Exploring teachers' scaffolding practices in the teaching of primary school mathematics at a school in Swaziland

By

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ABSTRACT

The purpose of this study was to explore participants' scaffolding practices in the teaching of primary mathematics at a school in Swaziland. Scaffolding refers to all the assistance a more knowledgeable other provides to learners in order to accomplish a task. The study was prompted by the observation that learners' performance deteriorated as they progressed to upper grades. This study describes the participants' understanding of scaffolding and how and why they implement scaffolding the way they do in the teaching of primary mathematics. This study is guided by an interpretive paradigm and a qualitative methodology. Two experienced primary school teachers were conveniently selected for the purpose of the study. Data were collected through a questionnaire, document analysis, lesson observations and one-on-one interviews. The captured data were later coded, organised analysed, and discussed. The participants understood scaffolding in the teaching of primary school mathematics to be diverse, developmental, fostering learning processes as well as being mediated in the zone of proximal development. They used scaffolding through practices such as excavating, questioning, explaining and parallel modelling, as well as collaboration. It also emerged that they sometimes used some of the scaffolding practices unknowingly. The participants' personal conceptual understanding and contextual factors such as time, class size, availability of resources, the school's expectations as well as their attitude influenced the implementation of scaffolding. This study contributes to a better understanding of teachers' scaffolding practices in the teaching of primary school mathematics. It is envisaged that the findings will be of value to practicing primary mathematics teachers, professional development organisers, education officers, school principals and administrators.

DECLARATION

I, Topu Manyuchi declare that:

i. The research in this thesis, except where otherwise indicated, is my original work.

ii. This thesis has not been submitted for any degree or examination at any other university

iii. This thesis does not contain other persons' writing, unless specifically acknowledged as being sourced from other persons

iv. This thesis does not contain other persons' writing, unless specifically acknowledged as being sourced from other researched.Where other written sources have been quoted, then:

   a) Their words have been re written but the general information attributed to them has been acknowledged; and

   b) Where their exact words have been used, their writing has been placed within quotation marks, and referenced

v. The work described in this thesis was carried in the school of Education, University of KwaZulu-Natal, from February 2015 to December 2015 under the supervision of Mr. T. Chirikure

vi. Ethical clearance No. HSS/0521/015 was granted prior to undertaking the fieldwork.

Signed: ________________________Date:___________________________

As the candidate's supervisor, I, Mr. Tamirirofa Chirikure, agree to the submission of this thesis.

Signed: ______________________________ Date:________________

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My colleagues for willingly taking up my classes in my absence.

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Finally, my parents Elinah and Vengesai Manyuchi for inculcating in me the importance of education.

DEDICATION

To my late father Vengesai Manyuchi Chimutwe

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LIST OF ABBREVIATIONS

DE	Diploma in Education
DEST	Department of Education Science and Training
MKO	More knowledgeable others
MoE	Ministry of Education
SACMEQ	Southern and East African Consortium for Monitoring Educational Quality
SADC	Southern African Development Community
STD	Secondary Teaching Diploma
ZAD	Zone of actual development
ZPD	Zone of proximal development
ZPoD	Zone of potential development

CHAPTER 1
ORIENTATION OF THE STUDY

1.1 BACKGROUND TO THE STUDY

Mathematics education plays a pivotal role in human resource development that is significant to nations (McAteer, 2012). Over the years, there has been emphasis on quality teaching strategies that enhance mathematics learning. One such a concept is scaffolding. Wood, Bruner and Ross (1976) assert that scaffolding is "a process that enables a child or a novice to solve a problem, carry out a task or achieve a goal which would be beyond his or her unassisted efforts" (p. 90). Vygotsky (1978) further hypothesised scaffolding by saying that guided interactions with more knowledgeable others could aid learners' performance through the zone of proximal development (Rogoff, 1990). Effective ways of enhancing students' performance is through teachers' identification of appropriate strategies. Merely teaching without considering effective scaffolding practices could be detrimental to the learners' performance in mathematics.

The Southern and East African Consortium for Monitoring Educational Quality (SACMEQ) report of Moloi and Chetty (2011), in a survey carried out in four countries including Swaziland, found that performance of grade six learners was poor in mathematics. Another observation was that learners depended heavily on their teachers for solutions to mathematical problems (Rogoff, 1990).

