3 learners … and be active throughout the lesson …

Solso (2009) argues that teaching with constructivist instructional strategies in mind entails the learner being actively involved in the classroom; this is what Musa does in her classroom.

5.3.4 Betty (D)

Betty has been a teacher in the foundation phase for 23 years. She teaches at Reddy Primary, which is situated in a Black township. There are many learners at Reddy Primary School and as a result the classes are overcrowded. This school lacks material resources, but Betty is able to provide her own in her classroom. She uses the back of calendars as charts when she wants to draw graphs. Most of the learners in her classroom do not have pens; when they are given work to write they come to Betty to borrow pens. Some do not even come, but just sit and wait for other learners to finish writing and borrow from them. Betty provides for her learners because she has pens that she keeps in her cupboard for learners that do not have pens.

There are 1020 learners enrolled in the school; the learner/teacher ratio is about 60:1. There are 17 teachers on the staff. The school does not have a library or computers, except the one used in the administration office. Betty has a teaching diploma. Although Betty has many learners in her class, she manages to discipline them.

It is not easy for Betty to divide learners into groups because of the large class size and the space. Betty also involves learners when teaching data handling by asking them to read instructions aloud, asking learners questions, and also asking them to recite some tables (for example, 3×1 = 3; 3 × 2 = 6; 3 × 3 = 9; etc.). Before Betty starts to teach, her learners stand up and recite tables. When asked the reason for doing this she responded as follows:

> … we want them to be able to count and recall numbers … you can also see those people who cannot count and those who cannot count can learn by hearing others and join them. This will make them to be used to counting … will be able to tell you the answer quickly because it is in his /her mind …

Thus, Betty used the instructional strategies that actively involved learners. She used different instructional strategies in her teaching of data handling.

5.3.5 Charity (E)

Charity teaches at Blueberry Primary and she has 15 years' experience teaching in the foundation phase. Her school also lacks material resources, as did most of the schools that the researcher observed. Charity's school is situated in a rural area, and is built in the Roman Catholic Church premises. In the morning learners assemble and recite church prayers, and one teacher reads the bible for the learners and gives learners the moral lesson of the day.

Although the school lacks material resources, like Betty Charity makes her own (for example by using calendars as charts to draw graphs). There are 1100 learners at this school and the learner/teacher ratio is about 55:1. There are 20 teachers at Blueberry Primary, of which 15 teach mathematics. The school has moderately resourced library and computers are only in the administration office and the principal's office. However, learners still wish to attend this school because of the good discipline and the high pass rate. Moreover the community members believe that learners at Blueberry Primary behave well because of the church background, which is why there are such large classes there. In addition, learners at this school eat fresh vegetables because there is a big garden and the school is supported by the College of Agriculture. Teachers and learners have been trained to plant mushrooms, which they harvest every two weeks, cooking some for learners and selling the remainder. Thus the school does not only depend on the feeding scheme provided by the Department of Education.

Charity has a Bachelor of Education degree, and believes in demonstration when teaching data handling, which she refers to as "show and tell: "… It is when you show them … if they do not know… then you tell them". Charity believes that demonstration is the best instructional strategy when teaching data handling because it involves other strategies, such as the question and answer method.

Charity also gives examples referring to real-life situations. For example, when teaching learners about measurement she was asking them the kilograms of the maize meal that learners' parents buy at home, sugar, and other things. Learners were so excited to talk about the groceries that they buy for their homes and the food they eat. Kim (2010) argues that learning must not take place in isolation from the environment, implying that learning needs to be context related. Charity used different instructional strategies during her data handling lessons and mentioned that during the interview:

> You ask them … that is question and answer method … if they don't know… then you tell them … sometimes you even ask them to discuss in groups …

Despite having many learners in her class, Charity was able to involve almost all the learners when teaching. She arranged learners to sit according to their mental abilities. The learners who sat in the first row were those who were slow to grasp and she gave them more attention, especially when she gave them a class activity. Based on the observation and the interview with Charity, it could be seen that she was committed to helping her learners to understand data

handling and to making her lessons interesting. Her learners were always laughing and showed interest in what she was teaching. She was not interested only in teaching the learners but also in their well-being. Charity knew each and every learner in her class, and even the learners' backgrounds, although she stays in a suburb far from the school. It is clear that Charity loves her work as a teacher.

5.3.6 Vicky (H)

Vicky teaches at the same school as Fiona's – Purple Primary. Both grade 3 teachers at this school wanted to participate in this study, as mentioned in Chapter 4. Purple Primary is located in what was previously called a White neighbourhood, and has outstanding material and human resources, with a functional library, computers and sporting facilities. With reference to staff, there are 26 teachers and 500 learners enrolled at the school. The learner/teacher ratio is about 20:1. Vicky is a young teacher and she has been teaching in the foundation phase for 3 years. She has a Bachelor of Education degree. She believes that she has to consider the learner's ability for learning and understanding when teaching. Learners have diverse capabilities and backgrounds, so their participation will also differ (Stears, 2009). Vicky believes that her pace when teaching is determined by learners' abilities. Thus, Vicky is a social constructivist teacher.

Vicky is also of the notion that colours or visuals stimulate interest in young learners, since most of them are visual people. She made the following statement based on her use of colours when teaching: "… some learners are visual and need colours to assist them to differentiate between the different columns of data …".

She involves learners when teaching by asking them to read instructions aloud and also by asking learners to come and write answers on the chalkboard. When Vicky was asked the reason for asking learners to always read instructions aloud, she responded as follows: "… at grade 3 level learners need to be able to read their own instructions in preparation for the Senior Phase of their school career…". Thus, Vicky believed that by being able to read instructions learners would be able to proceed to the next phase.

5.3.7 Qinisile (B)

Qinisile is a young teacher at Blackberry Primary, which is is located in a Black township. The school lacks material resources to the extent that even the library is not well resourced and as a result is not functioning. The learner enrolment in this school is 601 and the learner/teacher ratio is about 40:1. There are 13 teachers at Blackberry Primary.

Qinisile has 10 years' experience teaching in the foundation phase and has a teaching diploma. She uses different instructional strategies when teaching and also believes that group work is the

best instructional strategy: "…they learn better in groups because they help each other…". Here she is referring to what Wood et al. (1976) call scaffolding, because learners help those in the group who do not understand.

5.3.8 Jabu (F)

Jabu is a teacher at Pink Primary, which is located in an informal settlement with shacks in the area. The learner enrolment is 1500 and the learner/teacher ratio is approximately 50:1. The number of staff in this school is 30. Pink Primary lacks material resources. There is no library in the school but there are a few computers. However, learners do not have access to the computers because there are too many learners.

Pink Primary caters for learners with special education needs (LSEN). It is a full-service school, which is assisted and maintained to provide for the complete range of these learners' needs. Special education needs are experienced by some learners such that different education measures are taken into consideration to meet their needs (National Commission on Special Needs (NCSNET) & National Committee on Education Support Service (NCESS), 1997). Examples of such special measures as stated by Motiswe (2012, p. 23) are:

- Additional time is expected to be provided for such learners to complete their test, exam paper or activity;
- Special seats must be organised since some of the learners are in wheelchairs;
- Special tuition is required because certain learners may have been left behind others and need to catch up; and
- Additional assistance is needed in some learning areas to overcome difficulties experienced.

Jabu expressed her concern that they were not trained to teach LSEN. There were many LSEN in her classroom and who were above the usual age; as a result she had difficulty in even disciplining or controlling noise. When the researcher observed her lessons, there were learners disrupting the lesson while Jabu was teaching. When asked how she dealt with the LSEN she responded as follows:

> … that is a problem because we have a lot of kids in our classrooms so we go with those who grasp easily. They [LSEN] do not get the special attention because there are many learners that we have to attend to … how can I cope if I can give few learners individual attention? They move to the next grade even if they do not know…

Jabu has a teaching diploma and 5 years' experience teaching in the foundation phase.

Common views emerged from among all of the participants; for example, they believed that use of colours in the data handling lesson attracts the attention of the learners, since most of them are

visual learners. The participants also believed that demonstration, reading instructions and group work are effective instructional strategies when teaching data handling. They said that if demonstration is used in the classroom it is not easy for learners to forget what they have seen. Moreover the participants believed in the reading of instructions, because they said they are preparing learners for the ANA paper, since learners are not assisted when they write. The reason for teachers considering group work as one of the effective instructional strategies is because learners were able to help each other when given work to discuss.

5.4 An analysis of the lesson observations

The participants were observed teaching data handling, and after lesson observations coding was also done. The participants and their schools were given pseudonyms. Two data handling lessons were observed in each school, but some of the participants did not allow the researcher to observe them for a second time, stating that they were busy in their classrooms with other things besides teaching, for example administrative work.

Such observations are the most essential instruments of qualitative research, as the researcher observes all the procedures of instruction while actually being in the natural location (Cohen et al., 2007). This was done to explore the instructional strategies which the participants used to teach data handling. The researcher was able to witness first-hand the types of instructional strategies used during the data handling lessons. Therefore in this section instructional strategies that were used by each participant were listed, in response to the first research question.

By listing the instructional strategies which teachers used, common instructional strategies were identified. Most of the participants used question and answer, talk and chalk, resources and demonstration when teaching data handling. Table 9 lists the instructional strategies that were used by the participants when they were observed teaching. This was done to organise data so that they would be easier to work with.

Table 9: The instructional strategies that were used by each participant

Teacher	Type
Musa	Chalk and talk, question and answer, demonstration, resources, worksheets, repetition, colours and recitation
Qinisile	Chalk and talk, question and answer, work-sheets and repetition
Honey	Chalk and talk, question and answer, demonstration, resources, worksheets, repetition, recitation, colours and group work
Betty	Chalk and talk, question and answer, resources, recitation and colours
Charity	Chalk and talk, question and answer, resources, repetition, and recitation
Jabu	Chalk and talk, question and answer and resources
Fiona	Question and answer, resources
Vicky	Question and answer, resources

Data handling lessons were observed to explore the instructional strategies used and also how those instructional strategies were used when teaching. The participants used different instructional strategies to teach data handling. Learners were actively involved and they (learners) became very excited. When the teacher asked learners questions, they lifted their hands and also stood up, pleading to be pointed out to answer the questions. Vygotsky (1978) is of the opinion that children learn better when they are actively engaged, as has been mentioned before. If one learner gave the wrong answer they also corrected that particular learner by giving the correct answer. What the researcher noticed was that in all of the schools the learners seemed to enjoy data handling.

Table 10 shows how each participant used instructional strategies when teaching data handling, and the data collected assisted in answering the third research question. The third research question is: How do foundation phase teachers use instructional strategies when teaching data handling? During lesson observations the researcher examined how instructional strategies were used. Most of the participants used instructional strategies in the same way, by using worksheets, repetition of what the teacher or other learners were saying, use of colours, reciting time tables and reading the instructions. These data are represented in a table to ensure that the data are easy to recover and to work with (De Vos, 2002).

Table 10: How do foundation phase teachers use instructional strategies when teaching data handling?

Teacher	**How does the teacher use instructional strategies?**
Musa	Worksheets, demonstrations, repetition, reading, recitation
Qinisile	Worksheets, repetition, recitation
Honey	Worksheets, demonstration, group work, repetition, colours, recitation and reading
Betty	Repetition, colours, reading, recitation
Charity	Colours, reading, workbooks, repetition, recitation
Jabu	Reading, colours, workbooks
Fiona	Reading, colours, workbooks
Vicky	Reading, colours, workbooks

What was remarkable during lesson observations is that most of the learners in most of the schools were seated in a formal way, all facing forward in the same direction. Consequently such learners could not interact, since the desks were not arranged in a manner that would be easy for learners to hold discussions. This implies that most of the teachers employed the whole-classroom approach as a strategy to teach data handling. However, Honey and Musa arranged their learners to sit in groups.

Out of eight teachers who were observed, only two allowed their learners to work collaboratively in groups. Musa gave different tasks to different groups, because some of the groups were fast and finished quickly. When the group had finished discussing and writing the task, she gave that particular group another task. On the other hand, other teachers gave the same task to all the learners in the classroom and each learner wrote his or her own work.

The researcher is of the belief that different tasks need to be allocated to the learners because of their different capabilities. In other words, learners do not grasp at the same pace. This may allow all of the learners to participate not only in doing tasks but also in supporting each other.

Donald et al. (2010) and Van de Walle (2007) believe that teachers could consider using different instructional strategies when teaching mathematics, in this case data handling.

After the lesson observations coding was done, and common themes were developed. The common themes were used to assist in formulating questions for interviews. Subsequently eight foundation phase teachers were interviewed. Creswell (2007) points out that themes emerge during the process of coding. Table 11 presents the themes that emerged during lesson observations.

Table 11: Initial themes that emerged during lesson observations

Theme 1	The use of visuals
Theme 2	The use of resources
Theme 3	The use of group work in the classroom
Theme 4	Using the question and answer method in the classroom
Theme 5	The use of demonstration in the classroom
Theme 6	Repetition as an instructional strategy
Theme 7	Recitation as an instructional strategy

Themes that were related were combined; for example, themes number 1 and 2 from Table 11 were combined into the theme of manipulatives (Table 12). Manipulatives are any concrete tools used for teaching (Nelson, 2002), which enhance the learners' understanding of concepts. Professional associations, teachers and researchers have suggested that teaching with manipulatives is a successful classroom instruction practice (Marley & Carbonneau, 2014). Themes 3, 4 and 5 were also combined, into social constructivist methods. Social constructivist methods are those that allow learners to be actively involved during the teaching and learning process, for example in group work, question and answers and demonstration. The, social constructivist perspective envisages teaching and learning as a discussion process (Mishra, 2015). Although there are other instructional strategies, social constructivist methods remain extremely important tools because they allow teachers and learners to develop a broad understanding of mathematics and its application to real-life situations (Lew, 2010). These themes will be discussed further in the next chapter (Chapter Six).

Table 12: New themes after combining the related themes

Theme 1	The use of manipulatives as an instructional strategy
Theme 2	Using social constructivist instructional strategies
Theme 3	Using memorisation as an instructional strategy

5.4.1 Teacher-learner interaction

Generally, in all seven schools, the researcher observed interaction between teachers and their learners. Teachers were using the question and answer instructional strategy to actively engage learners during the teaching and learning process. As has been mentioned before, the majority of teachers used the whole-class teaching strategy, and learners were responding as individuals or as the whole class to the questions asked by the teacher. Another strategy that was used by most of the teachers was repetition. Learners repeated what the teacher had said or what one learner had said in response to the question asked by the teacher. Therefore teacher-child interaction took place through the use of some instructional strategies including question and answer and repetition.

5.4.2 Learner to learner interaction

Regarding learner to learner interaction, it was noted that in two schools where learners were arranged in groups, learners were working together and reporting to the whole class how they had arrived at the answers. While learners were working in groups they were helping each other in doing the data handling exercises.

5.4.3 Teaching and learning resources

Teaching and learning materials are the essential instruments that teachers may use for effective teaching and for learners not to forget what they have learnt. Generally, in all of the schools observed, the classroom walls displayed mathematics and English information. The classrooms had colourful charts hanging on the walls, but none of the teachers used or referred to those charts when teaching. Most of the participants used worksheets, coloured chalk and workbooks when teaching data handling. Different data handling topics were observed, and those topics are listed in Table 13.

Table 13: Data handling topics observed on different days at each participating school

School	Topic, day 1	Topic, day 2
Green Primary	The weather calendar and graphs	Days of the calendar
Blackberry Primary	Arbour day (planting of trees)	Graphs
Yellow Primary	Graphs	Graphs
Reddy Primary	Different types of graphs	Sorting and summarising data
Blueberry Primary	Graphs	Days of the calendar
Pink Primary	Collecting and summarising Data	Graphs
Purple Primary	Collecting and sorting data	Graphs

During the first observation at Green Primary the teacher asked the learners about months of the year and asked them to recite these. Learners were asked to identify the signs of the weather, for example the sun, wind, rain and the clouds. The teacher drew a pictograph on the chalkboard with the signs of the weather. The learners were able to read and interpret the graph, but sometimes the challenge was in understanding the instruction or question. For example, the question was: How much more are the days of the wind to that of the clouds? There were 7 windy days on the graph and 3 cloudy days. The learners were supposed to subtract 3 from 7 and get the answer, which is 4 (7-3=4). Regarding that question, the learners did not give an answer; instead they were all quiet. The reason for not giving an answer was not that the learners were unable to calculate, but they had a problem understanding the question. When the teacher asked learners to give the answer of seven minus three (7-3), they were able to give the correct answer.

The challenge of learners not understanding the questions was also identified at Blackberry Primary. The teacher drew a pictograph with trees since she was teaching about Arbour Day. On the X axis the teacher wrote the names of the schools and on the Y axis she drew the trees. For example, Qinisile's question was: "*In these 18 trees bring back Xolophambili's trees*", meaning that learners should add the number of Xolophambili's trees to 18. In the previous instruction she said they should take away Xolophambili's trees, implying that they had to subtract the number of those trees. The problem then was bringing the trees back. Even when the teacher continued and asked how many schools had more trees, again the learners could not give the correct answer. Qinisile's response was: "*You don't understand the question … How many?*" Therefore

the researcher concluded that learners had a problem of understanding the instructions although they were in their vernacular language. Moreover, it might happen that the learners had a challenge with the word sums, because when the teacher used words like "add" or "subtract" the learners could understand what they were supposed to do.

Although the learners found the pictograph easy to understand, they had a problem reading or interpreting the bar graph. In Yellow Primary School Honey was teaching measurement. She drew the bar graph on the chalkboard, the X axis being the days of the week and the Y axis showing the litres of milk delivered. The teacher, for example, asked the learners how many litres of milk were delivered on Wednesday, and a learner said 15 instead of 44. Honey's response was: "*No … the government will say go and count people and you will come back with wrong statistics because of your carelessness*."

The same challenge of learners having a problem understanding the bar graph was also observed at Blueberry Primary. Charity was also teaching measurements in her classroom. Charity gave learners the exercise about babies' weights, and hung the chart with the bar graph on the chalkboard. On the X axis the names of the babies were written, and on the Y axis the mass in kilograms (kg). When the teacher asked the learners the weight of the first baby, learners gave the wrong answers. The teacher assisted them by pointing at the chart, showing learners the weight of the first baby. Then they were able to give the correct answer.

At Reddy Primary Betty taught learners different types of graphs, and she had drawn those graphs on the chart (the back of the calendar). The graphs that Betty showed learners were the pictograph, line graph and bar graph. When she gave learners an exercise, Betty asked learners to draw a bar graph. That was difficult for the learners to draw and align what was on the X axis with what was on the Y axis. The class exercise was in the learners' workbooks, and none of the learners presented the data correctly on the bar graph. As a result most of the learners struggled until the end of the mathematics period.

At Pink Primary Jabu's learners also could not draw the bar graph on the chalkboard. Jabu wrote the table on the chalkboard with learners' ages from 8 to 11 years. Jabu then asked learners to lift up their hands as she called their age. The challenge was when she asked learners to draw the graph on the chalkboard using data that were in the table. Jabu then assisted learners by drawing the bars herself. Therefore for foundation phase learners the bar graph is a challenge, and teachers need to devise some strategies to alleviate this problem.

What the researcher found remarkable was that when the same topic (graphs) was taught in Purple Primary School, learners did not have any difficulty in understanding and reading the bar graph. The learners were given an exercise based on the pictograph, bar graph and pie chart (graph). The learners at Purple Primary were using their workbooks designed by the school. Every time Fiona gave learners some work to do, she would ask learners to read an instruction. She always said *"What is your instruction? Read."* This helped the learners to think of what was

expected before writing or answering the questions, and this might be the reason for the learners in this school not struggling with understanding the graphs, especially the bar graph.

Since the observations were done in the same school term (third term), most of the topics which were taught in the different schools were the same. More details about the topics taught by teachers will be discussed in the next chapter (Chapter Six).

5.5 Analysis of the semi-structured interviews

After lesson observations with the participants in the classroom, semi-structured interviews were conducted with each foundation phase teacher. The intention of the interview was to clarify what was observed in the classrooms and to explore the instructional strategies the participants used to teach data handling. In addition the semi-structured interviews were to clarify why foundation phase teachers used the instructional strategies that they used when they were observed teaching data handling. The interviews are discussed according to the four main interview questions.

Question 1: Which instructional strategies are effective in your teaching of data handling?

When asked about the effective instructional strategies in their teaching of data handling, most of the foundation phase teachers mentioned the question and answer method, group work and demonstration, not mentioning most of the instructional strategies that they actually used when observed in the classrooms. Those instructional strategies were chalk and talk, recitation, repetition, colours and reading. This may imply that foundation phase teachers were unaware that they were also using those instructional strategies.

The researcher observed that 88% of foundation phase teachers used chalk and talk, and 88% also used repetition, recitation and reading. It was also noticed that all of the foundation phase teachers used colours when teaching data handling. When asked the reason for doing that, they said bright colours excite learners and keep them interested in the lesson. Jabu stated that "… *bright colours attract young children ... catch the learners' attention …".*

Question 2: Which concepts did you cover using those instructional strategies that you have mentioned?

When asked about the concepts covered using the instructional strategies they mentioned, the participants talked about graphs, counting, subtraction and addition. There are many concepts that they covered when observed in class, but that were not mentioned. These were comparisons, data analysis and summarising of data. The participants asked learners to compare data based on the graph given and most of the time it was the pictograph and the bar graph. Learners were also

asked to analyse the information that was given on worksheets or shown to them on the chalkboard.

Question 3: How do those instructional strategies help learners in understanding data handling?

The participants pointed out that the instructional strategies that they used helped learners to grasp concepts easily. Qinisile went on to mention demonstration as the best strategy, because if a teacher uses it the learner does not forget easily, because he/she saw other learners demonstrating or he/she was the one who was called to demonstrate. Most of the participants mentioned group work as the best strategy that helps learners to understand, since they help each other. Qinisile stated that "… *when you give them individual work they have a problem. They work better in groups because they help each other…".*

Question 4: What can you say about the response of learners to the instructional strategies used?

The participants indicated that learners respond with excitement and interest, especially when they use demonstration. Nevertheless, having mentioned that, Qinisile argued that when learners are given work to do on their own they have problems: "… *that is why in ANA paper they do not perform well".*

Data were collected in different contexts. In a case study context is important since people are affected by the environment around them (Thomas, 2011). Data were collected in three rural schools, one ex-Model C school and three township schools.

Information about each participant is presented. The data for this section were acquired from the teacher questionnaire, lesson observations and participant interviews. Then the data collected are discussed in order to respond to the research questions.

5.6 Conclusion

This chapter commenced with a discussion revolving around the coding of the questionnaire, the participants and the participating schools. Subsequently each foundation phase teacher's information is presented. Each foundation phase teacher is discussed with respect to the schools they taught at, their professional qualifications and their beliefs about the instructional strategies used to teach data handling.

After the presentation of the coding of lesson observations common themes that emerged were presented using a table. The chapter concludes with a discussion of the interview questions.

After analysing the data it was revealed that the participants used different instructional strategies to teach data handling. However, learners have a challenge in understanding instructions, and this may be the reason for learners not performing well in the data handling section. What also emerged in this study was that foundation phase learners also had a challenge in understanding the bar graph. This will be discussed in detail in the next chapter (Chapter Six).

Chapter Six

Findings and discussion

6.1 Prelude

The focus of this study was to explore foundation phase teachers' use of instructional strategies to teach data handling. In Chapter Five the data that were collected were presented and analysed. During the analysis the following themes emerged: theme 1 – the use of visuals; theme 2 – the use of resources; theme 3 – the use of group work in the classroom; theme 4 – using the question and answer method in the classroom; theme 5 – the use of demonstration in the classroom; theme 6 – repetition as an instructional strategy; and theme 7 – recitation as an instructional strategy.

The themes that were related were combined. For example, themes number 1 and 2 were combined into the theme of manipulatives. Themes 3, 4 and 5 were also combined into social constructivist methods, and themes 6 and 7 were combined into the theme of memorisation. These themes emerged from the data handling lessons that were observed in the different primary schools. Thematic analysis was used to capture the main instructional strategies that were employed by each participant when teaching data handling.

Data sets for the questionnaire, lesson observations and interviews will be discussed in detail. In this chapter a summary of the study synthesising the themes that emerged in Chapter Five is presented.

The analysis and subsequent results are based largely on the eight participants' responses to the teacher questionnaire, lesson observation transcripts and transcribed interviews. Video and audio recordings helped the researcher to make certain inferences about the instructional strategies used by the participants to teach data handling. Thus this chapter links the analysis of the teacher questionnaire, lesson observations and interviews with the research questions. The research questions that this study aimed to answer were:

1. What instructional strategies do foundation phase teachers use to teach data handling?
2. How do foundation phase teachers use these instructional strategies to teach data handling?
3. Why do foundation phase teachers use these instructional strategies to teach data handling?

In this chapter the main findings of the study are presented by addressing each of the research questions. The first question was addressed by the teacher questionnaire and lesson observations, the second research question was also addressed by the lesson observations, while the interviews

aimed to answer the third question. All of the participants employed various instructional strategies during the data handling teaching and learning process.

6.2 Theme 1: The use of manipulatives as an instructional strategy

Manipulatives are concrete objects used to assist learners understand mathematics concepts, as mentioned previously in Chapter Five (Peterson & McNeil, 2013). Marley and Carbonneau (2014) suggested that teaching with manipulatives is an effective instructional strategy. Manipulatives in this study include visual tools and resources. Learners might require real tools to build meaning at the outset, but subsequently are expected to reflect on their use of these real objects (Naidoo, 2012). This reflection helps learners in developing significant knowledge of ideas and to think about these concepts at an advanced level.

Learners need to be supported to do the work cooperatively with each other in order to socially construct meaning. Likewise, Ford and Wargo (2012) maintained that it is imperative to bear in mind that learners learn better when they are actively engaged. Significant learning requires that new knowledge is well-matched with prior knowledge in the learners' minds. To support the learners in assimilating new knowledge, the participants used different coloured chalk and highlighters to make data handling more comprehensible.

6.2.1 The use of visuals

All of the participants used visuals when teaching data handling in their classrooms. Researchers in the field of visualisation (Drews, 2007; Iline, 2013; Naidoo, 2012) argue that using visual instruments is important and effective in the teaching of mathematics. Iline (2013) states that using visual tools make ideas and concepts clear. Naidoo (2012) points out that the use of visual instruments make mathematics easier to remember and fun. By visuals the researcher refers to colours, graphs, gestures, etc.

The visual tool that was utilised by the majority of the participants was the use of different colours. The participants used colours as a helpful instrument to assist in gaining learners' comprehension of concepts, because colour prompts improve performance (Dzullkifli & Mustafar, 2013; Kercood & Grskovic, 2009). The learners may perhaps mentally manipulate the aspects that colour implies on the chalkboard to find meaning. This manipulation supported the teaching and understanding of data handling. The participants also highlighted that using different colours made data handling lessons interesting to learners. When teachers use instructional strategies that excite and engage learners, learners' achievement and motivation may improve (Moore, 2012). This is supported by Charity, who said "… this makes your lessons to be interesting to them [learners]. They get excited and stay interested …".

Most of the teachers used coloured chalk when they wrote on the chalkboard and also drew graphs on the charts using coloured pens. Different bars of the graphs were identified by using different colours. When asked about the reason for using different colours when teaching data handling, they all explained that colours attract the attention of the learners, since young children like bright colours. Charity went on to say that "... even when they [learners] colour their work … they see their work being beautiful and they really feel that they have achieved something …".

The participants also pointed out that colour emphasises the difference when teaching. For example, Honey presented data in a bar graph and she used seven different colours, each bar in the graph represented in a different colour. When Honey was asked the reason for using colour when teaching data handling, she responded: "... you use colours so that learners will see the difference when you are teaching." Different colours can be used to highlight different concepts in data handling. Jabu also pointed out that "... we use colour to stress the difference … Like when you draw a graph you use different colours".

Betty was also of the same opinion that teachers use colours when teaching data handling to highlight the difference:

> So I use coloured chalk when writing the days of the week, for example, because Monday is not the same as Tuesday so you want to show the difference … You use coloured chalk just to stress the point that the days of the week for example are different …

In addition, the use of different colours attracted the learners' concentration. Gaines and Curry (2011) suggest that colour captures the learners' attention. These viewpoints are captured by the following excerpts from the interview transcripts:

> **Qinisile:** "... different colours for kids attract and also make them to pay attention ..."
>
> **Honey:** "... bright colours catch the children's attention ..."
>
> **Jabu:** "... just decorating so that it will catch the learners' attention, as a result they will concentrate ..."

These participants' responses indicate their viewpoint that in order to attain understanding, the initial step is to get and sustain focus and attention. Their responses are in agreement with what Back, Brooksbank and Faux (2007) stated – that learners learn best when they take pleasure in their learning in a comfortable, encouraging and focused setting.

6.2.2 The use of resources

Resources are important tools that teachers can use for effective teaching and learning; moreover learners do not easily forget concepts and ideas if concrete tools are used (Machaba, 2013).

Generally, in all of the participating schools, the classroom walls displayed informative charts but the teachers were not referring to them when teaching. However, displaying information and not using it is of no benefit.

For example, in Musa's classroom public holidays were displayed on the walls. The dates and the names of those holidays were written, but one of Musa's data handling lessons was about the calendar – and she did not refer to her wall display. The researcher assumes that learners were not used to referring to the wall displays, because even learners did not refer to the wall for answers when asked questions. Resources, especially wall charts, are of benefit if they are used.

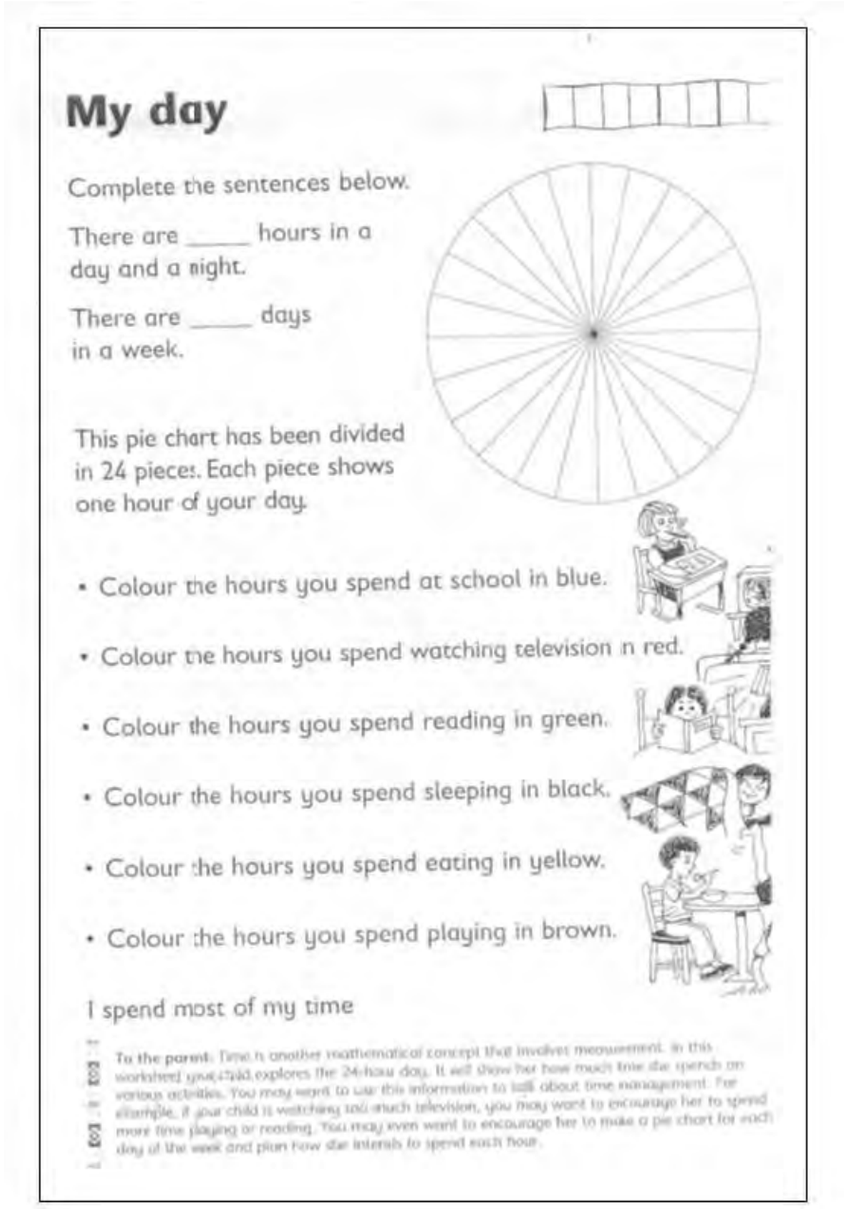
Teachers used different resources to teach data handling. According to Iline (2013) resources support retention, understanding and capturing of concentration. Moreover resources can make the learning process simpler and more enjoyable (Fullan & Langworthy, 2014; Iline, 2013; Froyd & Simpson, 2010). The participants confirmed this point during interviews when asked about the effective instructional strategies in their teaching of data handling. As Qinisile put it:

> … designing your own resources for teaching data handling … if you want to draw a graph for learners to see, you make your own chart … and your lesson will be simple and easy to deliver…

Schools need to ensure that teachers have the resources to provide learners with the best learning opportunities (Anthony & Walshaw, 2009).

Some of the teachers used worksheets when providing learners with an activity to do in the classroom. They also used the Department of Education workbooks, while one school (Purple Primary) had its own workbooks. For example, Vicky from Purple Primary School was teaching learners how to summarise data collected by using a pie chart, and learners were using their workbooks designed by the school. The lesson focused on a pie chart concerning hours in the day. Vicky was using a real-life situation when teaching learners about the hours of the day. The pie chart had 24 pieces representing the hours in the day. Vicky asked the learners to colour in the graph according to how they spend hours in a day. For example, if they said they spent 7 hours at school, they had to colour in 7 pieces in the pie chart, and if they said they spent 2 hours playing, they had to colour in 2 pieces, and so on until all of the pieces in the pie chart were given an activity. While learners were writing, Vicky walked around checking whether learners were doing the work correctly and also explaining to those who did not understand.

Purple Primary workbooks included a note to the parents below each activity, letting parents know how that activity would help the learners in real life. The above exercise example is shown in Figure 9.



My day

Complete the sentences below.

There are _____ hours in a day and a night.

There are _____ days in a week.

This pie chart has been divided in 24 pieces. Each piece shows one hour of your day.

- Colour the hours you spend at school in blue.
- Colour the hours you spend watching television in red.
- Colour the hours you spend reading in green.
- Colour the hours you spend sleeping in black.
- Colour the hours you spend eating in yellow.
- Colour the hours you spend playing in brown.

I spend most of my time

To the parent: Time is another mathematical concept that involves measurement. In this worksheet your child explores the 24-hour day. It will show her how much time she spends on various activities. You may want to use this information to talk about time management. For example, if your child is watching too much television, you may want to encourage her to spend more time playing or reading. You may even want to encourage her to make a pie chart for each day of the week and plan how she intends to spend each hour.

Figure 9: The school worksheet given to learners at Purple Primary School.

The worksheet as depicted in Figure 10 was used by Honey at Yellow Primary School. This worksheet is from the Department of Education's workbook. It is written in IsiZulu since learners in the foundation phase learn in their vernacular language. The learners had to read off information from the graph and answer questions related to the graph. The learners had a challenge answering the questions, especially number 5. The question was "*Wagijima kangaki uMnuz Naidoo eminyakeni emithathu?*" (How many times did Mr Naidoo run in 3 years?). Some learners looked at the longest bar and gave 200 as an answer based on that. Although this worksheet was used on reflection, the teacher could have phrased this question differently. The way the question was phrased was confusing to the learners. The Y axis on the graph is labelled as "*ukugijima*" (the races) and it is not clear whether it is the number of races or kilometres that Mr Naidoo ran. The answer to question 5 that the learners would have given would be 3 times, according to the way the question is phrased. The expected answer for that question was 400.

For example, for Mr Naidoo the longest bar indicates that he ran 200 times but in 1998, not in 3 years as learners thought. The learners were supposed to add the number of the races Mr Naidoo ran in 3 years, for example: 200 + 120 + 80 = 400

Therefore, the way in which question 5 was phrased and the expected answer did not match. Although learners had a challenge understanding the bar graph, unclear questions were also contributing to the problem.

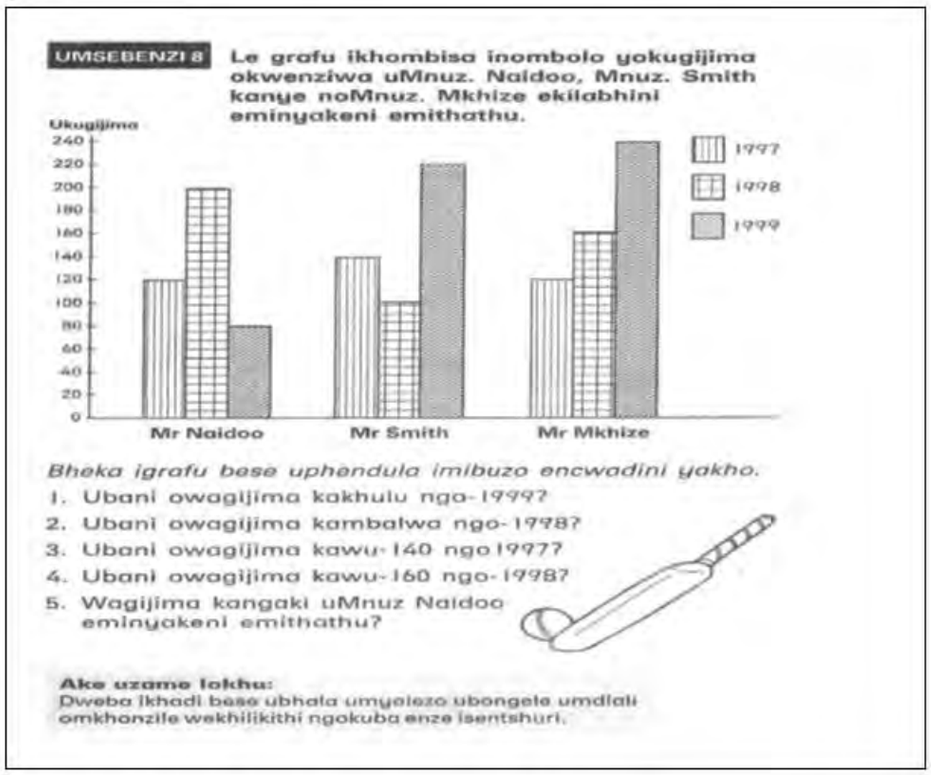


Figure 10: The worksheet used at Yellow Primary.

6.3 Theme 2: Using social constructivist instructional strategies

The use of social constructivist methods in this research study refers to the use of demonstrations, group discussions and the question and answer method. These instructional strategies, that were used by the majority of the participants, are referred to as social constructivist methods (Solso, 2009). Orey (2010) argued that teaching with social constructivist instructional strategies in mind engages the learner as a dynamic contributor in the classroom setting. Since the instructional strategies that were used by the participants were allowing learners to be actively involved in the classroom, they are social constructivist methods.

An efficient teacher possesses many instructional strategies and can choose those that will be most successful for directing the learners to a required behaviour (Adekoya & Olatoye, 2011). All participants that were observed were using different instructional strategies when teaching

data handling. Charity pointed out that "If I see that they [learners] do not understand, then I change the method I was using, because it means that it did not work." Therefore it is important for a teacher to check whether the instructional strategies that he/she is using are working, so that if they do not work he/she can change them and use others.

Social constructivist methods provide the learners with the opportunity to think critically (Solso, 2009). Learner interaction is a useful instrument for learning, and is also the best motivator (McDermott & Naaz, 2014).

When Jabu was teaching data handling in her classroom, she was using real-life data. Libmam (2010) proposed that real-life examples be used when teaching data handling. Mvududu and Kanyongo (2011) also pointed out that the objective of statistics is to respond to real-world problems. Jabu asked learners their age and calculated the number of learners who were, for example. 9 years of age before she drew the bar graph on the chalkboard. Therefore learners were taught the bar graph using what they could relate to, which was their real age. Vygotsky (1978) suggested that authenticity is vital when it comes to problems given to learners to solve.

6.3.1 The use of demonstration in the classroom

The majority of the participants who were observed using demonstration were using learners as the demonstrators. The learners were excited to be a part of the lesson. Demonstration is the undeviating means of clearing up things to the learners (Iline, 2013). The majority of the participants mentioned demonstration as the most effective instructional strategy of teaching data handling. They pointed out that learners understand better when the demonstration technique is used. Qinisile said "As I mentioned that if you call learners to come forward and show the class what you want to say using learners as an example, they understand better". Learners grasp more easily when demonstration is used, and that may raise the learners' achievement (Adekoya & Olatoye, 2011).

Iline (2013) argued that the demonstration technique allows learners the chance to see and hear the details related to what is being taught. When the researcher observed Honey's lesson teaching measurement, she had bottles with different capacities. Normally it is not easy to forget something that a person has seen. Research shows that learners can retain information from their science class demonstration for numerous years (Shmaefsky, 2005). Qinisile confirmed this by saying "they do not forget what was shown using other learners". Demonstration helps in understanding abstract ideas or concepts (Shakashiri, 2011; Milne & Otiemo, 2007). Therefore demonstration may raise learners' performance in data handling, and is an effective mode of instruction when teaching (Adekoya & Oladoye, 2011).

Fiona had plastic blocks in different sizes in her classroom which she used for demonstration. For example, when Fiona asked the learners to write the number sentences on the chalkboard for

subtraction, some started with small numbers. In other words, they subtracted a big number from a small number. For example they would write 3-5 = 2. Then Fiona showed learners an object with 3 blocks and asked "...these are the 3 blocks, can I take away 5?". By demonstrating to learners that a big number could not be subtracted from a small number using a concrete object, learners understood. They were able to see and comprehend the details of what was being taught.

Jabu pointed out that demonstration contributed to learners' understanding of data handling: as follows:

> … they become excited if it is something they can see. For example, if you show them something related to what you are teaching they remain interested and concentrate … demonstrating what you teach …

According to Sola and Ojo (2007) demonstration increases retention, motivates learners and encourages collaboration. Qinisile also mentioned demonstration as assisting learners to understand data handling:

> "*Ayabasiza ukuthi babambe masinya, njengoba bengishilo* [helps them to grasp easily, as I mentioned] ... and you show the class what you want to say using learners as an example, they understand better. They also stay interested in the lesson because it is not boring. *Kufana nokudlala kubona...abayikhohlwa into abayikhonjisiwe kusetshenziswa abanye abafundi* [It is like playing to them … they do not forget what was shown using other learners].

The demonstration method of teaching is effective in raising the learners' achievements (Adekoya & Olatoye, 2011; Ekeyi, 2013). Therefore the demonstration method assists the learners to be proficient (Iline, 2013). Using this strategy to teach data handling may be of great benefit to the learners and may improve their performance in data handling.

Therefore, social constructivist methods of teaching assist learners to learn in a more collaborative, genuine and responsible manner (Reuy, 2010).

6.3.2 The use of group work in the classroom

Two participants out of eight used group work as one of their instructional strategies. Nevertheless all teachers when interviewed mentioned group work as an effective instructional strategy when teaching data handling. To maintain the progress of collaborative and communication abilities, learners should be provided with opportunities to do activities jointly on a problem (Chiu, 2004). The participants stressed that learners work better in groups. Qinisile said "they work better in the groups because they help each other". Although Qinisile did not use group work during her lessons, she had an understanding of its benefits to the learners as they assist each other. This is what Wood et al. (1976) refer to as scaffolding.

With scaffolding instruction, a more well-informed person gives guidance to make the learners' development possible (Siyepu, 2013; Van der Stuyf, 2002). Many studies indicate that it is beneficial for learners to work in groups (Felder & Brent, 2007; Brijlall & Maharaj, 2009; Eison, 2010). Working with other people may assist learners to develop their abilities by allowing them to notice other people's viewpoints (McCoy, Smyth & Banks, 2012). When learners interact in a discussion in class they learn to consider other learners' opinions. Therefore learners gain more conceptual understanding when interacting than when the teacher is the only one delivering information.

Discussions increase learners' learning and can also motivate them (National Council of Teachers of Mathematics (NCTM), 2013). Thus allowing learners to work in groups may help them to benefit from each other. Honey engaged learners in group discussion but did not mix learners by different ability levels. Learners who were slow to grasp were working in one group; as a result they could not finish the task because they were struggling, and they also could not present their answers to the whole class. Those learners who were quick to grasp were able to present their answers to the whole class. This means that although Honey uses group work, she does not do so in the way the literature suggests for scaffolding purposes.

Group discussion is an effective strategy, especially for good learners because they attain an advanced level of understanding by sharing ideas and are also able to help other learners (Mahalingam, Schaefer & Marlimo, 2008). Anthony and Walshaw (2008) suggested that groups be mixed according to academic achievement, since insights can be provided at different levels. What the researcher observed at the participating schools was the opposite, because learners were arranged according to their ability levels. The participants said that they made that sitting arrangement so that they could identify learners and help them according to their level of understanding (Critelli & Tritapoe, 2010).

The participants mentioned group work as one of the effective instructional strategies, although they hardly utilised this strategy. Qinisile's comment about group work was "they [the learners] work better in the groups ... that is why it is said we have to let them work in groups". Group work involving small numbers of learners can be used as a fruitful instructional strategy (Baines, Blatchford & Chowne, 2007). Paine, Monk-Turner, Smith and Sumter (2006) state that there are a number of benefits of using group work, which include learners learning teamwork, advancing their critical reasoning skills and attaining more insight about a certain topic.

Thus, group discussion is effective when teaching data handling since the literature recommends this strategy and states that group work is a collaborative approach and involves classroom interaction (Delucchi, 2006; MacQuarrie, Howe & Boyle, 2012). Therefore, allowing learners to work in small groups may enhance their understanding of data handling, and that may contribute positively to their performance.

6.3.3 Using the question and answer method in the classroom

All of the participants used the question and answer method more frequently than other instructional strategies. When asked the reason for doing so, they said that the question and answer method is effective because one is able to see whether learners understood or not. When Fiona was asked about the importance of using this, her response was "it is a great way to effectively assess the understanding". Asking probing questions could reveal the cause of the learners' misunderstanding (Sibuyi, 2012). By asking questions a teacher can determine whether learners understand or not. Thus all the participants recommended the question and answer method as an effective instructional strategy. A teacher provides learners with scaffolds when questioning learners, because he/she is assisting them to understand what is being taught (McCoy et al., 2012). It can be concluded that scaffolding is one of the best instructional strategies (Sa-Ngaphan, 2013). All participants provided scaffolds to their learners during the teaching of data handling.

Charity recommended the question and answer method as an effective instructional strategy that contributed to learners' understanding. Questioning is used to identify and broaden the learners' thoughts and to scaffold their thinking (Ahtee, Juuti, Lavonen & Suomela, 2011). Charity's comment about how learners benefit from the instructional strategies she used was: "… and I also pose some questions and that makes them to understand. So the question and answer method helps them to understand". Thus posing questions during the teaching and learning process enhances learners' understanding.