This study was generated from the observation that learners' performance in primary mathematics education seems to deteriorate as they progress from the middle to the upper grades at school including the one I teach in. Their performance in both daily exercises and examinations falls as they progress from lower to higher grades. Those who perform well in mathematics in lower grades develop serious challenges in solving simple mathematical concepts in later grades, for example, find it difficult to solve simple concepts like finding perimeters of regular objects. Although they find it easy to solve routine mathematical problems, they struggle to solve real life mathematical problems.

A study by Grasha (2004) found that teachers' could influence student achievement by either assisting or hindering their ability to acquire new knowledge. He further argues that more awareness of teaching strategies helps teachers to attune their strategies to target the individual needs of the learners. This resonates with Wayne and Young's (2003) assertion that teachers were particularly responsible for the positive impact on student's achievement. Feza (2002a), in her study of mathematics knowledge found that South African students performed poorly in Mathematics despite the country's effort to improve the situation. She pointed out that the dismal performance could be attributed to, among other factors, the lack of foundational knowledge and emphasised the need for effective teaching strategy to assist students' achievement. There was, therefore a need to explore teachers' scaffolding practices with a view to understanding the poor performance in mathematics in the upper grades at a primary school in Swaziland.

1.2 Focus of the study and purpose of the study

This research is an exploratory study of participants' understanding of scaffolding practices in the teaching of primary school mathematics in Swaziland. In this study, scaffolding means all the pedagogical assistance provided by a teacher to enhance learning. According to Boblett (2012), scaffolding is a strategy that describes a system of temporary guidance offered to learners by the teacher and is tactically withdrawn when the former no longer needs it. The main objective was to investigate ways in which participants use scaffolding as a pedagogical practice to help learners understand basic mathematical concepts. This is because scalfolding is one of the key strategies in the teaching of primary school mathematics. The emphasis of this study was on the teachers' understanding of scaffolding, how they used the scaffolding practices and why they preferred to use this concept in their day-to-day teaching of primary school mathematics. The study, in essence, explored the practitioners' understanding and use of scaffolding practices in the teaching of primary mathematics. This is because scalfolding is a method that is essential in the teaching of this subject.

1.3 Rationale for the study

The rationale serves to indicate how the researcher develops an interest in a particular topic and why he/she believes his/her research is worth conducting (Leedy & Ormond, 2001). The interest in studying scaffolding was stimulated by the fact that when results are released in our school each year, it is evident that learners who did very well in formative years have performed poorly in later years. This performance has resulted in many learners performing dismally or dropping mathematics in secondary education. This is unfortunate because there is currently an emphasis on the importance of the subject of mathematics in primary and secondary education.

Ferguson (2012) and McCosker and Diezmann (2009) encourage teachers to always consider the level of understanding of their learners before using scaffolding practices. The implication of their studies is that what works for one group of learners may not necessarily work for the other. McCosker and Diezmann (2009) advise teachers not to accept learners' responses without probing for justification. Equally important is the supporting of learners' way of thinking rather than imposing teachers' rules and formulae on the learners. Failure to acknowledge, optimise and use learners' thinking could result in the imposition of teachers' methods and rules that may not mean much to them. This could end up weakening their zeal to learn.

Nowadays we are in a technological era which is influenced in part by the knowledge of mathematics. Mathematics is extremely important to humankind. It influences almost all of daily life individually or collectively. The economic and technological advancement of nations are dependent on mathematics because it underpins science and engineering. It is therefore critical that children have the best possible solid foundation in mathematics during their primary years (McAteer, 2012). For this reason Blum, Galbraith, Henn, and Niss (2007) posit that all people should have an opportunity to learn mathematics, since it does not only provide a channel through which to understand the world around them, but also prepares them for future professions. In view of this, Ngcobo (2011) postulates that learners should be expected to learn mathematics at all levels of their primary schooling in Swaziland.

The concept of scaffolding in education is one of the key practices that help learners easily grasp mathematical concepts. Research has shown that many learners may develop a phobia for mathematics (Sparks, 2011) if they are not well taught in primary education. A solid mathematical foundation in primary school may see more learners taking up the subject in high school and beyond. According to Wile (2014), knowledge and implementation of scaffolding practices helps to demystify mathematical concepts, resulting in more learners developing a positive attitude towards the subject. In view of this awareness, it was deemed important to carry out a study based on the participants' understanding of the concept of scaffolding in the teaching of primary mathematics education.