Honey stated as follows:

> … question and answer method clears some misconceptions because as you pose questions it is like guiding or directing them [learners] to the correct answer… As a teacher you keep on phrasing questions differently if you see that learners do not understand until they reach the expected understanding

Cruickshank, Jenkins and Metcalfe (2009) point out that it is important to ask learners to substantiate their responses, in an effort to direct them to the right answer. When teachers ask questions, it is required that they use probes as a means to follow-up and provide guidance through questioning and allowing learners to form their own answers with minimum support (Berk, 2009). Therefore considering the participants' comments, the question and answer instructional strategy is of benefit to learners' learning of data handling. Musa pointed out that questioning is of vital importance in data handling:

> … in some cases they [learners] might be asked to do their own survey where they might be expected to interview other learners and record all the responses … without questions learners would not be able to solve data handling problems. Questioning is part and parcel of data handling …

Questioning also promotes critical thinking (Popil, 2011).Moreover, learners are actively engaged and there is interaction between the teacher and the learner. According to Critelli and Tritapore (2010) the teacher needs proper questioning skills to keep learners actively involved and interested in what he/she is teaching. Reuy (2010) states that instructional strategies that require interaction and collaboration are of benefit to learners because learners support one another's learning. Therefore active learning assists learners to develop skills, including problem solving, critical thinking and being able to analyse (Kunselman & Johnson, 2004).

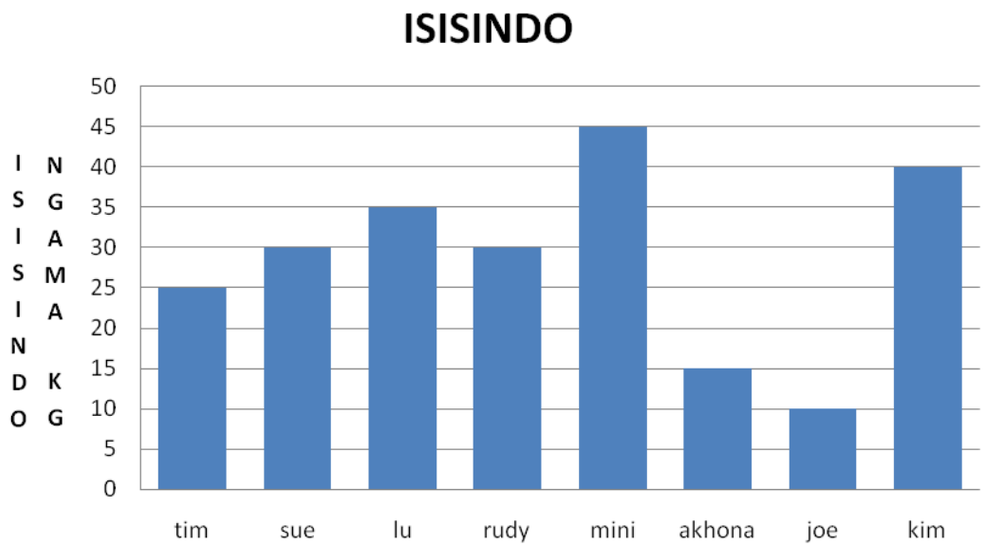
Active learning refers to an instructional strategy that actively involves learners in the learning process (Prince, 2004). Therefore, learners perform better when they are actively engaged in learning (O'Grady, Simmie & Kennedy, 2014). All of the above mentioned skills are essential in the learning of data handling, since a problem is posed and learners have to solve that problem by collecting and analysing data, and they have to reason critically to solve the given problem. Therefore, by asking questions during each data handling lesson the teacher is guiding the learner and also encouraging critical reasoning. Moreover, questioning promotes classroom communication and interaction (Ahtee et al., 2011).

Bloom's taxonomy is important when determining the types of questions the teachers should ask their learners (Critelli & Tritapoe, 2010). Bloom pointed out that there are six different levels of thoughts – knowledge, comprehension, application, analysis, synthesis and evaluation (Cruickshank et al., 2009). In describing these six levels of thinking, Bloom stated that the first three represented the low-order thinking and the last three represented the high-level thinking. Therefore teachers need to appeal to each level of thought to encourage learners to draw conclusions, associations and applications of what they receive during the learning process (Critelli & Tritapoe, 2009).

Thus, teachers need to ask questions that appeal to different mental operations. For example, teachers need to ask learners to justify their answers (Cruickshank et al., 2009; Maharaj, 2014; Ndlovu & Brijlall, 2015). At the schools in this study most of the participants were not asking follow-up questions. On many occasions the learners would respond as a 'choir' and the teacher would move on to the next question. If one learner gave an answer, the participant would ask the class to applaud for him/her or alternatively repeat what that particular learner had said. If teachers do not follow-up on answers or ask learners to justify their answers, other learners might be left behind. Moreover, asking learners to justify their answers promotes critical reasoning (Colton, 2010; Thomas, 2011; Moodley, 2013).

Charity used the question and answer instructional strategy throughout her lesson and then at the end of the lesson gave individual work for learners to solve. Charity was teaching the learners about measurement and also used the bar graph to represent data. What the researcher realised was that learners had a problem reading the bar graph. According to the ANA report (DBE, 2014) learners are expected to compare data, as mentioned in Chapter 5. Charity, Honey and Betty presented data using a bar graph. When the participants asked questions based on the bar

graph, some learners could not find the answers from the graphs. The bar graph is illustrated in Figure 11 is the class activity that Charity used to teach her data handling lesson.



Funda igrafu bese uphendula imibuzo elandelayo (Study the graph and answer the following questions.

1 Ubani osinda kakhulu kunabo bonke? (Who has the highest weight?)

2 Ubani osinda kancane kakhulu? (Who has the least weight?)

3 UMini usinda kakhulu ngobani kunoLu? (Mini weighs how much more than Lu?)

4 Obani abantwana abanesisindo esilinganayo? (Who have the same weight?)

5 Shono isisindo sabantwana sebebonke. (Give the total weight of all the babies)

Figure 11: The bar graph used, adapted from Charity's worksheet.

Charity provided a summary of babies who went to the clinic for immunisation in a bar graph. On the X axis she wrote the names of the babies and on the Y axis she wrote the babies' weights in kilograms (kg). Charity asked learners the weight of the first baby (Tim), and they gave the wrong answers (instead of giving 25 kg as the correct answer). Charity's response to the learners' wrong answers was "Hey grade 3 be careful, make sure you give the correct answer ... Haybo! (Oh no!) What is your problem ...?" Charity would ask learners questions until she showed them the answer by pointing at the graph.

Charity used the question and answer instructional strategy more frequently than other instructional strategies. Perhaps if Charity had given the learners the chance to discuss the bar graph in groups, they would not have encountered so much difficulty in solving the questions. They would have helped each other and as a result would understand the bar graph better. Even during Charity's second lesson, when she taught learners the calendar, she used the question and

answer instructional strategy throughout the lesson to assist with the memorisation of concepts. She then proceeded to provide learners with an individual exercise to complete. Using a variety of instructional strategies is important because learners have different levels of understanding (Felder & Brent, 2005; Pashler, McDaniel, Rohrer & Bjork, 2009).

Charity arranged her learners to sit according to their learning capabilities. Those who were slow to grasp concepts sat in their own row, which was the last one. Those who were quick to grasp sat in the first row. When Charity was asked about that, she said she wanted it to be easy for her to help learners as individuals. Nevertheless, Charity was unaware that she was giving more attention to the learners who grasped quickly. Even when teaching she stood in front of the learners who were more capable because they gave her the answers. Those who were struggling seemed to be ignored, because they were always quiet.

Mixing learners of different ability levels would be of benefit to those who have challenges in grasping information, because they would be motivated by those who are quick to grasp**.** Therefore allowing learners of varying levels of understanding to interact in a group is of benefit to all of the learners in a group.

Betty also used the question and answer instructional strategy more frequently when teaching data handling. She taught learners various types of graphs (line, pictograph and bar graphs), but spent much time on teaching the bar graph. When Betty gave learners the class activity, she asked them to draw the bar graph. For grade 3 drawing the bar graph was a challenge. They took a long time, and at the end produced incorrect drawings. The learners could not correctly establish what was on the X axis and what was on the Y axis. Nevertheless, Betty engaged her learners when teaching. She also asked learners to write answers on the chalkboard while employing the question and answer instructional strategy. When Betty was teaching learners how to summarise data using the tally table, she also asked learners to draw tallies on the chalkboard. Her learners seemed to enjoy the lesson because most of them wanted to go and write on the chalkboard.

Fiona used different instructional strategies in her data handling lessons. She used the question and answer instructional strategy and also kept encouraging her learners to read the instructions. Fiona also engaged learners when teaching by reading the instructions and asking them to write answers on the chalkboard. During her interview she expressed the importance of reading an instruction as follows: "... it is important for everyone to read instruction in order to succeed in life ... it is for holistic development". Fiona was not teaching learners to achieve only the LOs specified by the mathematics curriculum, she was teaching them how to apply what they learnt in real-life situations.

Fiona's lesson revolved around sorting and summarising data. She provided her learners with worksheets with pictures; learners had to cut the pictures out and sort them by pasting pictures on another worksheet to design a pictograph. She consistently checked on her learners to see

whether or not they were doing the work correctly. Fiona also helped those learners who were slow by cutting for them while the learners had to paste. Therefore Fiona was interacting with her learners while scaffolding the instruction to learners. She only moved on to the next step when all the learners had understood what she was teaching. Fiona provided individual assistance during each lesson.

Fiona's class size contributed to the way she taught, because it was small. She had 20 learners in her classroom. Thus providing individual attention to the learners was not a challenge to her. Moreover, Fiona had all the resources she needed for her data handling lessons, and her learners also had everything they needed for their learning, including the necessary pens, coloured pens, glue and scissors.

6.4 Theme 3: Using memorisation as an instructional strategy

Memorisation is a traditional method of teaching where teachers 'drill' learners to support learning. For example, as the learners recite tables, they also memorise them. This type of instructional strategy is influenced by Skinner's approach (Solso, 2009). Teachers who use the traditional method of teaching believe that it is the only way that teachers can help learners to grasp mathematical skills (Molefe & Brodie, 2010; Solso, 2009; Sessions, 2008). According to the NCTM (2013), when using the traditional method of teaching the teacher is in charge of the topic. Teachers are also in charge of the pace and steering the direction of the progress of the topic. In other words, this traditional method of teaching is teacher-centred.

However, it is a challenge to teachers who as a learner never experienced another type of instruction other than lectures or recitations, to explore other strategies (Morrongelle & Rasmussen, 2008). The researcher asked each participant during the interview why she was using the memorisation instructional strategy, for example recitation and repetition when teaching data handling. The participants believed in coaching learners by asking them to recite number tables, calculations and repeating after the teacher or after the learner who gave an answer. When the participants were asked the reason for using memorisation when teaching data handling, their responses were as follows.

> Honey: "... that is the old method that was used in my time ... But even now it helps because it trains learners to be able to memorise numbers …"

> Jabu: "... even us, that is the way we learnt …"

For example, recitation was also done by the researcher during her school years. Every morning before the mathematics lesson, learners had to stand up and recite tables, for example 3×1=3; 3×2=6. McDermott and Naaz (2014) conducted a study on the effectiveness of recitation, but could not find its benefits to teaching. Eison (2010), Sharma (2013), McDermott and Naaz (2014) emphasised the importance of retention during teaching and learning, which is not evident

when recitation is used as a method of teaching. Learners memorise and forget easily. The researcher witnessed this during lesson observations. Learners were reciting numbers every day, but still could not remember this information in the following lesson. They would struggle, for example, with the 3 times table.

When the researcher observed the participants teaching data handling, memorisation was the dominant instructional strategy. This traditional method of teaching does not provide learners with an opportunity to share ideas about the data handling topic presented (Mahalingam, Schaefer & Morlimo, 2008). Thus, this method deprives learners of the collaborative learning which promotes critical thinking. Traditional strategies generally encourage learners to memorise facts rather than to develop conceptual understanding (Birgin, 2011).

Nevertheless, memorising the mathematical equations and concepts is not important, but what is imperative is to capture the satisfaction produced by comprehending the reason things happen (Riveros, 2012). This is part of critical thinking. Memorisation is in contrast with social constructivism, because social constructivist teachers believe that learners have to be guided properly to be able to formulate answers on their own (Solso, 2009). In other words, learners do not need memorisation to master mathematical skills. Memorisation does not promote discovery or collaborative learning (NCTM, 2013).

In addition, memorisation does not promote critical thinking and communication (Towler, 2014). Out of eight participants, two did not use the memorisation instructional strategy. When asked the reason for not using, for example, the repetition method, Felicity stated as follows:

> … I do not ask learners to repeat anything in class because I want them to learn to listen to an individual when talking … If they know that something is going to be repeated they will not listen …

Felicity was emphasising the importance of the listening skill in the classroom, because if learners lack this skill they may experience a problem in their learning. Other teachers had a different opinion about using the memorisation instructional strategy, for example Betty's comment was the following:

> … we want them to be able to count and to recall numbers ... we get so interested when we see them being able to count. You can also see those people who cannot count and also those who cannot count can learn by hearing others and join them … it stays in their heads when they repeat. We do it for those who do not listen in class. So when you make them repeat you want them to understand what you are saying. They can repeat even more than two times so that they will understand …

Betty believes that learners will be able to understand what is taught when they memorise mathematical concepts. In other words, she was of the opinion that coaching learners is the effective way of teaching and assists learners to grasp what is taught. Jabu also believed that memorisation is effective when teaching data handling: "… so it is better to make them repeat so

that even the one who did not understand while I was explaining will do …". Jabu believed that memorisation assists learners that do not understand when she explains. In other words, she used memorisation to accommodate all of the learners.

According to Gordon and Nicholas (2005), learners who learn by memorising, when asked leading questions, show a lack of understanding to accompany that learning. Therefore most of the time learners repeat and reproduce what they learn not because they understand, and at a later stage they might forget or may not be able explain around those facts or concepts.

Most of the participants (6 out of 8) were asking learners to memorise facts rather than understanding them or allowing learners to find ways of understanding data handling concepts on their own. Peter (2012) states that mathematics teachers can develop learners' critical thinking skills by assessment strategies that challenge learners intellectually rather than memory recall. Therefore the issue of memorisation has been a barrier to thinking and reflection in the classroom (Vassall-Fall, 2008).

Cai and Wang (2010) conducted a study that investigated Chinese and American teachers' beliefs concerning effective mathematics teaching. The Chinese and American teachers believed that there are two kinds of memorising: memorisation after understanding and memorising before understanding. According to the findings, the teachers from these two countries recommended memorisation after understanding. The reason they gave was that memorising after understanding assists learners in retaining knowledge, and that knowledge could be applied efficiently to solve problems. Therefore the Chinese and American teachers were not against memorisation, but felt that memorising is effective if it is done for retaining after understanding is gained.

What the researcher realised in the participating schools is that teachers asked learners to memorise before understanding, because the participants used the memorisation strategy first before employing other instructional strategies. However, Schollar (2008) and Taylor (2008) argue that the loss of the importance of memorisation, and the initiative of discovery learning and that learners cannot be wrong are the origin of much learner underachievement.

Therefore, there are many different ideas on the notion of memorisation as an instruction during the teaching and learning process. Some researchers view memorising facts as effective and others not. However, drawing the two ideas together – using memorisation together with other instructional strategies – could be of benefit to the learners.

It is important to check the learning goal before employing the instructional strategy when teaching (Ermeling et al., 2015). A good instructional strategy for one learning goal might not be effective for another (Sapon-Shevin, 2013; Emerling, et al., 2015). Thus, the participants used different instructional strategies to teach data handling. The participants needed to plan or to have objectives to use certain instructional strategies when teaching, so that they would teach according to the desired learning goals. For example, if the learning goal was for the learners to

know numbers, then they could ask them to recite number tables. Repeating facts and memorising throughout the lesson may not contribute to learners' understanding of data handling concepts or content.

6.5 Conclusion

The majority of the participants used the question and answer instructional strategy most frequently during the data handling lessons. Six out of the eight teachers used memorisation throughout their lessons. Teachers believed in coaching and recitation in their teaching. This might be the reason for low performance, because learners cannot retain what they have memorised for a long time. In other words, some teachers did not encourage critical thinking in the learners. The teachers need to use instructional strategies that promote critical thinking.

Although the participants used other instructional strategies, for example social constructivist instructional strategies, they still believed in the traditional way of teaching. Out of eight participants only two used group discussions. Large class sizes could be a possible reason for participants not using group discussions during teaching. In most of the participating schools the classrooms were overcrowded, especially those in rural areas and townships. Additionally, the researcher noticed that the participants spent a lot of time providing learners with individual work. Learners had to complete class work as individuals and they (learners) had to keep quiet.

The findings of this study suggest further that group work was mostly utilised by the participants who had undergone professional development. Thus, attending professional development programmes may encourage teachers to apply new strategies for teaching mathematics and statistics (Foley, Khoshaim, Alsaeed & Er, 2012), in this case data handling.

Moreover, the findings from the study also suggest that some of the learners had a challenge in working with bar graphs. Learners were unable to compare or read information from the bar graph. The learners responded well when they were taught in the classroom and they remained interested in the data handling lessons, but when they had to work individually they had a challenge. Learners had a problem understanding the instructions without having them explained to them before writing. This might be the reason for learners not performing well during formal assessments, for example in the ANA. Teachers need to construct instructional strategies that will encourage learners to read the instructions before answering the question.

This chapter dealt with the findings around the instructional strategies the participants used during their data handling lessons and how they used those instructional strategies. The reasons for using such instructional strategies were also explored in this chapter. This study was worth doing because the instructional strategies which teachers use during the teaching and learning process have the potential to influence learners' achievements (Firmender et al., 2014). In this

case, the instructional strategies teachers use to teach data handling may influence learners' performance.

The next chapter concludes the study by discussing the recommendations and the limitations of the study.

Chapter Seven

Concluding remarks, recommendations and limitations

7.1 Prelude

In Chapter Six the themes that emerged as a result of this study were discussed. This chapter presents the concluding remarks, recommendations and limitations relating to this study. This study began with exploration of foundation phase teachers' use of instructional strategies to teach data handling. The participants were selected from primary schools within the Pinetown district. Eight female participants were observed, video recorded and interviewed.

The study explored the use of instructional strategies that foundation phase teachers used to teach data handling. Additionally, the study focused on how and why the foundation phase teachers used these instructional strategies in their data handling lessons. To answer the research questions, three research instruments were employed in this study. The first was the teacher questionnaire, which was used to gather information focusing on the biographical data of each participant.

The second research instrument was an observation schedule, which was employed to examine the instructional strategies used by the participants during the data handling lessons. The third research instrument used in this study was a teacher interview schedule. One-on-one interviews were conducted using a semi-structured method with a set of interview questions to steer the investigation. The interview schedule assisted in exploring the teachers' thoughts about why they used specific instructional strategies when teaching data handling. The researcher probed each teacher's responses to establish the reasons for using specific instructional strategies in data handling lessons. The probing was imperative because during the lesson observations the teachers used different instructional strategies, and the researcher wanted to know the reason for this. When the participants were asked about the use of those instructional strategies, they indicated that they used them to enhance the learners' understanding.

To gather rich data for this study a qualitative methodology was used. The one-on-one interviews with the participants exposed a broad account of the factors that influenced their decisions to use different instructional strategies to teach data handling. Descriptive information was derived from the video-recorded lessons and audio-taped interviews. A thematic coding classification was developed to analyse the data generated. Themes emerged from the coded transcripts and these were analysed qualitatively.

7.2 The researcher's thoughts

Data handling is considered by many as the easiest section in mathematics, yet when one looks at the ANA report (DBE, 2014) this is not evident. Although data handling is considered to be easy, learners are not performing well in this section. Data handling is one of the sections in mathematics that links to the real world, unlike other mathematical concepts such as algebra and trigonometry. Learners can learn data handling using their daily life experiences. Moreover, it is not difficult for teachers to think of activities to use so as to make a connection between the teaching of data handling and the real world. Therefore examining how data handling is taught in the foundation phase was important, and was done by exploring the instructional strategies which foundation phase teachers used when teaching data handling.

The teachers employed different instructional strategies during their data handling lessons. The learners showed interest while those instructional strategies were employed during the lessons. It was seen that while some of the learners understood when the teachers were teaching, but had a challenge when they had to write as individuals. Even the participants indicated that learners understand when they were taught but that there was a problem when it came to individual assessment. The participants did not know the cause of the low levels of achievement when learners had to write individual tasks. However, the learners were actively involved during data handling lessons.

In the light of the research done in this study, the contribution that this study makes is that one has to use an instructional strategy guided by the learning goal that one seeks to achieve. For example, if the goal is to promote critical thinking skills in the learners, then group discussion and problem solving have to be employed. At the foundation phase level teachers should familiarise learners with activities that develop problem-solving skills. This can be done by using higher-order questions, and learners need to learn to explain the strategies they used to solve the problem.

These different instructional strategies explored in data handling classrooms may be used in any classroom within any social setting. Some instructional strategies are a challenge to use in overcrowded classrooms, for example group work. Most of the participating schools had large classes. In such cases teachers should encourage learners to work in pairs.

As far as the learners' success is concerned, the essential task of the foundation phase teacher is to mediate between the learners' present performance and the learners' potential level of performance. The conditions that are created and opportunities that are provided by the teacher need to assist the learner through his/her ZPD. If teacher development programmes focus on the use of instructional strategies, there may be an improvement in terms of learner achievement. Also, in these professional development workshops teachers need to be made aware that what the DBE gives them to use in schools is a guide. Teachers should be flexible enough to adapt the teaching material to their context, like Purple Primary School did, while adhering to the specific

aims and skills as outlined in the CAPS document. Therefore teachers can use the DBE workbook activities in a way that will benefit the learners and rephrase the questions in a way that will make sense to the learners.

What was apparent in most of the classrooms was the dominance of memorisation as an instructional strategy. Although most of the teachers used memorisation as an instructional strategy in their classrooms, they also employed social constructivist strategies of teaching. In this way learners were active participants and worked collaboratively during the teaching and learning process. The participants were acting as the guides for the educational practice of their learners. While these researcher thoughts are based on the lesson observations, each participant provided reasons for their use of different instructional strategies, and this is discussed in the section that follows.

7.3 Responding to the critical questions

Observations and findings were distinguished with respect to the realities of the data handling classrooms within diverse social contexts. Within the limits of the present study, the following findings with respect to the critical questions of the study could be drawn.

7.3.1 Which instructional strategies do foundation phase teachers use to teach data handling?

The first critical research question focused on identifying all the instructional strategies which the foundation phase teachers used to teach data handling. The participants in this study employed different instructional strategies in their teaching of data handling. Each participant used the instructional strategies she believed were effective for the lesson being taught.

Whilst exploring each instructional strategy employed, social constructivist theory was implemented to discuss the interaction during lessons. The teacher-learner interaction was evident in the data handling classrooms. The evidence for interaction was compiled using data generated via the teacher questionnaires, classroom observations, video recordings and teacher interviews. Since this study explored foundation phase teachers' use of instructional strategies to teach data handling, the empirical data were located within data handling classrooms in various contexts. For this reason it was essential to interrogate interactions within each social context.

During lesson observations in different contexts it was revealed that the apartheid era affected many schools (Rakometsi, 2008; Sedibe, 2011; Mouton, Louw & Strydom, 2012), some in a positive manner and others in a negative manner. The former Model C schools were well resourced in all aspects, while the former Black schools were inadequately resourced, as discussed earlier in Chapter Five. This was evident at six of the seven research schools. Until

these disadvantages are addressed, schools are operating within unjust environments, and this is the issue of social justice highlighted in Chapter Two. Despite the lack of resources in the schools, the participants were inventive in creating their own manipulatives using available materials. These resources were discussed in Chapters Five and Six of the study.

The participants at the six underprivileged schools used their innovative skills to provide manipulatives which they used as scaffolding tools in the teaching and learning of data handling. Charity, for example, used the back of a calendar to draw the bar graph. She made her own chart because the school could not provide charts for the teachers. The availability of resources is important for highlighting what is being taught (Drews, 2007; Falconer, McGill, Littlejohn & Boursinou, 2013).

The overcrowded classrooms in the underprivileged schools made it difficult for the participants to employ some instructional strategies, such as group work. Although the participants knew the benefits of giving learners the opportunity to work collaboratively in groups, it was not possible to use this instructional strategy. Nevertheless, two participants from the underprivileged schools – Musa and Honey – managed to allow learners to work in groups although they had overcrowded classrooms. For example, Honey taught data handling lessons and then gave the learners the opportunity to work in groups when solving the problems; for this there was learner-learner and learner-teacher interaction. Once the learners had an opportunity to be actively involved in the problem-solving practice, each group had an exercise book to write down the solutions. The learners were given one small exercise book per group because they did not have charts to write on since the schools lacked resources. By using the exercise books, when the groups presented their answers they could not show the whole class how they reached their solutions. The group representatives just read from their exercise books what they had written. In terms of being actively involved and working collaboratively as groups, the members of the groups benefitted. In terms of the whole-class benefit, some learners could not see how different groups worked out the solutions because they could not see the solution process. However, the learners seemed to enjoy working in groups.

The participants at the well-resourced school (one of the seven research schools in the study) did not experience difficulties when it came to teaching materials. The privileges associated with a well-resourced school influenced the way the participants taught. The participants in this school focused on the teaching and learning. They did not have to worry about learners not having pens to write with. In other schools the learners had to borrow pens and rulers from the participants in order to complete class work. To assist with this aspect in the well-resourced school, parents made sure that learners came with all the equipment they needed in the classroom. This included pens, coloured pencils, scissors, glue and highlighters, and assisted the participants.

Memorisation was the basis of the majority of the participants' instructional strategy, as previously mentioned in Chapter Six. Six out of eight participants used memorisation as one of the instructional strategies, asking learners to memorise numbers and concepts. The first thing

that participants did before introducing the lesson was to ask learners to recite numbers or calculations. Then during the course of the lesson the participant would ask learners to repeat after her or after the other learners when they were giving answers.

However, repetition strategy was not promoting interaction among the learners; Vygotsky (1978) suggests that learners learn best when they are actively involved. Repetition and recitation were encouraged by the participants during their data handling lessons. In this way learners were memorising without understanding the data handling concepts and calculations. Memorisation is inefficient and it encourages learners not to think (Klemm, 2007). Similarly, other research reveals that memorisation does not promote understanding, scrutiny or retention of information (Vasall-Fall, 2008; Mbabazi, Dhalgren, & Feje, 2012). In other words, learners memorise and forget easily, and this might contribute to foundation phase learners not doing well in data handling.

7.3.2 How do foundation phase teachers use instructional strategies to teach data handling?

The second critical question focused on how the foundation phase teachers used instructional strategies in the data handling classroom. In order to respond to this question, the data generated from all the research tools were interrogated and analysed.

The participants used different instructional strategies, depending on the learning goal they wanted to achieve. By using different instructional strategies the participants accommodated learners with different learning ability levels (Gangi, 2011; Tulbure, 2011; Arnold-Garza, 2014). The participants engaged learners in their teaching. For example, they used learners as demonstrators of what they were teaching. Honey called a boy and a girl to stand in front of the class and asked learners to compare them. This was how she introduced her lesson when she was teaching learners the bar graph. Honey told learners that in data handling they have to learn to compare and realise the difference between various aspects.

The participants also used the question and answer instructional strategy as a scaffold to the correct answer (Chin, 2007; Kim, 2010; Radford, Bosanquet, Webster & Blatchford, 2015). The participants guided learners to the correct answer by means of questioning. The participants kept the learners actively involved by asking them to write answers on the chalkboard. The learners enjoyed writing on the chalkboard because they ran forward and most of the learners wanted to do the writing.

Moreover, the participants used real-life situations when teaching data handling. For example, Qinisile gave a task with data for the local schools on Arbour Day. She gave data regarding the number of trees which were planted by different local primary schools that learners knew. By so doing she raised the learners' interest (Sullivan, 2011; Barak, Nissim & Ben-Zvi, 2011). Vicky

also used a real life situation when teaching data handling. She asked learners to colour in the pieces of a pie chart according to how learners spent their 24 hours per day. For example, if the learner said he spent two hours playing, he would colour two pieces of the pie chart that had 24 pieces in total (highlighted in Chapter Six).

7.3.3 Why do foundation phase teachers use those instructional strategies to teach data handling?

The third research question addressed the reasons why the foundation phase teachers chose the instructional strategies that they used to teach data handling. This section deals with what each participant revealed with regard to why they used specific instructional strategies in their data handling lessons. Explanatory information was derived from the one-on-one teacher interviews. It emerged in the study that the participants used different instructional strategies to teach data handling for different purposes.

7.3.3.1 Effective instructional strategies when teaching data handling

The majority of the participants mentioned the question and answer instructional strategy, demonstration and group work as effective instructional strategies in teaching data handling. However, they were using memorisation the most. The researcher asked each participant during the interview why she was using memorisation strategies like recitation and repetition when teaching data handling. The participants' responses were that they encourage learners to memorise in terms of repetition and recitation so that learners will understand what they are taught. However, there is no evidence that learners understand what they are taught when they memorise facts. Jabu stated this as follows when she was interviewed: "Even though they recite tables, some learners still have a problem with calculations ...".

7.3.3.2 Concepts covered in data handling using those instructional strategies

The participants stated that the concepts covered during data handling lessons included sorting, comparing, interpreting and presenting data. Thus the participants used different instructional strategies to cover these concepts. Musa's comment was as follows:

> ... while other learners grasp the content fast, those that might show that they are struggling, they will be further accommodated by means of using different strategies such as group work, questioning or individual teaching. Nonetheless, it is imperative to note that for the individual struggling learner, learning content can be taught in small chunks to encourage room for steady progression ...

7.3.3.3 Learners benefit from instructional strategies used to teach data handling

The participants indicated that learners benefit from the social constructivist instructional strategies, which include questioning, demonstration and group discussion. The participants stated that as learners interact they help each other, and that enhances their understanding. Qinisile: "They work better in groups because they help each other and that helps them to understand concepts that they did not grasp while I was explaining."

7.3.3.4 The response of learners to the instructional strategies used

The participants indicated that learners respond with interest and excitement when they use different instructional strategies, and they seem to understand data handling. However, the participants indicated that although the learners seem to respond well when they are taught, when they are given individual work to write, some learners have a problem. Thus, once the scaffold is withdrawn for the learners to operate in their ZPD (Vygotsky, 1978), they experience a problem. A strategy needs to be devised to address this issue, because it is the cause of learners' low achievement in data handling during the formal assessment. Qinisile and Charity shared their sentiments on this issue:

> Qinisile: "... they [learners] respond positively when you teach them but when they have to write on their own they have a problem ... that is why learners have a problem when they write ANA ..."
>
> Charity: "... the problem starts when they have to write as individuals ... I am worried because when they write exams especially ANA there are not allowed to ask ... I think that is why they fail ANA ..."

To sum up the responses of the participants to the third research question: firstly, the participants wanted to make data handling comprehensible for their learners. Secondly, the teachers used different instructional strategies to assist their learners in memorising important concepts and calculations. Thirdly, the participants used group work to promote critical thinking. Fourthly, the participants used the question and answer method to clear up some misconceptions. Lastly, the participants employed different instructional strategies to prepare learners for the ANA paper. Each of these goals was discussed in detail in Chapter Six.

7.4 The significance and contribution of this study

This study is significant since it highlights effective instructional strategies supported by literature and research findings to teach data handling. It was suggested that the teacher needs to use the instructional strategy according to the learning goal that he/she wants to achieve. The

participants were able to voice their views as well as their concerns on the teaching and learning of data handling. A concern of the participants was, for example, that learners seem to understand when they are taught but have a problem when they are given individual work to complete. In other words, foundation phase learners have a problem in engaging in an activity without assistance.

The researcher has not come across literature focusing on instructional strategies used to teach data handling in the foundation phase. There are studies that have been conducted in the foundation phase focusing on different mathematics sections other than data handling, and those studies are mentioned in Chapter Two.

Therefore, this study explored the instructional strategies used by foundation phase teachers to teach data handling since this section is part of the mathematics curriculum. This study revealed that the instructional strategies used in different contexts are not the same. In other words, the issue of context contributes to the way in which data handling is taught. For example, in some schools they do not have enough material resources to teach, and they also have overcrowded classes. The lack of resources and overcrowding in the classrooms limits the instructional strategies that the teacher may use. For example, in an overcrowded classroom it is a challenge to use group work as an instructional strategy, although it is effective for learners to work collaboratively.

7.5 Recommendations

Eight teachers from seven different primary schools within KwaZulu-Natal were participants in this research study. While this has been adequate in exploring foundation phase teachers' use of instructional strategies to teach data handling, it is recommended that a broader study that includes more foundation phase teachers within the province be carried out. Alternatively, this study may be extended to the instructional strategies used to teach data handling in other grades. Mathematics teachers in all grades need to employ effective instructional strategies when teaching data handling in order to promote learner achievement. Therefore, including other grades in a similar study may present valuable data.

It has been revealed that some of the foundation phase learners have a challenge when confronted with doing individual work, and a strategy needs to be devised to address this issue since it is a concern for the majority of the teachers. It has been found that most of the primary schools in rural areas and townships have overcrowded classrooms, with the result that it is a challenge to arrange learners sitting in groups. So allowing learners to work collaboratively and share ideas is a problem in this situation. This study therefore recommends that the Department of Education provides more classrooms, even in a form of prefab buildings, so that there will be enough space for all the learners.

Moreover, some of the schools lack resources for teaching. Since resources make teaching and learning simpler and enjoyable, it is recommended that rural and township schools be provided with enough resources for teaching by the Department of Education.

In addition, the majority of the participants pointed out that they had not attended data handling workshops. It is recommended that the Department of Education provide professional development workshops in data handling to equip teachers with effective instructional strategies for teaching this subject. With this said, teachers should also take it upon themselves to seek professional development and to attend workshops. The majority of the participants still believe in the traditional approach to teaching. Therefore, attending workshops could be of benefit to teachers in terms of teaching data handling by using other instructional strategies.

7.6 Limitations of the study

To begin with, this study has a small range. Only issues directly relating to the sample of foundation phase teachers and the instructional strategies they used in teaching data handling lessons were investigated. Nevertheless, there were other aspects that could have been examined, but those were not within the scope of this study.

Secondly, since this study was carried out in primary schools that were selected in terms of convenience and accessibility and the readiness of the participants to be observed, the circumstances in other schools may have been different. While it is not the purpose of this study to claim that the results of this study conducted in seven primary schools in Pinetown district, SA, may be generalised to all foundation phase classrooms, this study's results are worthy of consideration.

Thirdly, the teachers were provided with letters asking for their consent to participate, and the letters outlined particulars of the study and the procedure that would be followed. This information might have contributed to the way in which the participants taught. Nonetheless, the researcher addressed that concern by carrying out one-on-one interviews with the participants, asking for reasons for using particular instructional strategies in their data handling lessons.

Fourthly, the time planned for each lesson was different across the different participating schools. This meant that in one school the researcher observed a 30-minute lesson and in another school a 50-minute lesson. These timeframes may have influenced the way in which the participants engaged with the learners and the way they taught. The timeframes also influenced the instructional strategies used during the lessons.

Lastly, upon interrogating each video recording, it was found that it would have been beneficial to use two video cameras, one focusing on the participant and the other on the learners to capture their responses to the instructional strategies used by the teacher.

7.7 Conclusion

This chapter began with the researcher's thoughts based on what was observed throughout the study. A summary of the study was also presented, and key aspects related to each research question were discussed. The significance as well as the contribution of the study were also discussed.

The focus of the study was to explore foundation phase teachers' use of instructional strategies to teach data handling. Based on data generated in this study, using different instructional strategies was of benefit to both the participants and the learners. Using different instructional strategies enhanced learners' understanding during the teaching and learning of data handling. Moreover, the instructional strategies teachers used allowed learners to be engaged as active participants in the classroom and the teacher acted as a guide and facilitator.

This chapter concluded with recommendations and limitations which the researcher identified.

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Appendix

A i

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

11 February 2015

Ms Nokuphiwa D Mkhabela (209529051)
School of Education
Edgewood Campus

Dear Ms Mkhabela,

Protocol reference number: HSS/0119/014D
Project title: Exploring Foundation Phase teachers' use of instructional strategies of teach data handling

Full Approval – Expedited Approval

With regards to your response received on 18 July 2014 to our letter of 20 May 2014. The documents submitted have been accepted by the Humanities & Social Sciences Research Ethics Committee and **FULL APPROVAL** for the protocol has been granted.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

Please note: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)

/ms

Cc Supervisor: Dr Jayaluxmi Naidoo
cc Academic leader Research: Professor P Morojele
cc School Administrator: Ms Bongi Bhengu / Ms Tyzer Khumalo

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
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Appendix A ii

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

KWAZULU-NATAL DEPARTMENT OF EDUCATION POSTAL: Private Bag X 9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa PHYSICAL: 247 Burger Street, Anton Lembede House, Pietermaritzburg, 3201. Tel. 033 392 1004 Fax : 033 392 1203 EMAIL ADDRESS: kehologile.connie@kzndoe.gov.za; CALL CENTRE: 0860 596 363; WEBSITE: WWW.kzneducation.gov.za

Enquiries: Sibusiso Alwar Tel: 033 341 8610 Ref.:2/4/8/1/130

Ms ND Mkhabela
A803 Mpumalanga
Township
Hammarsdale
3700

Dear Ms Mkhabela

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"EXPLORING FOUNDATION PHASE TEACHERS USE OF INSTRUCTIONAL STRATEGIES TO TEACH DATA HANDLING",** in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the
Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 01 July 2014 to 30 May 2015.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Mr. Alwar at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report / dissertation / thesis must be submitted to the research office of the Department. Please address it to The Director-Resources Planning, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu- Natal Department of Education

Nkosinathi S.P. Sishi, PhD
Head of Department: Education
Date: 11 July 2014

Appendix A iii

A803 Mpumalanga Township

Hammarsdale

3700

10 April 2014

The Education Officer

Department of Education

Pinetown District

Dear Sir / Madam

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN PINETOWN DISTRICT SCHOOLS

I am a second year PhD student at UKZN (Edgewood Campus) and currently planning a research project for my thesis. The topic of my proposed research is: EXPLORING FOUNDATION PHASE TEACHERS USE OF INSTRUCTIONAL STRATEGIES TO TEACH DATA HANDLING. The aim of this study is to explore instructional strategies that foundation phase teachers use when teaching data handling and the findings may help other mathematics foundation phase teachers. I request permission to conduct the research in 20 primary schools in Pinetown district this year (2014). It will be a qualitative study that will involve 20 foundation phase mathematics teachers. Teachers will be required to complete a teacher questionnaire and they will be observed four times while teaching data handling. These lessons will be video recorded and also the selected teachers will be interviewed. Each interview will be recorded.

Please feel free to contact me or my supervisor if you have any queries regarding the study.

Thank you

Regards

_____

Nokuphiwa D. Mkhabela (Researcher)

nokuphiwamkhabela@gmail.com

083 385 0441

Dr J. Naidoo (Supervisor)

Naidooj2@ukzn.ac.za

031 260 1127

Appendix A iv

A803 Mpumalanga Township

Hammarsdale

3700

10 October 2013

The Principal

Pinetown

3660

Dear Sir / Madam

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN YOUR SCHOOL

I am a first year PhD student at UKZN (Edgewood Campus) and currently planning a research project for my thesis. The topic of my proposed research is: EXPLORING FOUNDATION PHASE TEACHERS USE OF INSTRUCTIONAL STRATEGIES TO TEACH DATA HANDLING.

I request that you allow me to conduct the research in your school next year February 2014. It will be a qualitative study that will involve one foundation phase teacher. A teacher will be required to complete a teacher questionnaire and also he/she will be observed 4 times teaching data handling. Those lessons will be video recorded and also a teacher will be interviewed.

Please feel free to contact me or my supervisor if you have queries.

Thank you
Regards

_____

Nokuphiwa D. Mkhabela
nokuphiwamkhabela@gmail.com
083 385 0441
Dr J. Naidoo
Naidooj2@ukzn.ac.za 031 260 1127
Miss P. Ximba
ximba@ukzn.ac.za 031 2603587

I..(Full name of the principal) hereby confirm that I understand the nature of the research and I allow Nokuphiwa Mkhabela to conduct a research at this school.

Signature of the principal Date

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Appendix A v

A803 Mpumalanga Township

Hammarsdale

3700

10 October 2013

Dear Participant

I am a first year PhD student at UKZN (Edgewood Campus) and currently planning a research project for my thesis. The topic of my proposed research is: EXPLORING FOUNDATION PHASE TEACHERS USE OF INSTRUCTIONAL STRATEGIES TO TEACH DATA HANDLING.

I request that you participate in my study and anonymity and confidentiality will be ensured.

I will issue you questionnaire forms, interview you and I will also observe 4 of your data handling lessons in the classroom. I will be video recording the information. I would like to assure you that no real names will be used in the write up of the report and information will only be used in my study. Financial expense is not involved in this project. Should you wish to withdraw from participating from this study you are free to do so.

Thank you in advance for your assistance. For more information about my study please contact my supervisor.

Regards

Nokuphiwa Mkhabela

nokuphiwamkhabela@gmail.com

083 385 0441

Dr J. Naidoo

Naidooj2@ukzn.ac.za 031 260 1127

Miss P. Ximba

ximba@ukzn.ac.za

031 2603587

I.....(Full name of participant) hereby confirm that I understand the nature of the research and I agree to participate in the research project conducted by Nokuphiwa Mkhabela in my school.

Signature of participant Date

‘’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’ ‘’’’’’’’’’’’’’’’’’’’’’’’’’’’

Appendix A vi

A803 Mpumalanga Township

Hammarsdale

3700

10 October 2013

Dear Parent

I am a first year PhD student at UKZN (Edgewood Campus) and currently planning a research project for my thesis. The topic of my proposed research is: EXPLORING FOUNDATION PHASE TEACHERS USE OF INSTRUCTIONAL STRATEGIES TO TEACH DATA HANDLING.

I request that your child be part of the research project that will be conducted in his/ her classroom. Anonymity and confidentiality will be ensured. I will observe 4 data handling lessons in the classroom. I will be video recording the information. I would like to assure you that no real names will be used in the write up of the report and information will only be used in my study. Financial expense is not involved in this project.

Thank you in advance for your assistance. For more information about my study please contact my supervisor.

Regards

Nokuphiwa Mkhabela

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Dr J. Naidoo

Naidooj2@ukzn.ac.za

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Miss P. Ximba

ximba@ukzn.ac.za

031 2603587

I.....(Full name of parent/guardian) hereby confirm that I understand the nature of the research and I agree that my child ……(name of the child) be part of the research project conducted by Nokuphiwa Mkhabela in his/ her classroom..

Signature of parent/guardian Date

‘’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’’ ‘’’’’’’’’’’’’

Appendix A vii

L. Gething, M.Phil. (Science & Technology Journalism) (*cum laude*)

WHIZZ@WORDS

PO Box 1155, Milnerton 7435 Cape Town, South Africa; cell 072 212 5417

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8 December 2015

DECLARATION OF LANGUAGE EDITING OF FULL PHD (EDUCATION) DISSERTATION:

EXPLORING FOUNDATION PHASE TEACHERS' USE OF INSTRUCTIONAL STRATEGIES TO TEACH DATA HANDLING by Nokuphiwa D. Mkhabela

I hereby declare that I carried out language editing of the above dissertation by Nokuphiwa D. Mkhabela.

I am a professional writer and editor with many years of experience (e.g. 5 years on *SA Medical Journal*, 10 years heading the corporate communication division at the SA Medical Research Council), who specialises in Science and Technology editing - but am adept at editing in many different subject areas. I am a full member of the South African Freelancers' Association as well as of the Professional Editors' Association.

Yours sincerely

EXPLORING FOUNDATION PHASE TEACHERS USE OF INSTRUCTIONAL STRATEGIES TO TEACH DATA HANDLING

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Appendix B i

Foundation Phase Teacher Questionnaire

A. School Profile

1. School Name	
2. School Address	
3. District	
4. Circuit	
5. Number of teachers in staff	
6. Number of mathematics teachers	
7. Learner Enrolment	
8. Learner/Teacher Ratio	
9. Number of learners in grade 3	Girls_____ Boys_____
B. School Infrastructure	
1. Does the school have electricity?	
2. Does the school have the library?	
3. Does the school have a photocopier?	
4. Does the school have internet/email? (Provide email address)	
5. Does the school have computers?	
6. Does the school have computer room?	

C. Foundation Phase Teacher Profile:

1. Surname_____
2. Title (Mr/Mrs/Dr/Prof)_____

3. First Names (In full) _____
4. Gender _____
5. Age Group (tick) 20-30 31-40 41-50 51-65
   Other (please specify)_____
6. Qualifications

   _____
   _____
   _____
   _____

7. Subject/s teaching

   _____
   _____
   _____

8. Grade/s teaching

   _____
   _____
   _____

9. Number of years teaching mathematics_____
10. Was mathematics one of your major subjects at the higher institution?
11. Was there a section of statistics/data handling in your mathematics course at the higher institutions?
12. Total number of years teaching_____
13. Do you use textbooks when preparing for lessons?_____
14. If so, name

    _____
    _____
    _____
    _____

15. What other sources have you used when preparing your lessons?

    ---

16. What instructional strategies/teaching methods do you use when teaching data handling?

_____

_____

_____

_____

_____

_____

_____

_____

17. Do you engage in any professional development activity?_____
18. If so please elaborate

_____

_____

_____

_____

_____

19. Cell Number _____
20. Email Address (if available)

_____

Appendix B ii

OBSERVATION SCHEDULE

Teacher_____ School_____

Grade_____ Observer_____ Lesson observed_____

Start_____ Finish_____Date_____

IN THE CLASSROOM DURING DATA HANDLING LESSON

Critical questions:

1. **What instructional strategies do foundation phase teachers use to teach data handling?**

Instructional Strategies

Types of instructional strategies		

2. **How do foundation phase teachers use those instructional strategies to teach data handling?**

_____
_____
_____
_____
_____
_____
_____
_____

Appendix B iii

Semi-structured interview schedule for foundation phase teachers

School _____

Teacher's name _____

Date _____ Time_____

Critical questions:

1. How do foundation phase teachers use instructional strategies to teach data handling?
2. Why do foundation phase teachers use these instructional strategies when teaching data handling?

1. Which instructional strategies are effective in your teaching of data handling?

2. Which concepts did you cover using those instructional strategies that you have mentioned?

3. How do those instructional strategies help learners in understanding data handling?

4. What can you say about the response of learners to the instructional strategies used?

Appendix C i

Lesson Observation 1: Green Primary

Teacher: Morning

Learners: Morning Madam

T: What is the date today?

L: 5 August 2014

T: How many months are there in a year?

L: They are 12

T: Stand up and recite them.

L: January, February, March, April, May, June, July, August, September, October, November, December.

T: Ok sit down. Here we have months of the year. When does January end?