1.4 Significance of the study

This study is significant because it explores what takes place in the teaching of mathematics in a primary schooling Swaziland. It also reveals the gaps and shortcomings which inhibit good scaffolding practices in primary education. Findings may help spur teachers to interrogate their scaffolding practices in accordance with learners' needs and help identify areas for staff development in the use of scaffolding in the teaching of the subject. Furthermore, the research provides a platform for further discussion on the use of scaffolding practices in the teaching of the subject. This study may also contribute additional insights into mathematics teaching using scaffolding as a pedagogical practice. The study is significant given that the area of scaffolding in primary school mathematics is somewhat under-researched in Swaziland.

1.5 Research aims

1. To explore teachers' understanding of scaffolding in the teaching of primary school mathematics.
2. To explore how teachers use scaffolding practices in the teaching of primaryschool mathematics.
3. To explore the reasons why teachers implement scaffoldingin the way that they do.

1.6 Research questions

The study sought to answer the following questions:

1. What do teachers understand by scaffolding in the teaching of primary school mathematics?
2. How do teachers use scaffolding practices in the teaching of primary school mathematics?
3. Why do teachers implement scaffoldingin the way that they do?

1.7 Research design

The study adopted an interpretive paradigm in exploring the participants' understanding of scaffolding in the teaching of primary mathematics. A research paradigm can be viewed as a lens or a way in which to think about the world (Jonker & Pennink, 2010). An interpretive paradigm examines an individual's personal judgment in relation to reality (Cohen, Manion, & Morrison, 2011). This study is qualitative by design. Qualitative research takes the researcher into the world of the researched and interprets their behaviours and experiences (Denzin & Lincoln, 2011). A case study design was employed to establish a deeper understanding of how the two informants gave meaning to scaffolding in the teaching of primary school mathematics. The two participants were specialist mathematics teachers at a selected primary school in Swaziland.

Four different methods of data collection were used: a questionnaire, document analysis, lesson observations, and in-depth interviews. The reason for using multiple data collection methods was to help with triangulation in order to enhance trustworthiness and the authenticity of the findings of the study.

An inductive approach was adopted to analyse the data thematically. O'Leary (2004) posits that thematic analysis encompasses the analysis of concepts, words or groups of words, non-verbal cues and other elements such as literary devices. In contrast to this, a quantitative methodology is based on statistical analysis. Qualitative data is usually put together in themes and categories with emphasis on a thick description of the participants' meanings and experiences rather than on the verification of a hypothesis (Rudenstam & Newton, 2001). For this reason, the findings from this study were analysed in order to address its three research questions which focused on the participants' understanding of the concept of scaffolding, how they used scaffolding and why they used scaffolding in the way that they did.

1.8 Findings

The findings of this study emerged from the analysis of the two participants' understanding of scaffolding practices in the teaching of primary school mathematics. A questionnaire, document analysis, lesson observations and individual interviews were used as principal methods of data collection for the study. Research findings sought answers to the three research questions. Each research question had a theme and subthemes that emerged from the findings.

It is anticipated that the findings from the study will contribute to literature on the problems associated with the use of scaffolding in the teaching of primary school mathematics.

1.9 Overview of chapters

This thesis consists of five chapters. Chapter 1 highlights a detailed and relevant background to the study, as well as the purpose, focus, rationale, and significance of the study. The chapter also outlines the research aims, research questions, research design and overview of the study.

Chapter 2 reviews literature that is related to the focus of the study. Literature from local and international authorities is reviewed in connection with scaffolding practices in the teaching of primary school mathematics. The literature review is divided into several sections including the following areas: a working definition of scaffolding in the field of education; major features of scaffolding and their significance to the teacher; different types of scaffolding practices; the role of the scaffolder in the implementation of the scaffolding; challenges to scaffolding; limitations of scaffolding in the teaching of mathematics; scholarly studies on scaffolding. The theoretical framework of Vygotsky's zone of proximal development which guided the study is presented. Finally, the chapter explains the relationship between the zone of proximal development (ZPD) and scaffolding in the teaching of primary school mathematics.