L: 31

T: Ok. March ends when?

L: 31

T: February?

L: 28

T: December?

L: 31

T: Ok. Girls stand up and stand here (pointing in front of the chalkboard)

L: (Coming forward)

T: Boys come and stand this side (Boys standing on the opposite side of the girls)

T: Calculate how many boys and how many girls are there (drawing the graph on the chalkboard) Count the boys.

L: 1, 2, 3, 4, 5

T: How many boys?

L: They are 5

T: Ok, count the girls

L: 1, 2, 3, 4, 5, 6, 7

T: How many?

L: 7

T: Good. Sit down. Now take out your books and open on page 13. Which page class?

L: Page 13

T: Page 13 is about the weather. Look at the calendar, class. Which months end on the 30th?

L: April

T: Good, another one

L: November

T: And which one?

L: (Quiet)

T: June. Look at the weather and the month. There are pictures of the sun, wind and the clouds. Count how many times in the calendar does the sun appear?

L: 1, 2, 3, 4, 5, 6, 7, 8, 9,10

T: Good. Continue the clouds?

L: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

T: The rain?

L: 1, 2, 3, 4, 5, 6, 7

T: The wind?

L: 1, 2, 3, 4, 5, 6, 7, 8

T: Again calculate

L; 1, 2, 3, 4, 5, 6, 7

T: It appears 7 times. Come and draw the sign that represents the sun.

L: (1 learner comes and draws on the chalkboard)

T: Ok, then for the wind? Come

L: (1 learner draws it)

T: Now the last one, for the clouds.

L: (1 learner draws it on the chalkboard)

T: Yes, clap your hands. Now on your books read number 1.

L: (reading) Sunny days are.....

T: Then count them

L: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

T: Yes 10. Here there is the sun (drawing the pictograph). Now copy this in your exercise books.

L: (Writing on their exercise books)

Appendix C ii

Lesson Observation 2: Green Primary School

Teacher: Stand up and count in 50's starting from 500.

Learners: 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000.

T: Ok this row, count in 10's.

L: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100.

T: Now, this row (pointing at the next row) count in 5's.

L: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100.

T: Now this row (pointing at the last row) in 2's up to 50.

L: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 44, 46, 48, 50.

T: Now we will learn about the months of the year. Stand up and recite them.

L: January, February, March, April, May, June, July, August, September, October, November, December.

T: Open your books to page 25.

L: (Opening their books).

T: When does February end?

L: On the 28th.

T: Why is it so short? Which holiday is in February?

L: valentine's Day.

T: Valentine. When does April end?

L: On the 30th.

T: Which big holiday do we have in April?

L: Freedom day

T: Yes, how many days are in May?

L: 31

T: June?

L: 30

T: July?

L: 31

T: August?

L: 31

T: September?

L: 30

T: October?

L: 31

T: November?

L: 30

T: And December?

L: 31

T: Now you have to know we talk about days and months. 60 minutes makes 1 hour. What does 60 minutes make?

L: 1 hour

T: How many days are there in a year?

L: 365

T: Yes 365. Sometimes we have what is called the leap year. It is when February has how many days?

L: 29 days

T: Then the year will have 366 days. Who is 10 years old in this class?

L: (1 learner lifts up his hand)

T: Then this one is a decade. Ten years makes a decade. A century is made out of 100 years. Do you know somebody with 100 years?

L: No

T: Read on your books.

L: (Reading) How many days are there in a week?

T: Yes write your answer. Use a pencil.

L: (Writing on their workbooks).

T: Number 2, 2 weeks are made of how many days? Write your answer.

L: (Writing their answer)

T: Read number 3.

L: How many months are there in a year?

T: Yes, how many months? Write down class. Let us count them.

L: (Counting from their books)

T: How many?

L: 12

T: How many months are there in 2 years? Write down.

L: (Writing on their workbooks)

T: How many months make 2 and half years?

L: (Looking confused)

T: How many months are there in half a year?

L: 3 months

T: No

L: 6

T: Yes 6. How many months are there in 2 years?

L: 24

T: Then add 6 months and 24 months. (She writes on the chalkboard adding 24 and 6) It is 30 months.

Then write down 30 months.

L: (Writing)

T: Now count, what is the 10^{th} month?

L: October

T: Yes, read the next question.

L: (Reading from their books) What is the 6th month?

T: June. Count class

L: (Counting on their books) 1, 2, and 3, 4, 5, 6.

T: Write the answer. It is June.

L: (Writing)

T: On the 1st of January where do we go?

L: We go to the beach.

T: Why?

L: Because it is summer time.

T: What is another reason?

L: It is New Year's Day.

T: What is that holiday called?

L: (Quiet)

T: New Year's Day. Say that.

L: New Year's Day.

T: What do we call 21 March?

L: Valentine

T: No, 21 March?

L: (Quiet)

T: Humans' Rights Day. What is it called?

L: Humans Rights Day

T: Ok, write down.

L: (Writing)

T: Everybody is writing. In which month were you born? Is there anyone who does not know? Tell me (pointing at a boy).

L: 1 January

T: On a holiday! Are there other people who were born on a holiday?

L: (1 learner lifting up her hand)

T: Yes, when were you born?

L: 24 September

T: Clap your hands for her. What is that holiday called?

L: Heritage Day

T: Yes, Heritage Day. Now take out your exercise books and write the next exercise.

L: (Learners taking out their exercise books and writing their class activity)

Appendix C iii

Lesson Observation: Blackberry

Teacher: What is the day today?

Learners: The day today is 20 August 2014.

T: Count using the table of 3, starting from 100 up to 200.

L: (referring on the tables pasted on their desks) 103, 106, 109, 112, 115, 118, 121, 124, 127, 130, 133, 136, 139, 142, 145, 148, 151, 154, 157, 160, 163, 166, 169, 171, 174, 177, 180, 183, 186, 189, 192, 195, 198, 201.

T: Now we will talk about data handling. What are we going to talk about?

L: Data handling.

T: We will talk about the schools and the trees as it has been an Arbour Week. Mention the schools that you know.

L: (Lifting up their hands)

T: Yes (pointing at a learner)

L: Wozanazo

T: (Writing on the chalkboard) another one?

L: Esihonqeni

T: Another one? (Writing on the chalkboard)

L: Vukuziphathe

T: Another one?

L: Isiqalo

T: Yes, you are very clever you know your school. Another one?

L: Uxolophambili

T: (writing on the chalkboard) Yes, when trees are planted there is no limit but it depends on the space available for planting trees. How many schools are there?

L: (Quiet)

T: How many schools are there (pointing at the chalkboard)?

L: 6

T: Ok in all these 6 schools, which one has many trees?

L: Ntando

T: She says it is Ntando. I don't disagree but what does another person say?

L: Uxolophambili

T: I did this to see if you can notice something. What is another one saying?

L: Ntando and uxolophambili

T: Yes, which school has few trees?

L: Vukuziphathe

T: What happened to Vukuziphathe?

L: It has few trees.

T: What is the total number of trees?

L: They are 34

T: When you give an answer and there are still hands lifted up, you must realise that your answer is wrong. Count the trees.

L: 39

T: Yes. How many, class?

L: They are 39.

T: If we subtract Ntando's trees how many will be left?

L: 21

T: Yes 21. In these 21 left, minus Vukuziphathe's.

L: (Quiet)

T: Minus Vukuziphathe's trees from 21 trees.

L: 18

T: Yes. In these 18 trees bring back Xolophambili's trees.

L: Vukuziphathe

T: No. Bring back Xolophambili's trees.

L: 27

T: In 27 trees add Ntando's trees.

L: 34

T: Is that true?

L: No

T: How many? Those who say no give me an answer.

L: (Quiet)

T: You don't know how to add? Ntando has how many trees?

L: 18

T: Then add 18 to 27

L: 45

T: Class

L: (Whole class responding) 45

T: Tell me how many schools have more trees?

L: 3

T: No, I am saying how many schools. You don't understand the question. How many?

L: 2 trees?

T: Not trees but schools.

L: 2 schools

T: How many have few trees?

L: 1

T: When we add Wozanazo and Sihonqeni trees, what is the total class?

L: 12

T: Again

L: 12

T: Now I want to see who will finish first. (Giving them worksheets). Read the questions on your worksheets and find the answers from the graph. Where are the answers?

L: On the graph

T: Now you are writing a test. Write your name and surname on top of your paper. The first letter in your sentence must be in capital letter not in a small letter. So be careful.

L: (Writing on the worksheets individually)

Appendix C iv

Lesson Observation: Yellow Primary school

Teacher: What is the date today?

Learners: The date today is August 14 2014.

T: (Writes the date) I will write in both English and IsiZulu so that when you are in grade 4 you will not have a problem. Who can tell me why I used coloured chalk here (pointing at what she has written on the chalkboard).

L: Because you want us to see osonhlamvukazi (capital letters).

T: Yes what do we call this in English?

L: Capital letters.

T: This drawing is the graph (pointing at chalkboard). What is this class?

L: It is the graph.

T: Graph is something that shows different things. We can use the graph to compare the economy of different countries. What is the currency of South Africa?

L: (Quiet)

T: It the Euro or the Rand?

L: Rand

T: We can also compare the money used in South Africa. Show me your money.

L: (Taking out their money)

T: You see Naledi has R1 and Simo has R2. We are comparing this money. What is the difference between R1 and R2? Are they equal?

L: No

T: Which one do you prefer between R1 and R2?

L: R2

T: Come here Manqoba and Naledi (calling a boy and a girl). Tell me the difference between them.

L: Manqoba is tall

T: Yes, Manqoba is tall.

L: Naledi is short.

T: What else?

L: Manqoba is fat

T: Yes, we are comparing class. Now you understand. What else:

L: Manqoba is a boy

T: Yes

L: Naledi is a girl

T: Yes, continue to compare them.

L: Naledi is light in complexion.

T: Yes Naledi is light.

L; Manqoba is dark in complexion.

T: Yes, we can compare many people in this class. We are comparing. We can also compare colours; green is not the same as blue. Look around. What do you see?

L: I see the chalkboard.

T: Yes, One has big eyes and the other has small eyes. We are not the same. In Zimbabwe they are so much billions and in South Africa they are so much billions. You see the statistics. We are comparing.

L: Yes

T: What can you think of at home that you can tell me about?

L: (Quiet)

T: In classes we are not equal number. In some classes they are 35 in others they are 45. Now let us look at the graph (pointing at the bar graph on the chalkboard). What letter is this one?

L: Letter L.

T: Yes L. Read this word.

L: Capacity.

T: Capacity. Hey be alive. Again.

L: Capacity

T: What do we weigh?

L: (Quiet)

T: Things that are liquid. What do you buy from the shops that are liquid?

L: Milk

T: Yes

L: Water

T: Yes very good. Clap hands for her.

L: (Clap their hands) Thank you very much, keep it up.

T: We clap hands because water is very important. We cannot live without water. In capacity we measure liquids. What does L stand for?

L: Litres

T: Yes, li...

L: tres

T: Something that is a litre is something big like this (showing them a bottle of liquor which is 2l). This bottle is 2l. What is its capacity?

L: 2l

T: There is what is below a litre which is a millilitre (showing them 750 ml). Here (pointing at the chalkboard) we are measuring milk which is delivered by a truck from Clover. What are we measuring?

L: Milk

T: Truck delivers litres and not millilitres. Here (pointing at the X axis) we have the days of the week. Read here.

L: Monday (written as Mon.)

T: Yes we said what does this dot mean (the dot after Mon.)?

L: It means we are shortening something.

T: Yes it means it is not complete, like S.A. which means South Africa. Like P.G. which means Pearl, Gugu. Who are you? (Pointing at a boy)

L: Aphelele

T: You are A. Now read (pointing at the graph)

L: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday.

T: How many days are there in a week?

L: There are 7 days.

T: Again there are 7 days in a week.

L: There are 7 days in a week.

T: Right, In a graph you use a graph because you are comparing. But you are lazy to think, we would have compared many things. Now I have left you alone. No look at the chalkboard. (Showing them the graph, X axis being the days of the week and the Y axis being litres. What do you notice?

L: (Quiet)

T: Is everything the same?

L: There is red chalk and blue chalk.

T: Yes, how many colours are here?

L: 7

T: How many days are there in a week?

L: 15

T: Hay bo! (Oh no!) 15 days in a week are you serious?

L: (Another learner lifts up her hand)

T: Yes Naledi

L: 7 days

T: Ok. Now tell me (pointing at the chalkboard) how many litres were delivered on Wednesday?

L: 15

T: No. Wednesday? The government will say go and count people and you will come back with wrong statistics because of your carelessness. Yes (pointing at another learner).

L: 44

T: 44 what?

L: 44 l

T: Yes Sunday?

L: 34

T: Hey 34 trees? I won't point at a person who says 34.

L: 34 l

T: Yes, Monday?

L: 174 l

T: When?

L: On Monday.

T: Then Thursday?

L: (Quiet)

T: How many?

L: 153 l

T: Yes, Friday?

L: 174 l

T: Yes, how much was delivered on Saturday?

L: 142 l

T: 142 l yes. Tuesday?

L: 172 l

T: Alright. Now answer this question. I will write it here (writing on the chalkboard). Read.

L: Which day has less milk?

T: Now this is problem solving. Which day?

L: (Quiet)

T: Which day? Talk.

L: Sunday

T: Yes, how many litres were delivered on Sunday?

L: 34 l

T: Which day has much milk?

L: (Quiet)

T: Which day? You don't see?

L: Monday

T: Tell me (pointing at another learner)

L: Monday and Tuesday

T: Yes I wanted a clever child who is going to notice this. It is on...

L: Monday and Tuesday.

T: If I can say quickly in your groups, add milk that was delivered on Monday to Wednesday, what can be an answer? Take the group exercise books quickly. Who does not have one?

L: (Lifting up their hands)

T: (Giving them exercise books) Choose the scriber and the one who will present in front. Work, work.

L: (Working in their groups, doing calculations)

T: (Giving them papers to use for calculations) Calculate, I am also calculating. Align the 10's and the 100's. Do not calculate with your heads because I gave you papers. Now stop writing, come and present your answers.

L: (Group representatives go forward with their exercise books)

T: Yes, we are...

L: We are blues

T: And the answer is...

L: 390

T: What?

L: Litres

T: Very good

L: We are purple, 390

T: Yes

L: We are red, the answer is 180

T: Ok

L: We are the greens

T: And the answer is...

L: 180

T: Now let us confirm an answer, if you answer does not have litres, I will not mark it.

174

172

+ 44

390

T: 4 plus 2

L: 6

T: Plus 4 is 10. We write 0 and carry...?

L: 1

T: 7 plus 7

L: 14

T: 14 plus 4 plus 1

L: 19

T: Then 1+ 1+ the other 1

L: 3

T: Then the answer is 390. Then clap hands for those with correct answers.

T: Now divide 142 into half. Separate it for 2 people. Continue in your groups.

L: (Working in their groups)

T: Quickly. Now come and present your answers.

L: (Group representatives go forward to present) we are pink, the answer is 0, 2 l

T: Ok, next.

L: We are red, 71 l

T: Next

L: We are blue, 0,2 l

T: Now don't be excited because you have not done well. When you are making half number do you use?

L: 2

T: Yes because you are separating for 2 people. (Writing on the chalkboard). The 1st answer is 7, how many 2s are in 2?

L: 1

T: Yes, 71 l. Clap hands for those who got it right.

L: (Clapping hands)

T: Yes, others got an egg (zero). If you listen carefully in class you wont have a problem and if you do not listen you get an egg. Now no one will be copying from another one. You will write your own work as an individual. (Giving them worksheets.) This is the graph Mr Naidoo running in the marathon. Use the information on the graph to answer questions. Be careful grade 3 how you read the information on the X axis and on the Y axis. All the answers are on the graph. Take your time to check the answers, don't rush. Now write down your answers.

L: (Learners writing individually)

T: (Walking between the desks checking whether learners are writing correctly and also explaining to those who do not understand the instruction)

Lesson Observation 1: Reddy Primary

Teacher: Count using the table of 10 starting from 400 to 1000.

Learners: 400, 410, 420, 430, 450, 460, 470, 480, 490, 500…..

T: How many 100's are there in 300?

L: 3

T: In 500?

L: 5

T: In 1000?

L: 10

T: Our lesson for today is the graph. What you have to now the graph is divided into 3. We have 3 types of graphs. Do you understand?

L: Yes

T: The first one we call it pictograph (igrafu yezithombe) because we are in grade 3 we learn in IsiZulu. Pictograph is like this (showing them a chart with a graph). What do you see?

L: Apples

T: Ok, another one?

L: Strawberry

T: Ok another one?

L: Plums

T: What do we call all these (pointing at the pictures)?

L: Fruits

T: Yes. The second one is called the bar graph. I will write in IsiZulu (bha grafu). Bar graph is like this (showing the graph on the chart). Do you understand?

L: Yes

T: Now the last one is the line graph (showing them the chart). You see?

L: Yes

T: It is important to be able to read the graph. How do you read something that is just drawn? What is this (point at the X axis)?

L: Numbers

T: (Pointing at the Y axis) what is this?

L: Names

T: Yes, Esihle, Owam, Thulani, Jane. Let us count Esihle's fruits.

L: 1, 2, 3, 4, 5, 6, 7.

T: Yes they are 7. Count Owam's fruits.

L: 1, 2, 3.

T: Yes 3 fruit, and for Thulani?

L: 1, 2, 3, 4.

T: Yes they are 4. For Jane?

L: 1, 2, 3, 4, 5, 6, 7, 8.

T: Yes 8. Who ate few fruit?

L: Tom

L: They are disagreeing. Yes (pointing at another learner).

L: Senzo

T: Who ate 2 fruits?

L: Tom

T: Yes, Who ate the most?

L: Jane

T: When we look here (pointing at the graph) there are those who ate the same number of fruits. Who are those?

L: Zola and Elihle

T: Yes. You can change pictograph and make it the line graph or the bar graph. Now here is Zola and Esihle (showing them bar graph on the chart). You see it is the same and they ate the same number of fruits. That is the way we read graph. Now take out your books and open on page 30.

L: (Taking out their books)

T: What do you see?

L: Bar graph.

T: Yes, bar graph. What is it all about?

L: It is about the days of the week.

T: Yes. Look at the graph; it is about cars that were washed during the week. Which day where few cars were washed?

L: Thursday

T: When were 7 cars washed?

L: On Sunday

T: On your exercise books you will draw your own graph for the learners who did come to school during the week. You will draw it with Monday Tuesday, Wednesday, Thursday and Friday because it is for the whole week. You have to follow the rule so that anyone can read it. Read the rule. On Monday…

L: On Monday only 1 learner came to school.

T: Right you will show that. Continue reading.

L: On Thursday there were 2 learners at school.

T: Yes continue.

L: On Friday there were 5 learners at school.

T: Now draw your graph showing all the information that you have been given.

L: (Taking pencils from the teacher's table starting to write)

T: Write quickly

L: (Drawing the bar graph on their exercise books)

Lesson Observation 2: Reddy Primary

T: Good morning class.

L: Good morning ma'am.

T: Take out the book for the Department and open on page 67. There it says school boys in Laduma wear caps, sizes 2, 3, 4. You are given sizes. Look, it says count how many are wearing size 4.

L: (Quiet)

T: (Drawing 3 columns on the chalkboard) Count how many wear size 4. Count on your own, don't shout. How many?

L: 25

T: Yes 25

L: No, 24.

T: Hey, learn how to count. I also got 25. Now look at the chalkboard. If we want to write tallies how do we do it? (Writing tallies on the chalkboard counting together with learners.) Now count how many wear size 3.

L: 19

T: Yes 19. Now who will come and write the tallies for 19?

L: (1 learner comes and writes on the chalkboard counting loudly.)

T: Yes, Your lines must be long and not short. Now count these tallies on the board.

L: (Counting up to 19.)

T: How many wear size 2?

L: 15

T: Now I want a boy who will come and write on the chalkboard. It means we have done our graph by tallies. (Writing on the chalkboard the names with different coloured letters.) Now what I want you to do in your exercise books, you will be doing this work. (Writing questions on the chalkboard.) Don't talk, you are writing. Talking will disturb you.

L: (Writing in their exercise books.)

T: You are guided by the questions, don't just answer.

1. How many times does O appear?

2. Check the total of a, i and u.

3. Add e and o.

T: Be quick.

L: (Writing.)

T: Hey, write, others have not yet started writing. Why are you talking? Leave 2 spaces when you draw a graph.

Appendix C vii

Lesson Observation 1: Blueberry Primary

Teacher (T): Calculate now in 10's starting from 500.

Learners: 500, 510, 520, 530, 540, 550, 560, 570, 580, 590, 600.

Teacher: Sit down. Remember we talked about weight, we also talked about liquids. Tell me about the units that measure length? The smallest one may be that you can use to measure the finger or the mouth.

Learner (L): mm

T: Is that true?

L: Yes

T: Another one

L: cm

T: Hands up and one person will talk.

L: cm

T: What do we measure?

L: Length

T: From here to the office?

L: m

T: To Johannesburg?

L: km

T: Tell me about liquids.

L: Water

L Paraffin

T: How do we measure?

L: kg

T: No.

L: mm

T: Hay (No) – you don't know what we use to measure liquids?

L: ml

T: Yes

T: How do the measurement for liquids end? With which letter?

L: L

T: Yes, now we will talk about weight. What do we use to measure weight?

L: kg

L: g

L: mg

T: What do we eat at home that is measured in kg?

L: Maize meal.

T: Yes.

T: Small sugar that we use at home what is written there?

L: mg

L: Mm

T: Hay (No), now you are guessing grade 3.

L: gram

T: Babies when they go to the clinic they measure weight. Who have gone with their mothers to the clinic?

L: (Lifting up their hands.)

T: Yes the baby is measured in kg. The baby is put in that thing like a tray and baby cries. The baby grows until he/she weighs exactly like the big packet of rice.

L: (Laugh.)

T: Yes grade 3, I have my babies here (showing them the chart with the weight of the babies and names). What do you see here grade 3? Give me the names of the babies. Look at this graph. Weight in kg.

L: Tim, Sue, Lu, Rudy, Min, Akhona, Joe, Kim

T: All these learners have gone to the clinic for immunisation. Now they are weighed. First one's weight?

L: 25 kg

T: Joe? Which weight?

L: 10 kg

T: Is that correct?

L: No.

L: 30 kg

T: Hey, grade 3 be careful look study the bar graph carefully.

L: 15

T: No.

L: 50 km

T: Hawu! (Oh!) you are lost.

L: 50 kg

T: Yes, then Rudy?

L: (Quiet for a long time looking at the chart.)

T: Akhona?

L: Quiet.

T: Senzo?

(Senzo does not respond.)

Hay bo! (Oh no!) What is your problem?

L: 30 kg

T: Kim? What is his weight? Yes Asanda?

L: 40 kg

T: Sue?

L: (Learners keep quiet.)

T: (Showing them.) All of you?

L: 30 kg

T: What is Mini's weight?

L: 45 kg

T: Bring to the nearest 10 Mini's weight.

L: 60 kg

L; 50 kg

T: Yes. Then Akhona's weight which is 20 kg, bring it to the nearest 10.

L: 20 kg

T: Why? Because in 45 we said 50 yini umehluko? (What is the difference?)

L: 5 is increasing.

T: Increasing what? The baby?

L: 10's

T: 4 is increasing 5 and 4 dies. Then why in 20 there is no change?

L: 0 does not increase.

T: Mention the numbers that make it increase.

L: 5; 6; 7; 8; 9.

T: Those that does not increase?

L: 0; 1; 2; 3; 4.

T: Increase Joe's weight.

L: (Quiet.)