Chapter 3 describes the research methodology employed in the study. This is an interpretive paradigm within a qualitative methodology in exploring teachers' scaffolding practices in the teaching of primary mathematics. The point was made earlier on that this is a case study and the chapter therefore presents multiple data collection methods, namely, a questionnaire, document analysis, lesson observations, and individual interviews which were used for the generation of data. Other significant issues such as rigour, ethical considerations and limitations of the study are highlighted as well.

Chapter 4 presents and discusses the findings of the study. Data generated from the informants is analysed through content analysis by isolating themes that provide answers to the research questions.

Lastly, Chapter 5 summarises the major research findings from the study and makes recommendations concerning the use of scaffolding in the teaching of mathematics at primary level. The next chapter covers the literature review related to the study.

Key terms

Scaffolding, scaffolder, more knowledgeable other, zone of proximal development, zone of actual development, zone of potential development.

CHAPTER 2
LITERATURE REVIEW

This chapter reviews literature on scaffolding as a concept in the field of education and in the teaching of primary school mathematics in particular. The chapter first looks at the working definition of scaffolding as a pedagogical practice in the teaching of mathematics in primary schools. It also looks at the major features of scaffolding, examples of scaffolding practices, the role of the scaffolder, the challenges as well as limitations of scaffolding and studies in the area of scaffolding practices in mathematics. The chapter also links scaffolding to the theoretical framework of the study which is the zone of proximal development (ZPD) espoused by Vygotsky. Finally, the chapter explains the relationship between the ZPD and scaffolding in the teaching of mathematics in primary schools.

2.1 Definitions of scaffolding

Scaffolding in education is used to describe all the temporary assistance and guidance employed by a more knowledgeable other (MKO) to a child's learning process so as to complete an activity that is otherwise beyond his/her competence (Killen, 2007). Wood, Bruner, and Ross (1976) were the first to coin the term 'scaffolding'. The term has its wellspring from the work of both Piaget and Vygotsky although neither of them used itas such (Anghileri, 2006). Vygotsky's (1978) viewpoint is that social interaction enhances learning and precedes development. Vygotsky (1978, p. 57) explains that "Every function in the child's cultural development appears twice: first on the social level and, later on the individual level, first between people (inter-pyschological) and then inside the child (intra-pyschological)". Vygotsky believesthat learning takes place first at the social level before it is internalised by the learner.

According to Cobb (2000), scaffolding is informed by a constructivist view of learning, which subscribes to the notion that knowledge is a product of understanding through one's experiences and that it cannot be passively transmitted to others (Simon, 2004). Glasersfeld (1989, p. 162) posits that “knowledge is not passively received but actively built by the cognising subject”. In other words, knowledge is an active process in which the learners construct knowledge through involvement in the learning rather than a passive process where learners are regarded as empty vessels to be filled with information from the more knowledgeable others (Von Glasersfeld, 1998). Proponents of this view argue that knowledge is not attained but constructed throughout the learning process (Von Glasersfeld, 1998).

Morrissey and Brown (2009, p. 107) state that “the aim of scaffolding is the ultimate transfer of responsibility of the task to the child as adult support decreases and child capability increases”. This is achievable through withdrawal of the support once the learner shows signs of competency. For effective scaffolding, instructions should focus on skills that are “not too easy, not too difficult, but just right” (Morrissey & Brown, 2009, p. 4). Bliss, Askew, and Macrae (1996) postulate that traditional teaching methods that offer meticulous explanation, have learners listen passively, and always engage in guided practice, have no place in scaffolding. This is a wakeup call for teachers to revisit the concept of scaffolding in education.

2.2 Link between Scaffolding and Constructivism

The concept of scaffolding in education is linked to the constructivist theory of learning. Constructivism entails knowledge construction through active, rather than passive processes. Proponents of this theory, namely Dewey, Piaget, Bruner and Vygotsky refute the notion that learners are passive recipients of knowledge; rather they emphasize the needy for learners to be actively involved in the construction of knowledge (Hausfather, 2001). The emphasis is on learning being done by the students, not something that is imposed on them. In other words, learners are active creators of their own knowledge through the generation of new concepts in relation to current or past knowledge (Kiong & Yong, 2001). On the other hand, scaffolding is a support strategy which a more knowledgeable other offers to learners to enable them solve tasks that are beyond their capabilities (Berk & Winsler, 2002). Scaffolding, just like constructivism places emphasis on students’ prior knowledge and the interaction between the learner and the material to be learned (Cobb, 2000). The concept of scaffolding is embedded in the constructivist theory of learning. It allows learners to construct their own knowledge through strategies that actively engage them (Ferguson, 2012). Scaffolding is therefore an important concept of constructivism in that it involves an interaction between the teacher and learners or among the learners themselves. When the learners work on a task, the teacher provides scaffolds by guiding students in the appropriate direction to follow within their ZPD.