T: Why? Did we have a fight? Why are you quiet?

T: Multiply Joe's weight by 2.

L: 30 kg

T: Now multiply Mini's weight.

L: 90 kg

T Yes. Do you buy 90 kg maize meal at home? Hands up those who buy 90 kg maize meal at home.

L: (Most of the learners lift their hands.)

T: Hee ... Niyadla bo! (You eat a lot!)

T: Make it half the weight of Lu. Calculate grade 3.

L: 18 and a half.

T: Now you are confusing me, now you get a half?

L: 22 kg

T: No. Another one.

L: 70 kg

T: Now those who got 18 and a half please tell us how did you calculate?

L: You divide 37 by 2 and 1 remains and then you divide 1 that remains by 2 and you get half. Then that is 18 and a half.

T: Yes. There are two ways of calculating this. We can split. This way (showing them that method).

T: Now who has the biggest weight? Don't tell me. Who has the smallest weight? Don't tell me – you will write. Mini weighs more than Lu in how much weight? Which sign are we going to use? Tell me the method only.

L: Subtraction sign

T: Yes. Now read the next question.

L: What is the total weight of learners (Reading aloud)?

T: Which sign are you going to use?

L: Addition.

T: What tells you that you are going to use the addition sign?

L: The word total.

T: Yes, very good, take R1 there on the table quickly. Brilliant boy. Ok now answer the questions in your exercise books.

Lesson Observation 2: Blueberry Primary

Calendar

T: What is the date today? All of you.

L: 21 August 2014.

T: That is how it helps us. What is written in that calendar?

L January.

L: February.

T: What are those January February?

L: Months of the year.

T: Say all of the months of the year.

L: (Shouting) January, February....

T: Yes. Now say the months of the year in IsiZulu.

L: January uMasingana; February uNhlolanja; March uNdasa; April uMbasa; May uNhlaba; June uNhlangulana; July uNtulikazi; August uNcwaba; September uMandulo; October uMfumfu; November uLwezi; December uZibandlela.

T: Very good. everyone knows the months of the year. How many days are there in a week?

L: 7

T: Yes. Then the days of school?

L: 5

T: Then holidays in one week?

L: 2

T: Yes. And how many days of the year?

L: 365

T: Sometimes it happens that the days are not 365 but how many?

L: 366

T: Yes. Why does that happen?

L: Because February ends in 29 but normally it ends on 28

T: What is that year called?

L Leap year.

T: Yes and which day is important in the beginning of the year?

L; Happy New Year.

T: Yes it's happy New Year. And on which day?

L: 31 December

T: Is that true?

L: Yes, no (some say yes and some no).

T; I know you are confused. It is 1 January. When does the day end? Time?

L: 12

T: Yes, that is why others say 31 December. So after 12 on the 31st of December the new day starts which is 1 January. Which other holiday is important?

L: 25 December.

T: Yes then what happens on that day?

L: We eat, drinks.

L: We eat cakes.

T: It is true but what do we celebrate?

L: (Silent.)

T: We celebrate the birth of Jesus Christ. Another holiday?

L: 27 April.

T: Yes what is that day for?

L: Freedom Day

T: Very good. All of you?

L: Freedom Day.

T: Yes were not free, before we did not even share the toilets with Whites.

Which other day is important in the calendar?

L: 9 August.

T: Yes what is it for?

L: Women's Day.

T: Yes and June 16 what is it for?

L: Youth Day.

T: Yes. In the olden days everything was learnt in Afrikaans. Then learners complained about learning in Afrikaans. When learners were marching the police shot them. Even the smallest child died, Hector who was of your age. So those kids helped because after that things changed and it was learnt in English. How Hector's story, is it good?

L: No.

T: Yes it is not good because the kids did not do anything bad. What is another important day that is in September?

L: 24 September.

T: Yes. What do we celebrate?

L: They celebrate culture.

L: They wear traditional clothes

T: It does not end in wearing traditional attire but also people eat their traditional food. Xhosas eat umnqushu (samp and beans). Is there a Xhosa-speaking person here?

L: (Quiet.)

T: Yes Indians eat briyani and Zulus eat Jeqe on the day. Then 27 April is the Workers' Day. What is for, grade 3?

L: Workers' Day.

T: Tell me grade 3, when is the Workers' Day?

L: 27 April.

T: Youth Day?

L: June 16.

T: The day for mothers?

L: 9 August.

T: Heritage?

L: 24 September.

T: Day of Reconciliation?

L: 16 December.

T: Right now you will write. You will read and answer the questions on your exercise book. Now open your books. Read the topic.

L: Ukusebenza kwe Calendar (How the calendar works).

T: Read the question.

L: How many days are there in 3 weeks?

T: Next.

L: How many Tuesdays are there in January?

T: Write the answer.

L: (Writing the answer.)

T: Read the next question.

L: When is the Day of Freedom?

T: Write.

L: (Writing in their exercise books.)

T: Read, grade 3.

L: Which month comes before Nhlaba (May)?

T: Write the answer.

L: (Writing.)

T: Which month comes after Nhlolanja (February)?

L: (Quiet.)

T: Tell me the answer class.

L: UMbasa (April).

T: No. Hands up. Yes Yolanda?

L: UNdasa (March).

T: Good. Which month is between Masingana (January) and Ndasa (March)?

L: (Quiet.)

T: You don't know the months in IsiZulu? Please ask your parents to help you. UNhlolanja (February). After Mbasa (April)?

L: UNdasa (March).

T: No, after Mbasa.

L: Nhlangulana (June).

T: No, that is not correct.

L: UNhlaba (May).

T: Yes, that is correct. Now I will come to your desk to mark for you.

Appendix C ix

Lesson Observation 1: Pink Primary School

T: What is the date today?

L: Today is 15 August 2014.

T: (Draws the graph on the chalkboard with the learners' age on the X axis and the number of learners on the Y axis) Hands up those who are 8 years old.

L: (Lift their hands.)

T: (Counts them.) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20. (She writes on the chalkboard.) 9 years? Lift up your hands.

L: (Lift their hands.)

T: (Counts them.) So many, 25. Lift up your hands those who are 10 years old.

L: (Lift their hands.)

T: (Counts them.) Ok, hands down, 15. Those who are 11 years old.

L: (Lift their hands.)

T: (Counting. You are 5. We said how many are 8 years old?

L: 20

T: (Draws the bar and aligns it with 20.) How many are 9 years?

L: 25

T: (Draws the bar of 25.) How many are 10 years?

L: 15

T: How many are 11 years?

L: 5

T: (Draws the graph on the chalkboard). Do you understand?

L: Yes, No.

T: Thobani, you did not understand?

L: No

T: Where?

L: Everything

T: Come and show me exactly where you do not understand.

L: (Going to the teacher and points at the graph on the chalkboard.) Here. (pointing.)

T: Ok, these are the years as we were asking learners their age and this is the number of learners with that particular age. Now do you understand?

L: Yes, madam.

T: Now take out your exercise books so that you will write. (Giving them rulers.)

L: (Copying the graph that was drawn by the teacher.)

Lesson Observation 2: Pink Primary School

Teacher: Here data has been collected for you, so you only have to answer the questions. Take out your books.

Learners: (Taking out their books.)

T: Page 20, It is the competition of planting trees (reading). This is done in September on the Arbour Day. Each tree is representing 10 trees. How many trees are planted by Shipstrait?

L: 8

T: How many? She is saying 8.

L: 8

T: How many?

L: 80

T: Why 80?

L: 1 tree is represented by 10 trees.

T: Yes, 1 tree represents 10 trees. How many trees are for Mthonjeni?

L: 60

T: Yes, for Sunstrat?

L: 90

T: For Shifong?

L: 40

T: Masiba? All of you?

L: 90

T: Some are not counting. (Drawing the graph on the chalkboard. On the X axis she writes the schools' names and on the Y axis she writes the number of trees.) Do we have a school here which will give the number of trees less than 10?

L: No madam.

T: I want somebody who will come and draw here.

L: (Learners come forward to draw on the chalkboard.)

T: Clap hands for them.

L: (Clapping hands.)

T: Now write. We have done all these (pointing on the book). Write quickly.

L: (Copying from the chalkboard but writing in their workbooks.)

T: I will mark for those who have finished writing. Lift up your hand when you have finished writing and I will come to you.

L: (Lifting up their hands.)

T: (Marking for them.)

Lesson Observation 1: Purple Primary

Teacher: What is data handling?

Learner: It is putting in the graph.

T: She says it is putting in the graph. What is another person saying? We have learnt this before.

L: Putting things together.

T: Yes, another one.

L: Collecting objects.

T: What is data?

L: It is information.

T: (Handing out worksheets.) What is on the big page?

L: Big box

T: Ok, big box.

L: Paper

T: And what else?

L: Milk.

T: Yes, milk and what else?

L: Newspaper.

T: Ok good. Now use this sheet to make your own graph (pointing at the worksheet she had given them). Do you remember when we learnt about food?

L: Yes, nutritious food.

T: Yes, do you remember when you had to sort your own food?

L: Yes.

T: What is your instruction?

L: (Reading from the worksheet.) Cut out and sort these cards.

T: You will cut and sort these cards (showing them). Cut one strip. From the strip cut 1 square and stick it on your big paper. Once you have finished sticking, continue to colour the pictures and we will talk about that once you have finished.

L: Yes Miss Fiona.

T: Miss Fiona I am done.

T: Ok. I am going to give you few more minutes. Now I will cut and you will paste (helping another learner who is left behind). What are you doing? What are you supposed to do? (Referring to the learner who is doing nothing.) Now work.

L: (Colouring pictures that they have pasted on the big paper.)

T: Let us look at milk, paper, newspaper and a box. How many small boxes are there?

L: 5

T: How many paper piles?

L: 2

T: Yes 2. How many newspapers are there?

L: They are 3.

T: Yes 3. How many boxes are there?

L: 4

T: Yes. Which was the most recycled?

L: Milk.

T: Which is the least recycled?

L: Paper.

T: Ok. If you add them altogether, what do you get?

L: (Quiet.)

T: What is the total?

L: 14

T: How did you work it out?

L: I said 5+2+3+4 = 14

T: Good. Another one?

L: I said 5+7+2 = 14

T: Yes.

L: I said 5+4+2+3 = 14

T: Yes, did anyone one add differently?

L: Yes I counted in 2.

T: Good. Another one?

L: I said 5+2+3+4 = 14.

T: What is the difference in the most collected item and the least collected?

L: 3

T: Yes, come and write the number sentence.

L: (Writing on the chalkboard.) 5-2 = 3

T: Yes. She took the big number and subtracted the small one. I know some are still struggling when we talk about the difference.

What is the difference between the boxes and the newspapers?

L: 1

T: Come and write the number sentence on the board.

L: (Writing) 4-3 = 1

T: Yes. The difference between boxes and paper piles?

L: 4-2 = 2

T: Yes. How many more newspapers are there than papers?

L: 1 more

T: How do you do that sum?

L: 3 divided by 2

T: No we are not sharing.

L: 2+1=3

T: 2+? =3

L: 2+1=3

T: How many less newspapers are there than milk boxes?

L: 2

T: Yes 2 less. Will you start with a bigger number or a small number?

L: Small.

T: No (showing them an object like 3 blocks). Can I take away 5?

L: No

T: 5-? = 3

5-2=3

5-? = 2

L: 3

T: What will be the word if you want to add up everything?

L: More

T: No. Who can tell me?

L: Altogether

T: Good. Putting all this information together was it difficult or easy?

L: Easy.

T: Use your sorted cards to draw your pictograph. Why is it pictograph?

L: Because there are pictures.

T: Finish colouring. When you have finished colouring I will give you mathematics books and you will paste your papers on them.

Appendix C xii

Lesson Observation 2: Purple Primary

T: Open on page ... on your workbooks.

L: (Opening their workbooks.)

T: Do you see the pie chart?

L: Yes

T: How many pieces are there in a pie?

L: 24

T: Yes because we are talking about hours in a day. How many hours are there in a day?

L: 24

T: How many days are there in a week?

L: 7

T: 7, right. Colour in the number of hours we spend at school. At what time do we start school?

L: We start at 7.

T: At what time do we finish?

L: We finish at 2 o'clock.

T: Count number of hours we spend at school starting from 7. (Counting with learners.)

L: (Counting.) 8, 9, 10, 11, 12, 13, 14.

T: Yes, 14 is 2 o'clock. Is it?

L: Yes.

T: So how many hours?

L: 7

T: Then colour in 7 spaces in your pie chart using blue. Colour in between the lines.

L: (Colouring.)

T: At what time do you go to bed?

L: At 7.

T: And wake up at?

L: 6

T: Yes.

L: I sleep at 10 and wake up at 5.

T: Another one?

L: I sleep at 7 and wake up at 6.

T: Ok most of the people sleep at 7 and wake up at 6. Now let us count the hours you sleep. (Counting with them using fingers.)

L: (Counting using fingers.) 8, 9,10, 11, 12, 1, 2, 3, 4, 5, 6.

T: Woo! People sleep for 11 hours! Now colour in 14 spaces in your pie chart using grey colour.

L: (Colouring their pie charts.)

T: We have got how many hours left?

L: 6

T: How many hours do you spend eating?

L: 1 hour.

T: Ok 1 hour.

L: 2 hours.

T: 2 hours. Another one?

L: 1 hour.

T: 1 hour. Yes most of the people spend 1 hour eating. Colour in 1 hour using yellow.

L: (Colouring their pie charts.)

T: How many hours do you spend reading?

L: 2 hours.

T: 2 hours, yes.

L: 1 hour.

T: Let us take 1 hour. What colour are we going to use?

L: Green.

T: Yes use green.

L: (Using green colour on their workbooks.)

T: How many hours do we have left?

L: 4

T: How do we use these 4 hours playing and watching TV?

L: 2 hours watching TV and 2 hours playing.

T: Ok, another one?

L: 3 hours watching playing and 2 watching TV.

T: That is 5.

L: 3 hours playing and 1 hour watching TV.

T: Ok, another one?

L: 0 watching TV and 4 hours playing.

T: Now you decide how you colour the hours left. Use brown for TV.

L: (Colouring their pie chart.)

T: Look at your pie chart. I spend most of my time doing what?

L: Sleeping.

T: Now turn to busy times at the clinic (referring to their workbooks). Look at the bar graph. How many people came in January?

L: (Quiet.)

T: How many people came in February?

L: 2000

T: How many came in May?

L: (Quiet.)

T: In June?

L: 3000

T: In July?

L: 3500

T: In September?

L: 4000

T: October?

L: 2500

T: November?

L: 500

T: December?

L: 1000

T: Why are so many people going to see the doctor on June to September?

L: Because they are sick.

T: Why?

L: Because it is winter. Yes, but in September it is spring?

L: Because of rain in September.

T: Yes. What about November and December?

L: It is summer.

T: Why many people go to the doctor in January and February because it is still summer?

L: It is because of the wind.

T: The wind is dry. Now answer question 1 to 4 on your books. Start a sentence with a capital letter and end the sentence...?

L: With a full stop.

T: Now write and keep quiet.

L: (Writing on their workbooks.)

T: (Walking around and checking how learners do their work and explaining to those who do not understand.)

Appendix D i

Interview with Musa

R: Which instructional strategies are effective in your teaching of data handling?

Musa: Direct instruction, I use it to introduce and teach new knowledge with the help of different teaching aids. Group work or group teaching, I use this strategy to consolidate what learners have learned and to help those that they might need extra assistance. Questioning, I use this strategy before, during and after the lesson in an attempt to determine whether learners understood the lesson or they might need more explanation. Individual teaching also is effective if used together with other instructional strategies.

R: What concepts did you cover using those instructional strategies that you have mentioned?

Musa: Collecting, comparing, interpreting data, organising, presenting data and other mathematical concepts are covered. The different graphs like pictographs and bar graphs are also covered when I teach data handling.

R: How do those instructional strategies help learners in understanding data handling?

Musa: The instructional strategies that I use in most cases accommodate all different learners' learning abilities. For example, if I use the telling method some learners will not understand but when I demonstrate what I was explaining then those who did not understand will start to understand. These strategies also help me to plan my learners' learning activities accordingly. In other words while other learners grasp the content fast, those that show that they are struggling, they will be further accommodated by means of using different strategies such as group work, questioning or individual teaching. However, it is important to note that for the individual struggling learner, learning content can be taught in small chunks to encourage room for steady progression.

R: What can you say about the response of learners to the instructional strategies used?

Musa: I can say that, through open and closed questions most learners respond well since data handling requires learners to interpret the given information. The problem starts when learners have to do work on their own. They fail to do the work on their own without assistance. That is why they we have a problem with ANA because we are not allowed to assist them to understand questions. Learners fail to respond to the instruction. It is not that they do not know but they need assistance to know what is expected.

R: Why do you use colours when teaching data handling? I saw you using different colours when I was observing your lessons.

Musa: Different colours are useful for the following reasons:

To enhance learning, to promote comprehension, to help learners interpret the given information and use it to answer the questions, to help them make decisions, to help them make judgements when answering the questions, to help them find it easy to record their answers. Different colours can represent different things or concepts. You use colours to show learners the difference. Having said all this, the main reason for using colour is that bright colours attract young learners and they become interested.

R: Is question and answer method effective when teaching data handling?

Musa: Yes.

R: Why?

Musa: Yes. Learners are expected to summarise, organise, collect and present data. In some cases they might be asked to do their own survey where they might be expected to interview other learners and record all the responses. In other words, without questions learners would not be able to solve data handling problems. Questioning is part and parcel of data handling.

R: I saw learners in your classroom reciting times tables before the lessons commence. Why?

Musa: Reciting tables help learners to remember numbers and be able to calculate without any difficulty. So when we ask them to recite numbers we are drilling them. It is like sharpening their minds. We want them to be quick when they do calculations and that they calculate without using a calculator. This helps especially in mathematics computations although there are some learners who still experience problems despite reciting tables.

R: I notice that most of the foundation phase teachers including you want learners to repeat what they have said. Why?

Musa: Yes, repetition helps learners who do not concentrate to catch up when concepts are repeated. Even the one who did not hear clearly the answer is able to hear when the answer is repeated by other learners. We want them to understand.

R: Are you not scared that this might encourage learners not to listen because they know answers will be repeated?

T: No. Foundation phase learners are young and they cannot concentrate for a long time. Thus repeating answers is of benefit to those who did not hear or for those who were sleepy. When the whole class speaks even the one who is drowsy wakes up.

R: I also noticed when I was observing your lesson that you also asked them to read the instructions. Why?

Musa: In grade 3 we encourage learners to read and re-read the instruction with understanding. Understanding what the instruction requires from them will definitely put them in a position of being able to solve the problem without having difficulties. This is also in accordance with ANA;

grade 3 teachers were not allowed to read the questions to learners. Teachers were allowed to read the exemplar questions and answers only. After that teachers acted as invigilators.

R: What is your philosophy of teaching: What were some of the factors that influenced instructional strategies you used?

Musa: My teaching philosophy is influenced by constructivism theory. This theory boosts learners' self-esteem in different ways. It allows the teacher to design and develop the teaching and learning content based on real-life contexts. This theory is in line with the instructional strategies I use in teaching grade 3 learners. It encourages learners to construct knowledge while interacting with each other in a group. It requires the teacher to develop teaching activities, and motivate learners to take learning seriously and be active throughout the lesson. Since they might be asked to collect their own data, summarise it and present it by means of a bar graph or pictograph.

R: Thank you Musa for your time.

Appendix D ii

Interview with Qinisile

R: Which instructional strategies are effective in your teaching of data handling?

Qinisile: Resources like charts and books, Creative, you teach with them, real objects.

R: What do you mean by creative?

Qinisile: Creative is when you become creative by designing your own resources for teaching data handling. Like if you want to draw a graph for learners to see, you make your own chart by using the back o the calendar.

R: Ok I understand, and you also mentioned that you teach with them, what do you imply?

Qinisile: Oh I see learners to teach. For example, if I want to ask them the number of boys and girls. I won't write on the chalkboard but I will call boys and girls to come in front. Learner will count and see. Learners grasp easily when we use this method.

R: Which concepts did you cover using those instructional strategies?

Qinisile: What do you mean by concepts?

R: Ideas, topics in data handling those learners have to know.

Qinisile: Ok, it is graphs, patterns, sequences and puzzles.

R: Can you please tell me more about puzzles?

Qinisile: For example, you give them an activity where different shapes are mixed together. Then you ask learners to group together shapes that are the same. They can group circles together and squares together and you will find that maybe there are 9 squares.

R: How do those instructional strategies help learners in understanding data handling?

Qinisile: Ayabasiza ukuthi babambe masinya, njengoba bengishilo (they help them to grasp easily, as I mentioned) that if you call learners to come forward and you show the class what you want to say using learners as an example, they understand better. They also stay interested in the lesson because it is not boring. Kufana nokudlala kubona (it is like playing to them). Abayikhohlwa into abakhonjiswe yona usebenzisa abanye abafundi (they do not forget what was shown using other learners).

R: Ok I understand. What do you say about the response of learners to those instructional strategies you used?

Qinisile: They respond positively when you teach them but when they have to write on their own then they have a problem. That is why learners have a problem when they write ANA. In other words, when you give them individual work they have a problem. They work better in the groups because they help each other and that helps them to understand concepts that they did not grasp while I was explaining. That is why it is said we have to let them work in groups.

R: What gives them a problem when they work on their own?

Qinisile: I think they do not understand what is asked and what they are expected to be doing. That is why even in ANA paper they do not perform well. They want somebody to explain the question to them, as you were doing when teaching them. Hey idata handling ayikho lula ezinganeneni, izinamba zingcono (Hey data handling is not easy to them, numbers are better). Learners fail to look for information that is in front of them especially in graphs. Look at this one (showing the graph); it is easy but most of them got the wrong answers. Data handling is not as easy as you think to these learners.

R: Tell me Qinisile, why do you use coloured chalk when writing on the chalkboard?

Qinisile: So that learners will see the difference when you are teaching. The topic will be one colour and the question for example will be another colour. When you write an answer also you will use a different colour. Different colours for kids attract and also make them to pay attention. May be let us saying you have used peach colour, learners will start to be interested and ask questions wanting to know what colour that is. May be other learners will know and tell them and also they can start to argue about that particular colour. Then the lesson will be interesting. Using different colours make learners to think critically. This also helps them to be able to identify different colours.

R: Is question and answer method effective when teaching data handling?

Qinisile: Yes.

R: Why do you say so?

Qinisile: Because as a teacher you want to find out whether learners understand what you are teaching them or what you have taught. Even if they have understood you want to find out how far they have understood. If you see that other learners did not understand then you explain again to the learners until they understand.

R: Ok, Why do learners have to recite numbers everyday for example table of 3?

Qinisile: (Laughing.) That refreshes the mind. You know in the morning they are from their homes think beans that they have been eating; now you want them to gear up. Another reason is to drill them so that they will be able to count. Numbers are very important to kids that are why they have to count every morning. When you start to teach them since Maths is taught in the morning, then learners would be fresh and ready to calculate. For example, if they have been

counting using the table of 5, when you ask them 35 divided by 5, they will use their fingers and say 5, 10, 15, 20, 25 and they will say 5. You see how easy it is?

R: That is interesting. In the foundation phase most of the teachers including yourself want learners to repeat what they have said, why?

Qinisile: So that a person who has forgotten can remember and understand better. Also we want what we are teaching to sink into the head of the learner.

R: Why do you use worksheets when teaching data handling?

Qinisile: It is because I want to see whether they can write on their own and also whether learners are able to read the instruction without being helped. Yes I want to see how many can read on their own because when I write on the chalkboard I read for them and explain before they write.

R: Ok, thank you for your time Qinisile, I really appreciate that.

Appendix D iii

Interview with Honey

R: Tell me about the effective instructional strategies when teaching data handling.

Honey: Hey, these kids have been writing ANA paper. The paper was not difficult it's just that these kids do not concentrate. Let me show you one script (showing me one script). Hey, you know what, the government is giving them a lot of work. The people who set these papers are those that are high there. They do not know anything about what is happening in the classrooms. Children do not finish writing because the paper is too long, here are the workbooks, here is the guideline, the work schedule, what can I say, polices. Now we are doing the score like the factory with our minds.

R: What do you mean by the factory score?

Honey: In the factory you are expected to sew 300 arms for the dresses; if you fail to do that then you are told that you will lose your job or you are given a warning. I will be told I don't do my work properly or I am slow. The same thing applies with our government, he wants us to do the score with the mind and you cannot change the mind of a person. These learners have problems, they have parents who are sick and they are also sick and our government does not consider that. You will be ask to account for the failure of learners and you will also be asked what were you doing the whole year. These kids have mothers who are kids themselves who also come here and fight with us and tell us that we must not touch her child. At the end of the day these kids must pass. The government will tell you to write a report and explain how did learners fail and forget that the government is the cause for the failure of these kids. Our government of South Africa does not have the policy of its own but they take the policies of other countries that were successful in those countries because of the environment, but not in our country. It started with OBE, NRCS, NCS, CAPS, themes, theme teaching, surprisingly enough they do not take teachers who are in post level 1 like myself and ask them. If they would ask me how it is going down there, I would tell them that the work is too much for the kids and they are not coping and learners do not finish writing. The worst part is that of teaching in IsiZulu. When you want to say 672, you will say amakhulu ayisithupha namashumi ayisithupha nambili. You see how long it is but if you say 672 it is simple and short. Teaching in IsiZulu is also a waste of time. Learners do not talk like in their homes, they do not count in IsiZulu, even when it comes to fruit and vegetables they do not say izaqathi (carrot). We need to have an input to the policies. So these learners will pass not knowing anything.

R: How are they going to pass if they do not know?

Honey: How can you allow learners to repeat the grade when you have so many learners coming from another grade? They will push them to me while I have many learners? I don't want to be a remedial teacher. There are teachers who do not care and they do not have this stress that I am taking out to you. They are avoiding headache and high blood pressure. When maybe 10 fail, the class will be overcrowded because there will be many coming from another grade.

R: Which instructional strategies are effective in your teaching of data handling?

Honey: Most of the time data handling is a questionnaire. It is a look and say in the olden days we use to call it that way. They do not create they answer based on what they see. But they can also create their own graphs if they are taught how to do so. He must be able to count and see the difference. The strategy is for them to see like here (showing me the bar graph). They must be able to see and be able to read the graph. The reason for teaching the graph is to compare. The learner must be able to compare for example a car and a truck. We can compare kilometres also. You see what I mean? This is another graph we use (showing me a worksheet with a graph).

R: Yes.

Honey: Also basic operation. Another question can require a person to add.

R: Which concepts did you cover using those instructional strategies you have mentioned?

Honey: In fact all maths work is covered when you teach data handling. There are LOs in maths. So there are number and operations like addition and subtraction and these is covered in data handling, there are patterns, and maybe this is not included in data handling. Oh no, it is included. There is also shape and space, two-dimensional and three-dimensional shapes. This is included in data handling because when you look here (showing me the bar graph) this shape is the rectangle. Then comes the measurement, litres, if I say how many litres are delivered in one week? Then now numbers and operations come in because you will be multiplying but in the measurement. Yes, all the LOs are included in data handling.

R: How do those instructional strategies help learners in understanding data handling?

Honey: The learners' book must have pictures so that a learner can see a picture before he/she learns anything.

R: What can you say about the response of learners to the instructional strategies used?

Honey: Oh they like data handling. It is easy for them to grasp. They get excited and they are able to identify what they have learnt in data handling even in other subjects. Data handling correlates with all other subjects. Some learners have a challenge when you give them the work to write individually. This means that critical thinking is lacking; they always want to be given a clue, and this does not happen when they write their ANA paper. I don't know what can we do to prepare them for ANA.

R: Why do you use colours when teaching data handling?

Honey: Colours are very important. Colours are part of maths. There are primary colours, secondary and tertiary colours. If you teach you have to show learners colourful things. You know, even a young kid, if he/she is crying he/she keeps quiet when she sees something colourful. Bright colours catch the children's attention.

R: Is question and answer method effective when teaching data handling?

Honey: Yes it is.

R: Why?

Honey: Because as you ask learners questions even those who do not grasp fast benefit as other learners give answers. Question and answer method clears some misconceptions because as you pose questions it is like guiding or directing them to the correct answer. As a teacher you keep on phrasing questions differently if you see that learners do not understand, until they reach the expected understanding.

R: I noticed that you ask learners to recite the table every morning. Why?

Honey: That is the old method that was used in my time. But even now it helps because it trains learners to be able to memorise numbers. If I say 7 multiplied by 7 he/she must be able to give me an answer quickly. Now we no longer use this method because of IsiZulu. If you say 2 x 3 = 6, how can you say that in IsiZulu? Recitation sharpens the mind of the learner. Although we ask them to recite times table every day, some learners are still struggling with calculations even with counting. It was better when we taught in English. Just imagine when you say the time is 6h30 when do you say ligamenxe elesithupha because the learner does not say that even at home. We take our kids to the ex-Model C schools and these who go to these schools suffer. This is time for transformation but the government is taking us back.

R: In the foundation phase most of the teachers including you want learners to repeat what they have said, why?

Honey: Repetition helps the learners that do not concentrate in class. So as I say again, those will start to concentrate and be attentive. These small kids learn by talking. You have to involve them because if they keep quiet for a long time, they lose concentration. We say again and also ask them to clap hands so that no one will fall asleep.

R: How does it help learners when you give them worksheets?

Honey: It is transformation of this time because we were not given worksheets in our time because there were no photocopiers. Learners are given worksheets so that they can be able to read for themselves and concentrate because they have to answer questions on their own. The learner is able to negotiate with the paper so the worksheet promotes silent reading.

R: I also noticed when I was observing your lesson that you ask learners to read the instructions. Why?

Honey: Like reading on the chalkboard?

R: Yes.

Honey: We want them to be attentive and so that they will be used to reading on their own. You know these learners write ANA paper and they have to write without any assistance. They do not pass this paper because they are not used to reading an instruction.

R: Thank you Honey for your time, you are doing a great job.

Interview with Betty

R: Betty, you are free to use your own language when answering questions and you are free to ask if you do not understand the question.

R. Which instructional strategies are effective in your teaching of data handling?

Betty: When you talk about instructional strategies you talk about methods that I use when teaching data handling?

R: Yes

Betty: Ok we draw in the chalkboard and we put different colours on the things that we draw so that they will be interested to what we are teaching them. Before drawing, firstly learners recite numbers so that they will recall numbers and I show them colours. If I make an example about the market day, learners selling cupcakes. Before you draw you make them recite numbers because they are going to use them. You also show them days of the week with different colours because Monday is different from Tuesday and also Wednesday, Thursday and Friday. If you group them according to the cakes they are going to sell they see days of the week. M for example will be blue.

R: So those are the only instructional strategies that you use when teaching data handling?

Betty: Writing on the chalkboard, question and answer method, demonstration, you involve learners by asking them come and write on the chalkboard and also recite numbers because they are going to use them when we say how many cupcakes were sold. They are not going to be able to write, for example, the number of cupcakes sold if they do not know numbers or if they cannot count the cakes.

R: What concepts did you cover using those instructional strategies that you have mentioned?

Betty: By concepts you mean counting of the cakes, counting and what else, they name, they recognise that on a particular day they sold so many cakes. They can also demonstrate.

R: If you say they demonstrate, what do you mean?

Betty: Ok, they come in front as a group and represent say Monday instead of writing Monday on the chalkboard, you will say for example Monday how many cupcakes did you sell? And they show those cakes, maybe show 2 cakes.

R: Interesting; how do those instructional strategies help learners in understanding data handling?

Betty: Those help them to know numbers, know the colours, to be able to differentiate other graphs from pictograph. They won't forget the pictograph.

R: What can you say about the response of learners to the instructional strategies used?

Betty: Learners get so interested and excited. They even ask questions saying why you mentioned so less numbers when we are many; they also give you instructions. They want you to be realistic or practical, like when you make an example using them they want you to write the actual number of learners in class. This shows interest to them. Really they are so interested, they want to know more.

R: Why do you use coloured chalk when writing on the chalkboard? I know you mentioned colour as one of your instructional strategies.

Betty: Coloured chalk makes diction, it makes sense. When you write numbers you use one colour because numbers are just numbers, they do not change. So I use coloured chalk when writing the days of the week, for example, because Monday is not the same as Tuesday so you want to show the difference. You use coloured chalk just to stress the point that the days of the week for example are different.

R: Is question and answer method effective when teaching data handling?

Betty: Yes.

R: Why?

Betty: It is important because you want to know whether they have grasped what you were teaching them. You also want to know how far they have understood the concepts you taught.

R: I have noticed that learners recite numbers, for example the table of 3. Why do learners have to recite numbers every day?

Betty: (Laughing.) Most of us foundation phase teachers get so interested to see them counting. We want them to be able to count and to recall numbers. You get so interested when we see them being able to count. You can also see those people who cannot count and also those who cannot count can learn by hearing others and join them. This will make them to be used to counting because even when you ask them 2 multiply by 2 he/she will be able to tell you the answer quickly because it is in his/her mind. It is like playing to them but they learn. This helps them a lot and they don't take it seriously.

R: I notice that most of the foundation phase teachers including you want learners to repeat what they have said. Why?

Betty: It stays in their heads when they repeat. We do it for those who do not listen in class. So when you make them repeat you want them to understand what you are saying. They can repeat even more than 2 times so that they will understand. We know that there are those learners who

do not listen when you teach, so when they repeat they also benefit. If you say something once some will not understand from the word go. So this is very effective to their learning.

R: I also notice when I was observing your lesson that you also asked them to read the instructions. Why?

Betty: Learners are not used to reading. They cannot read because teachers read the instructions for them. So letting learners read helps them to get used to reading an instruction for themselves and this will benefit them. During formal assistance, learners have to write without the assistance from the teacher.

R: Thank you Betty for your time.

Appendix D v

Interview with Charity

R: Charity, which instructional strategies are effective in your teaching of data handling?

Charity: Group work, discussion, making scenarios, question and answer method telling and also show and tell.

R: What do you mean by show and tell?

Charity: For example if they are making a cake. You bring all the ingredients and the containers with measurements. You ask them to put flour maybe in a 2 kg container. If it is said a learner has to measure using 2 tablespoons he or she must be able to differentiate between a tablespoon and a teaspoon. So that is show and tell. It is when you show them the calendar as you saw when I was teaching them about the months of the year. You also ask them about holidays so that is question and answer method; you see that, if they don't know the holidays then you tell them. So you see how it goes?

R: Yes.

Charity: You know these kids, they know the months but they do not know the holidays like Women's Day, Youth Day and their history. They do not know a particular holiday is important. They only know Heritage Day because we celebrate it here at school. We wear traditional attire, ask them to dance, sing and also prepare traditional food. So it is not easy for them to forget that day. Sometimes you even ask them to discuss in groups about heritage so discussion method comes in.

R: That is interesting. Which concepts did you cover using those instructional strategies that you have mentioned?

Charity: It is measurements, because I ask them to measure and weigh things. What else? And addition because I also ask them to calculate. Sometimes they also subtract, like you know in story sums. In fact all concepts that are in data handling are covered.

R: How do those instructional strategies help learners in understanding data handling?

Charity: There are questions that lead them to understand and I also pose some questions and that makes them to understand. So the question and answer method helps them to understand and also if I see that they do not answer it means they have not understood, so I tell them. So you see how the telling method comes in?

R: Yes.

R: What can you say about the response of learners to the instructional strategies used?

Charity: It becomes easy for them to understand like the show and tell. They understand easily because it is something that they do themselves and also things that they see make them to stay interested in the lesson. The problem starts when they have to write as individuals. I am worried because when they write exams, especially ANA, they are not allowed to ask. I think that is why they fail ANA.

R: Why do you use different colours when teaching? For example coloured chalk.

Charity: Learners like bright colours you know. Like you see in this class on the walls there are charts with bright colours, young kids do not like colours that are dull. This makes your lesson to be interesting to them. They get excited and stay interested. Different colours attract learners. You see what I mean?

R: Yes.

Charity: Even when they colour their work they get excited because they see their work being beautiful and they really feel that they have achieved something.

R: Is question and answer method effective when teaching data handling?

Charity: Yes, it is very effective.

R: Why?

Charity: You know I use question and answer before and after the lesson. I use it before to check how much they know about a particular topic or concept. Then I will know where and how to start teaching my lesson. Then after the lesson I also ask them questions to check now whether they have understood what I was teaching them. If I see that they did not understand, then I change the method I was using because it means that it did not work.

R: Why learners have to recite numbers? For example, you ask them to recite the table of 3 and of 5.

Charity: It is the warm-up and also they have to know the table since it helps them to be able to count. We want them to know numbers off by head although others still struggle to count especially if they are required to calculate using big numbers. Moreover, this is how we also learnt to count and do calculations.

R: In the foundation phase classes, most teachers including you want learners to repeat what teachers have said when teaching. Why?

Charity: You want what you are teaching to sink into the learners' minds. It helps with understanding when you allow them to repeat something. Those who were not concentrating will hear from others when they repeat the answer and join. It also helps if the learner did not hear the answer from the teacher or from another learner. When they repeat, then that particular child will hear.

R: Tell me again, why do you ask learners to read aloud the questions or instruction?

Charity: We want them to get used to reading instructions before writing or answering questions. You know we write ANA, so we are not allowed to read the instruction for learners, they have to read for themselves. So we are training them to get used to reading an instruction. But still learners have a problem; they do not understand the instruction when they have to write on their own. It would be better if we were allowed to explain to them the instruction during ANA paper. Maybe they would pass.

R: What if they get used to that and even in the higher grade they expect to be told what to do?

Charity: Hey, that would be a problem my dear.

R: You are doing a great job guys, keep it up. Thank you for your time Charity.

Interview with Jabu

R: Which instructional strategies are effective in your teaching of data handling?

Jabu: Hmmm … collecting data first but it must be things that they are familiar with. Like as you saw when you observed me, asking them their age or their shoe sizes. You can show them how to collect data like looking at teachers who have cars and those who do not have.

R: Which concepts did you cover using those instructional strategies you have mentioned?

Jabu: Hmm… number what, numbers and operations. Numbers that you deal with, counting and problem solving. How many are wearing this size, so that is addition or counting.

R: How do those instructional strategies help learners in understanding data handling?

Jabu: (Laughing.) I don't know. It helps because they become excited if it is something they can see.

R: What can you say about the response of learners to the instructional strategies used?

Jabu: In the stages that are there, there are others that they do not consider. Like they do not like collecting data but they get excited when they have to draw and do the shading. They might not get the answers correctly when it comes to collecting data. Like saying how many female teachers are there at school? But when it comes to drawing you can see that they like it, especially since we have LSEN in this school.

R: So how do you deal with LSEN?

Jabu: Eish ... That is a problem because we have a lot of kids in our classes, so we go with those who grasp easily. They do not get special attention because there are many learners that we have to attend.

R: How many learners in your class?

Jabu: 56, you see, how can I cope if I can give few learners individual attention? They move to the next grade even if they do not know.

R: Why do they have to go the next grade not knowing anything?

Jabu: They will remain and do what? They will move until they go to high school. Even here in our local high school they complain that we give them kids who do not know anything. At least if we were 2 in the classroom it would be better. If had an assistant I would do a better job. I

cannot do everything on my own having so many kids. We make them pass even if they are unable to write.

R: Why do you use colours when teaching data handling?

Jabu: We use colour to stress the difference. Like when you draw a graph you use different colours. Bright colours attract young children. More than you are just decorating so that it will catch the learners' attention as a result they will concentrate.

R: Is question and answer method effective when teaching data handling?

Jabu: Yes.

R: Why?

Jabu: That is how I assess them whether they have understood what I have taught. I realise that they did not understand I use another method.

R: Why do learners have to recite tables every day?

Jabu: You want them to get used to counting. Not all of them but those who cannot count like the slow learners. Even us, that is the way we learnt and we did not forget the numbers. It is easy to come up with an answer because it is in the mind. We also give them papers with those tables since we no longer have those exercise books with squares that we used to have. Even though they recite tables, some learners still have a problem with calculations.

R: How do you know that learners have problems with calculations?

Jabu: I see it as they are writing ANA. It is not only calculations that they struggle with but the graphs also give these learners a problem. The graph is drawn for them. This time it was about animals.

R: Do they cope?

Jabu: Yes some of them do because they have been taught. The problem is that they do not read the instruction. What I also found out was that even my HOD [Head of Department] did not know the answers to the questions based on the graph.

R: In the foundation phase most of the teachers want learners to repeat what they have said. Why?

Jabu: You want what you are teaching to sink into their minds. When you ask them whether they have understood they say 'Yes madam' but knowing that they did not. So it is better to make them repeat so that even the one who did not understand while I was explaining will do. Yes there will be those who will not understand still, but there is nothing you can do about that.

R: Why do you ask learners to read the instructions or questions in class?

Jabu: As we talked before when we were talking about question and answer method, they have to be used to reading an instruction. In this ANA paper, there was a question based on the graph and it was said each block stands for 10. So if a learner did not read that he/she will get the wrong answer. He/she will say there are 4 blocks instead of 40. So reading is very important to them.

R: Tell me what concerns you as a teacher?

Jabu: You know grade 3 is like grade 12 since they are writing a common paper. So you panic when the learners have to write ANA. When I give them tasks in class I read for them the instruction and tell them what is expected from them. Now when it comes to ANA, they have to read on their own and also they are invigilated by the teachers from other grades. Sometimes questions are tricky for them and you will find that even we teachers struggle to answer those questions. These learners are lazy to read. Moreover that is competition, since grade 3 classes are more than one. So if your class fails and learners in another class pass, then you are in trouble.

R: Thank you for your time Jabu, you are really doing a great job.

Appendix D vii

Interview with Felicity

R: Which instructional strategies are effective in your teaching of data handling?

Felicity: Discussions, group or pair work, practical data collection around the school, writing and drawing.

R: What concepts did you cover using those instructional strategies that you have mentioned?

Felicity: Sorting, sharing, grouping and ordering.

R: How do those instructional strategies help learners in understanding data handling?

Felicity: It gives learners a wide variety of methods to use, which helps them in their understanding through individual, group and practical activities.

R: What can you say about the response of learners to the instructional strategies used?

Felicity: Learners respond well to group and practical activities that aid in their understanding and thereafter their ability to record data on paper.

R: Why do you use colours when teaching data handling? I saw you using different colours when I was observing your lessons.

Felicity: Colours help learners to see the different sections of information collected rather than all the information as a whole.

R: Is question and answer method effective when teaching data handling? If yes, why?

Felicity: Not immediately, but it does because it is effective in showing and determining understanding. If you ask learners questions you are able to determine whether they have understood or not.

R: Learners in your class do not recite tables. How do you make sure that learners are able to remember numbers when calculating?

Felicity: In foundation phase learners are expected to learn to write, read and count. In Maths time-table is not the only oral activity they need to master. Different oral activities are done interchangeably. Meaning other oral activities such as decrease, increase, odd numbers, even numbers, add on, skip counting, days of the week, months of the year, mental calculation where they have to add or subtract without using counters, etcetera, all these oral activities cannot be done during the first 15 minutes before the lesson commences. I give them time to do

calculations on their own. I want them to find their own way which will make them not forget calculations or how to calculate. Once the learners find their methods of calculating and remembering numbers, they will not forget.

R: I notice that most of the foundation phase teachers want learners to repeat what they have said. Why?

Felicity: I do not ask learners to repeat anything in class because I want them to learn to listen to an individual when talking. If they know that something is going to be repeated, they will not listen.

R: I also notice when I was observing your lesson that you also asked them to read the instructions. Why?

Felicity: Because at grade 3 level, learners need to be able to read their own instructions in preparation for the Senior Phase of their school career.

R: What is your philosophy of teaching? What were some of the factors that influenced instructional strategies you used?

Felicity: Demographics, learners' energy levels, type of learners, e.g. visual or audio learners, learners' pace, ability and understanding.

R: Thank you for your time Felicity.

Appendix D viii

Interview with Vicky

R: Which instructional strategies are effective in your teaching of data handling?

Vicky: Discussions, group work, pair work, practical data collection and writing.

R: What concepts did you cover using those instructional strategies that you have mentioned?

Vicky: Sorting, ordering, sharing, grouping

R: How do those instructional strategies help learners in understanding data handling?

Vicky: It gives learners a varying understanding of data handling through practical, group, interaction and individually attempting it on their own.

R: What can you say about the response of learners to the instructional strategies used?

Vicky: The learners enjoyed the practical and group work the most, but were proud of themselves once they managed to do it on their own.

R: Why do you use colours when teaching data handling? I saw you using different colours when I was observing your lessons.

Vicky: Some learners are visual and need colours to assist them to differentiate between the different columns of data.

R: Is question and answer method effective when teaching data handling? If yes, why?

Vicky: Not at first, but once there is an understanding of the concept, it is a great way to effectively assess the understanding.

R: Learners in your class do not recite tables. How do you make sure that learners are able to remember numbers when calculating?

Vicky: We ask them to count, ask them to subtract, add and multiply. Moreover we give them a lot of work to do at home. We ask parents to help them with their homework.

R: I notice that most of the foundation phase teachers including you want learners to repeat what they have said. Why?

Vicky: I do not ask them to repeat because I want them to learn to listen and hear something first time. If I ask the learners to repeat, they will not listen to other learners or the teacher when talking because they will know that it will be repeated.

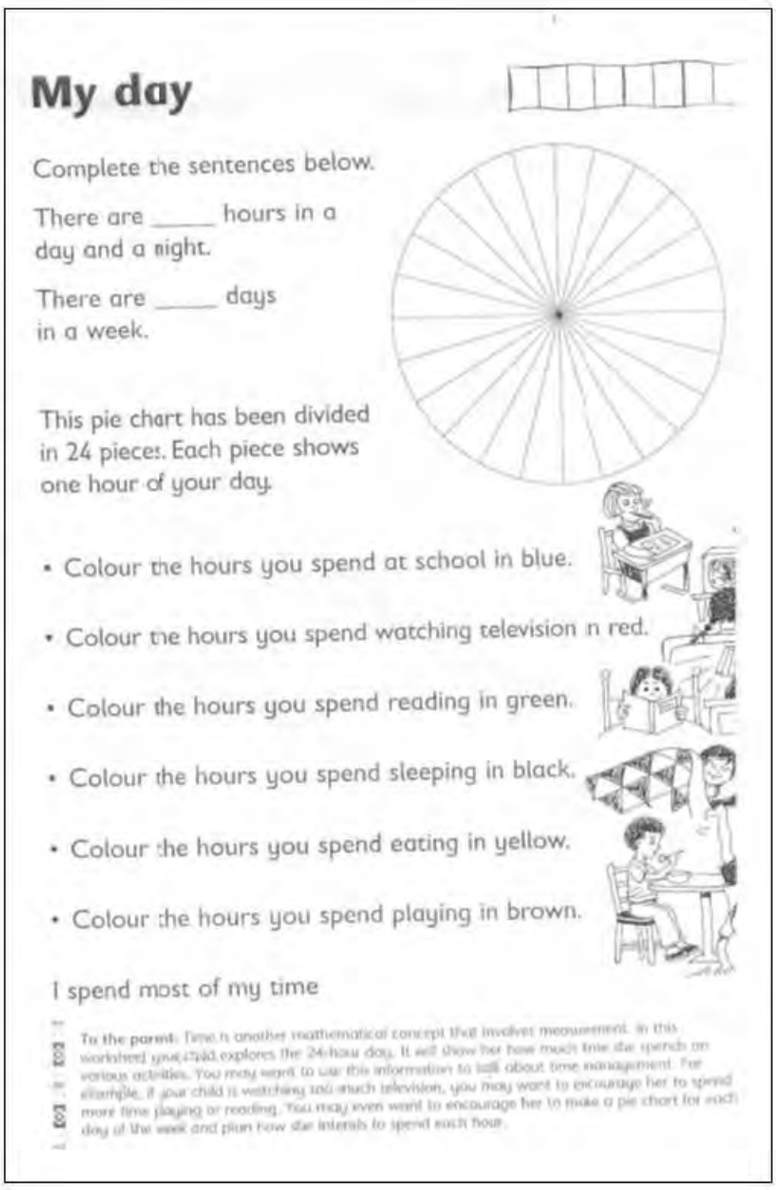
R: I also notice when I was observing your lesson that you also asked them to read the instructions. Why?