2.3 Reasons for choosing the concept of scaffolding

There is an array of teaching strategies such as peer tutoring, co-operative learning, modeling, explicit instruction, thinking aloud, evidence based, and so on that the researcher could have focused on (The IRIS Centre, 2010). However, scaffolding was chosen because it falls into the constructivist theory which allows students to make sense of reality based on the interpretation of their experiences. In addition, scaffolding is beneficial to the teaching and learning process in that it provides for a supportive learning environment that allows interaction among students in the learning of new material (Hartman, 2002). As a teaching strategy, scaffolding allows the teacher to be more of a mentor and facilitator rather than an expert. Furthermore, it encourages students to assume a more active role in their own learning, resulting in the ownership of the learning event (Berk & Winsler, 2002). According to Alibali (2006), while scaffolding can be done to individuals, it can also be successfully done with an entire class. Overall, scaffolding encompasses all the assistance that teachers can offer to students in order to facilitate learning. Nevertheless, it is important to note that though scaffolding was chosen ahead of other strategies, it is by no means the only best strategy in the teaching of Mathematics.

2.4 Major features of scaffolding

Wood and Wood (1996) Identify several major features of scaffolding in the field of education. The first characteristic is that scaffolding is temporary and is withdrawn once learners exhibit competency in a given task (Aschermann, 2001). Graves, Graves, and Braaten (1996) say that the task must be engaging in order to sustain the learner’s interest. Secondly, scaffolding should be operational within the ZPD, and thirdly, it should be withdrawn as soon as the learners show competence in the task (Berk & Winsler, 2002). Withdrawal entails the tactical removal of scaffolding techniques reminiscent of the way a builder dismantles the scaffolding after the completion of a building (Palincsar, 1998). While the builder's removal is quick, the educational one is timely, gradual and tactical (Berk & Winsler, 2002).

Self-regulation is another feature of scaffolding. Mastery over one's behaviour is the ultimate goal of scaffolding in the learning process (Berk & Winsler, 2002).

2.5 Types of scaffolding practices

Competent teachers can choose from an array of scaffolding practices in their day-to-day teaching (Pressley, Hogan, Wharton-McDonald, Mistretta, & Ettenberger, 1996). The Researching Numeracy Project Team (2004) studied approaches in teaching mathematics for students in the early years (Prep - Year 4) and the middle years (Years 5 and 6) in a range of Victorian (Australia) schools and identified 12 scaffolding practices. These are: excavating, modelling, collaboration, guiding, convince me, noticing, probing, orienting, reflecting, receiving, extending, and apprenticing. This list of scaffolding practices was used as a reference point in the conducting of this study.

The Researching Numeracy Project Team (2004) coined the term 'excavating' which involves "drawing out, digging, uncovering what is known and making it transparent". According to Chaiklin (2003), the teacher taps the learners' prior knowledge through questioning and probing. This helps to link previously learnt material to the current concept being explored.

Reciprocal scaffolding involves two or more learners collaborating in the learning process. The Researching Numeracy Project Team (2004) identified collaboration and apprenticing as scaffolding practices. Collaboration involves the teacher acting as a co-learner in problem solving, while apprenticing entails offering capable peers a chance to operate as teachers in groups (Berk & Winsler, 2002). On the other hand, guiding involves prompting, hinting, navigating, noticing and shepherding learners in order to determine their understanding of the concepts (Researching Numeracy Project Team, 2004; Simeon & Virgona, 2003). Wood and Wood (1996) describe this as a 'funnel pattern' where the teacher narrows and focuses the learners' responses onto a particular task. Brush and Saye (2002) identify two levels, namely soft and hard scaffolding. Soft scaffolding occurs when the teacher moves around the classroom discussing and questioning learners' approaches, while hard scaffolding is planned before the lesson (Brush & Saye, 2002).