Vicky: It is important for everyone to read instruction in order to succeed in life. It is for holistic development.

R: What is your philosophy of teaching; what were some of the factors that influenced instructional strategies you used?

Vicky: Demographics, the learners' energy levels, dependent on the learner if he/she is a visual or audio learner. If the department of Education can allow us to read the instructions for learners, they could perform well in the ANA paper, especially the weak readers.

Purple Primary worksheet



My day

Complete the sentences below.

There are _____ hours in a day and a night.

There are _____ days in a week.

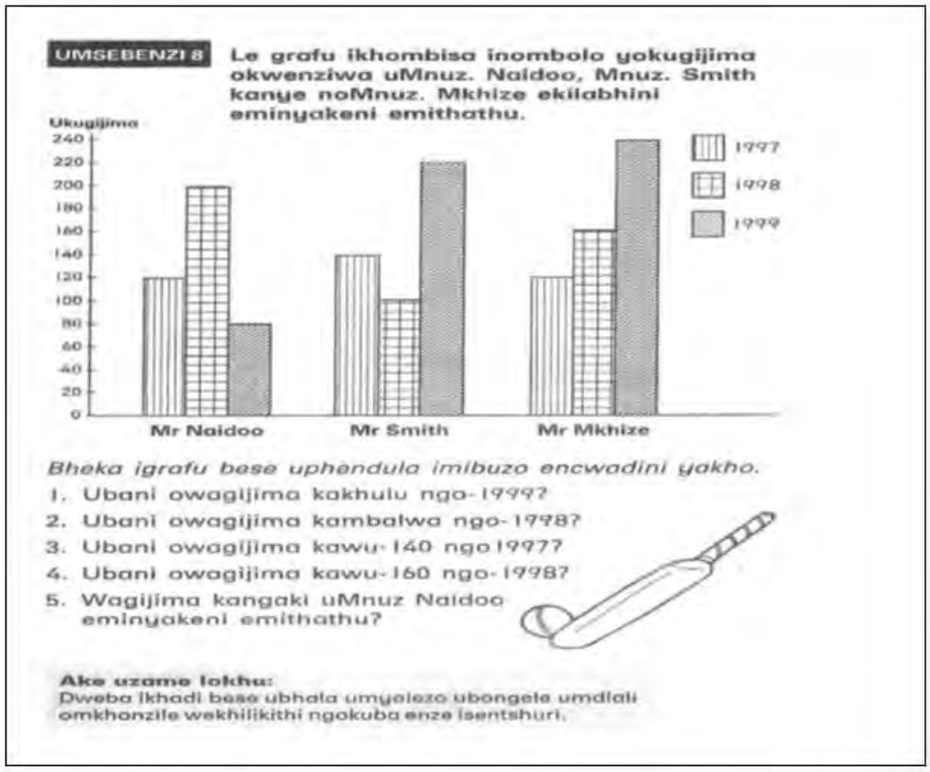
This pie chart has been divided in 24 pieces. Each piece shows one hour of your day.

- Colour the hours you spend at school in blue.
- Colour the hours you spend watching television in red.
- Colour the hours you spend reading in green.
- Colour the hours you spend sleeping in black.
- Colour the hours you spend eating in yellow.
- Colour the hours you spend playing in brown.

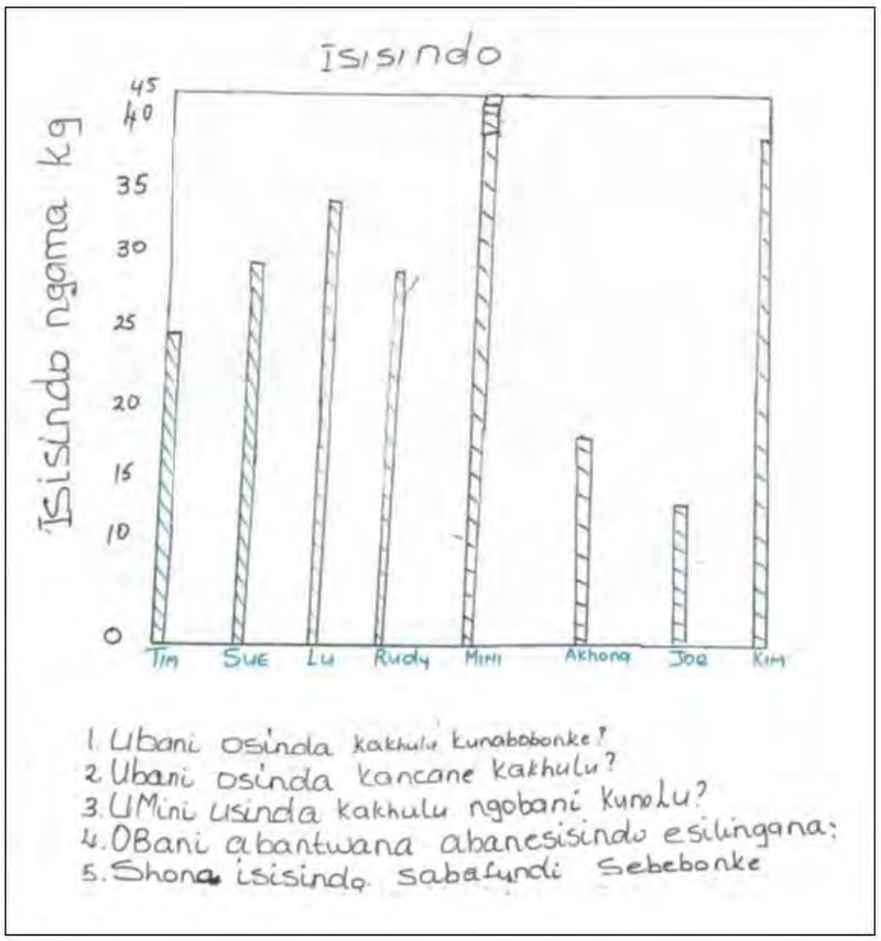
I spend most of my time

To the parent: Time is another mathematical concept that involves measurement. In this worksheet your child explores the 24-hour day. It will show her how much time she spends on various activities. You may want to use this information to talk about time management. For example, if your child is watching too much television, you may want to encourage her to spend more time playing or reading. You may even want to encourage her to make a pie chart for each day of the week and plan how she intends to spend each hour.

Yellow Primary worksheet



Blueberry Worksheet



Purple Primary Worksheet

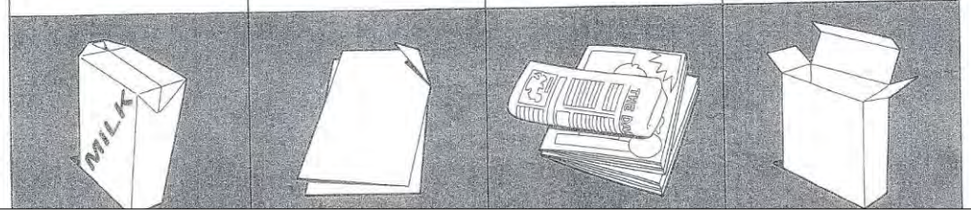
FOUNDATION PHASE

Name: .....

Activity 2b Collect and sort paper Grade 3

Use your sorted cards to draw your pictograph here.

Pictograph key:

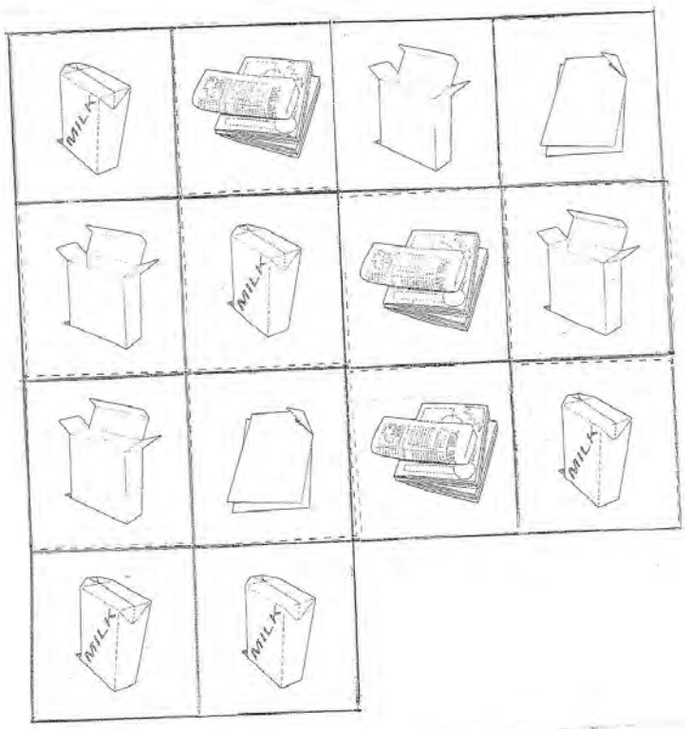


Appendix Ev

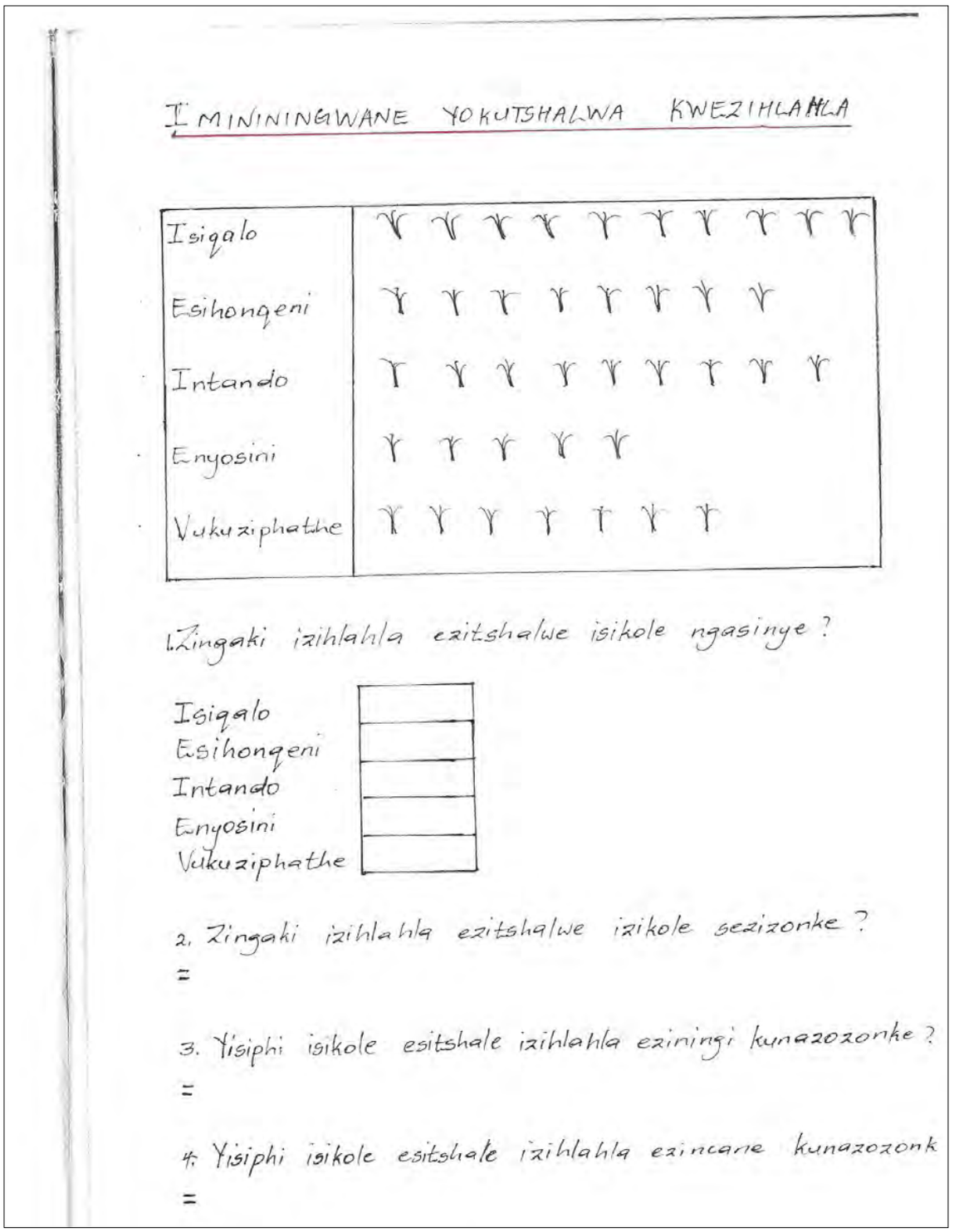
Purple Primary Worksheet

Activity 2a Collect and sort paper

Cut out and sort these cards.



Blackberry Primary worksheet



I MININGWANE YOKUTSHALWA KWEZIHLAHLA

Isigalo	10
Esihongeni	8
Intando	9
Enyosini	5
Vukuziphathe	7

1. Zingaki izihlahla ezitshalwe isikole ngasinye?

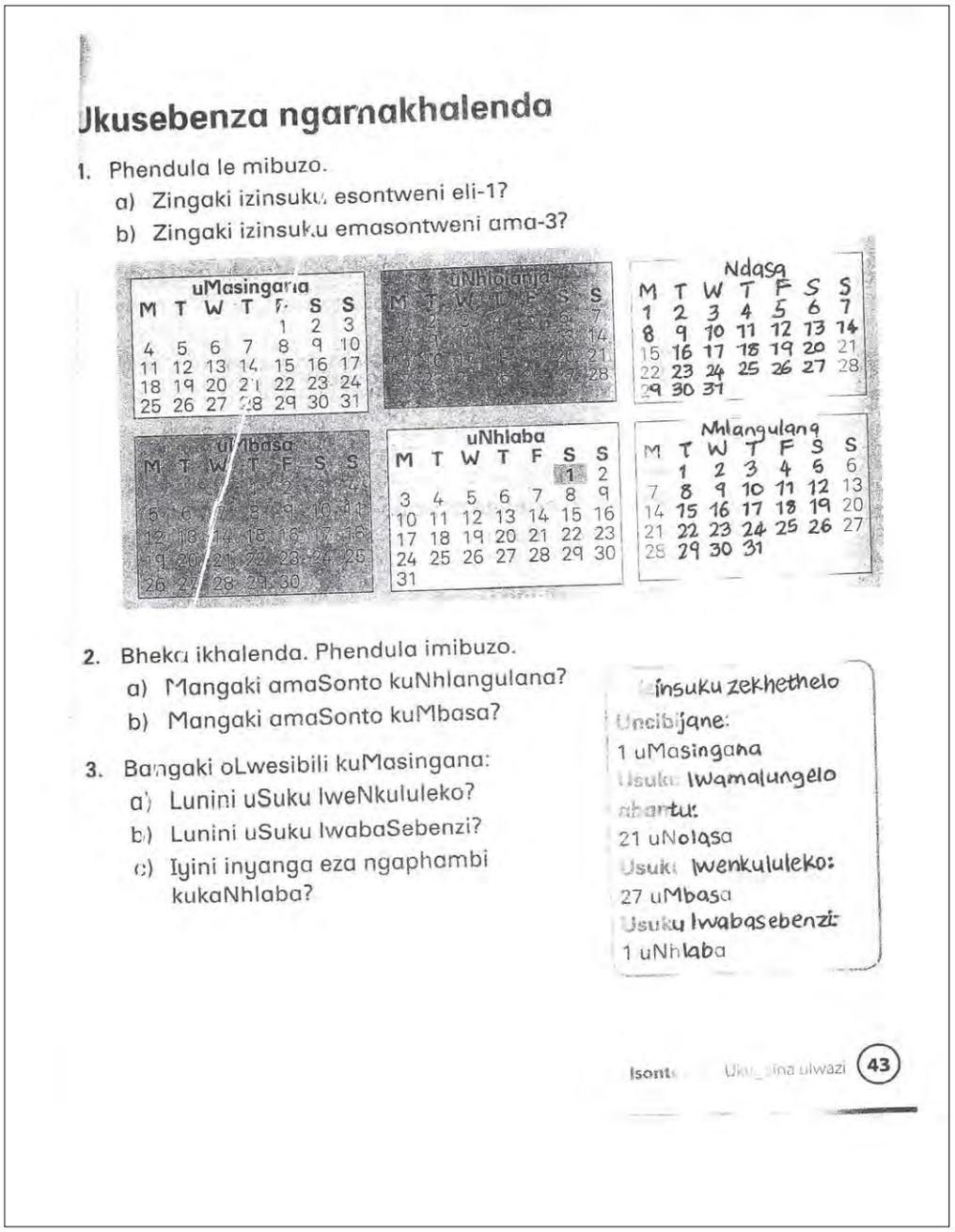
Isigalo
Esihongeni
Intando
Enyosini
Vukuziphathe

2. Zingaki izihlahla ezitshalwe izikole sezizonke?
=

3. Yisiphi isikole esitshale izihlahla eziningi kunazozonke?
=

4. Yisiphi isikole esitshale izihlahla ezincane kunazozonk
=

Blueberry Primary worksheet



Ukusebenza ngamakhalenda

1. Phendula le mibuzo.
   a) Zingaki izinsuku esontweni eli-1?
   b) Zingaki izinsuku emasontweni ama-3?

uMasingana

M	T	W	T	F	S	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

uNhlolanja

M	T	W	T	F	S	S
						7
						14
						21
						28

Ndasa

M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

uMbasa

M	T	W	T	F	S	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

uNhlaba

M	T	W	T	F	S	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Nhlangulana

M	T	W	T	F	S	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

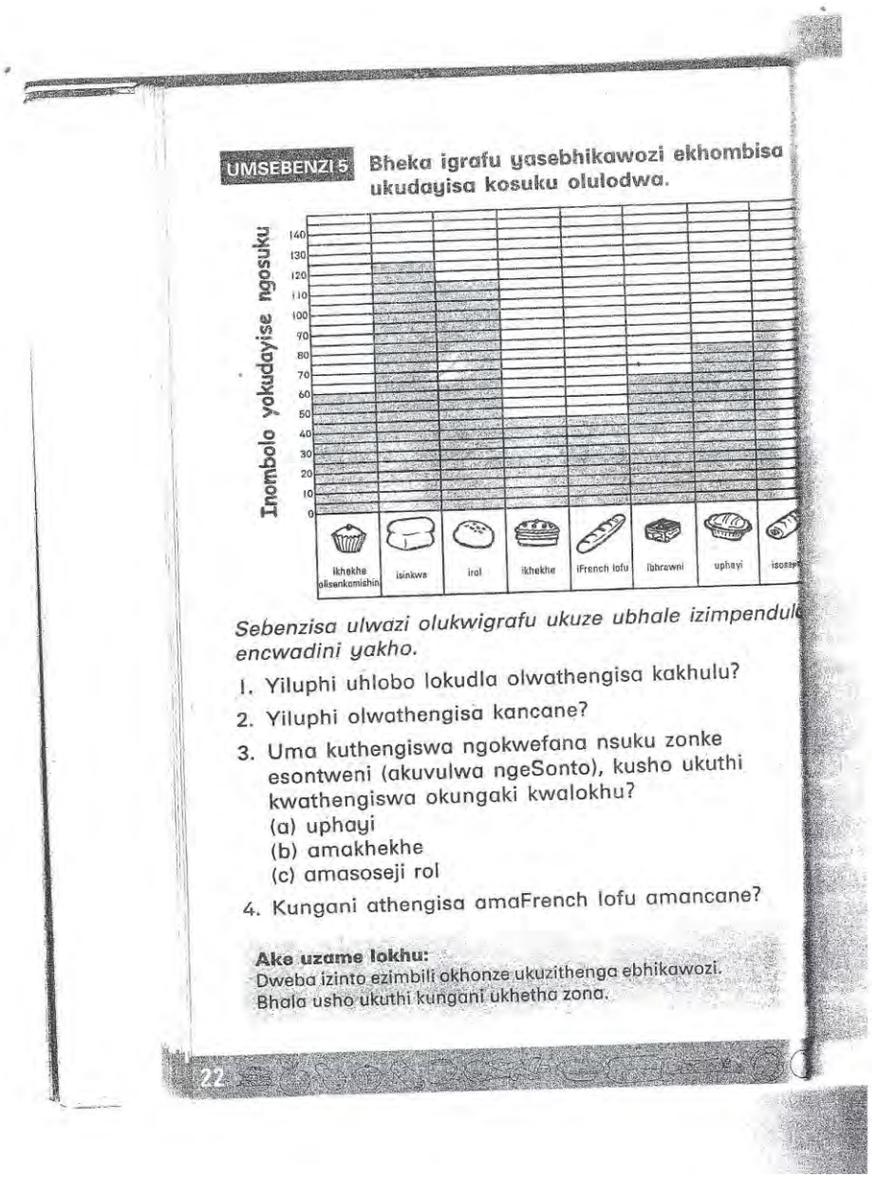
2. Bheka ikhalenda. Phendula imibuzo.
   a) Mangaki amaSonto kuNhlangulana?
   b) Mangaki amaSonto kuMbasa?

3. Bangaki oLwesibili kuMasingana:
   a) Lunini uSuku lweNkululeko?
   b) Lunini uSuku lwabaSebenzi?
   c) Iyini inyanga eza ngaphambi kukaNhlaba?

insuku zekhethelo
Uncibijane:
1 uMasingana
Usuku lwamalungelo abantu:
21 uNdasa
Usuku lwenkululeko:
27 uMbasa
Usuku lwabasebenzi:
1 uNhlaba

Isonto Uku...ina ulwazi 43

Green Primary worksheet



UMSEBENZI 5 **Bheka igrafu yasebhikawozi ekhombisa ukudayisa kosuku olulodwa.**

Inombolo yokudayise ngosuku

140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

ikhekhe olisenkomishin | isinkwa | irol | ikhekhe | iFrench lofu | ibhrawni | uphayi | isosej

Sebenzisa ulwazi olukwigrafu ukuze ubhale izimpendul encwadini yakho.

1. Yiluphi uhlobo lokudla olwathengisa kakhulu?
2. Yiluphi olwathengisa kancane?
3. Uma kuthengiswa ngokwefana nsuku zonke esontweni (akuvulwa ngeSonto), kusho ukuthi kwathengiswa okungaki kwalokhu?
   (a) uphayi
   (b) amakhekhe
   (c) amasoseji rol
4. Kungani athengisa amaFrench lofu amancane?

Ake uzame lokhu:
Dweba izinto ezimbili okhonze ukuzithenga ebhikawozi.
Bhala usho ukuthi kungani ukhetha zona.

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