Anghileri (2006) identifies three categories of scaffolding practices, namely: environmental provisions, reviewing or/and restructuring, as well as developing conceptual thinking. Anghileri's first level is concerned with scaffolding through the creation of conducive environments such as displayed puzzles, tools, sitting and grouping arrangements, use of computers, encouragement, as well as organising structured work. The second level has to do with reviewing and restructuring so as to vary the showing, telling, and explaining that dominate classroom teaching. Anghileri (2006) identifies five types of reviewing, which are manipulation through working, touching, verbalising, asking learners for explanation, and justification. The "Researching Numeracy Project Team" 2004) calls this 'convince me' where the teacher can play the role of the 'devil's advocate' in order to get justification from the learners.

Parallel modelling involves the demonstration and solving of a task similar to the one given to the learner (Anghileri, 2006). Wood, Bruner, and Ross (1976) call these 'solution' paths as they help point out the steps learners take in order to arrive at the answer. Restructuring entails consolidating learners' understanding through providing meaningful contexts, demystifying tasks, rephrasing learners' comments, and negotiating meanings (Anghileri, 2006). Level two of Anghileri's scaffolding practices are summarised in Figure 1.

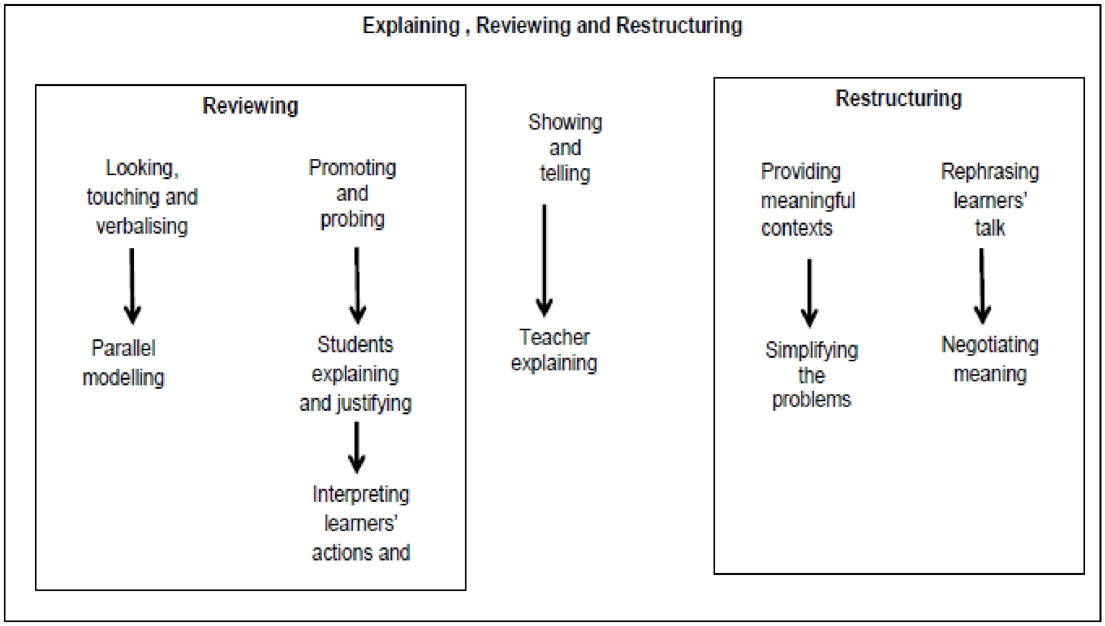

Figure 1: Teacher practices for learning at Level 2 (Adapted from Anghileri, 2006)

Developing learners' conceptual thinking through generalisation, extrapolation and abstraction is Anghileri's third level which entails the realisation that, for example, triangular prisms and cones are found on roofs of some classrooms and rondavels respectively (Anghileri, 2006). It also involves the awareness that, for instance, $^2/_5$ of 60; 0, 4 x 60 and 40% of 60 are the same.

Ferguson (2013) identifies three scaffolding practices, namely the use of discussions, manipulatives and explicit attention concepts. The author suggests that discussions and explicit attention to concepts enhance assertiveness because learners interact in groups or as a whole class. Manipulatives offer tactile motivation because the learners handle and manipulate concrete objects. Table 1 summarises scaffolding practices as described in the literature.

Table 1: A summary of scaffolding practices

Type of scaffolding	Activity
Environmental provisions	Displayed puzzles, tools, sitting arrangements, collaboration in groups, apprenticing, technology (computers, mobile phones), and encouragements
Reviewing and structuring	Questioning, probing, parallel modelling, justification/ 'convince me', explaining/ demystifying, negotiating meanings, excavating, guiding
Conceptual thinking	Extrapolation, abstractions, generalisations

2.6 The role of a scaffolder

The premise upon which the concept of scaffolding in education is built is that every student is capable of learning once the MKO provides suitable support within the ZPD (Palincsar, 1998). One of the key roles of a scaffolder is not only the completion of a task but also the identification of the learner's ZPD and the appropriate support to be rendered (Denhere, Chinyoka., & Mambeu, 2013). According to Denhere et al. (2013), failure to identify the ZPD can result in either teaching concepts that are below or beyond the learners' capabilities.

The scaffolder's role involves clear understanding of the learner's current knowledge so as to devise scaffolding practices that foster independence in the learning process (Cobb, 2000; Hartman, 2002). Once learners master a task, the scaffolder plays a pivotal role in identifying the child's next ZPD because it is dynamic and always shifting forward (Lepper, Drake, & O'Donnell-Johnson, 1997). The scaffolder also models, highlights, and provides cues that help to elicit correct responses from the learners (Wood et al., 1976). Engaging the child's interests and instilling confidence by demystifying tasks are other significant roles of a scaffolder (Hogan & Pressley, 1997). The scaffolder engages in direction maintenance so that learners do not stray from the desired goal (Wood et al., 1976). This does not entail "showing and telling" but is a responsive action to the learners' own constructions Anghileri (2006, p. 33). The scaffolder should be wary of the frustration that may creep in. Frustration can be warded off through appropriate guidance, probing and encouragement (Hartman, 2002).

According to Hogan and Pressley (1997), the scaffolder is a facilitator whose role entails "selecting and shaping" learning experiences until independence in solving tasks is attained (Denhere et al., 2013, p. 32). The scaffolder allows learners to solve problems on their own, rendering assistance only when it is absolutely necessary (Wood & Wood, 1996). In view of this, Anthony and Walshaw (2003, p. 18) believe that an "effective scaffolder supports the learners when they are stuck, not by giving full solutions but by prompting them to search for more information, try another method, or discuss the problem with classmates". The scaffolder also constantly monitors and provides support so that learners proceed without giving (Wood & Wood, 1996). Another significant role of the scaffolder is the timely and gradual withdrawal or weaning of the scaffolding which marks the learner's ownership of the learning process, a feat that teachers should strive for (Berk & Winsler, 2002). In other words, the scaffolder facilitates the transfer of responsibilities resulting in independence in the learning process. In conclusion, the scaffolder should not steal the limelight from the learners but allow them to be leading actors in the learning process.

2.7 Challenges to scaffolding

A major challenge to scaffolding is the size of classes which inhibit the identification of each learner's ZPD (Aschermann, 2001). A teacher can have a general understanding of the ZPD of the whole class but has to contend with each learner's ZPD since scaffolding entails one-to-one encounters. Tharp and Gallimore (1988) also argue compellingly that large numbers of learners, different groups of learners and the dictates of the curriculum are some of the major challenges to scaffolding. Minimising the demand for a one-to-one engagement with the teacher is one way of ameliorating these challenges (Hogan & Pressley, 1997).

2.8 Limitations of scaffolding

Scaffolding does not address the two-way relationship between the teacher and the student "but rather implies a one sided view ... where a teacher provides support for the learner" (Denhere et al., 2013, p. 375). The scaffolder is seen as preparing the scaffolding support system and presenting it to the learners (Daniels, 2001). According to Stone (1998, p. 349), strict adherence to scaffolding could lead to “the imposition of a structure on the learners” resulting in learners becoming overly dependent on the teacher if weaning is not timely.

2.9 Studies on scaffolding practices

Previous studies on scaffolding in mathematics looked at aspects ranging from identifying scaffolding practices (Siemon & Virgona, 2003), effects of scaffolding on the performance of learners, on metacognitive scaffolding (Casem, 2013; Jbeili. 2012), the impact of conversation and manipulatives on low attaining learners in upper primary school mathematics (Ferguson & McDonough, 2010; McCosker & Diezmann, 2009), the use of discussion, manipulatives and explicit attention to low attaining learners (Ferguson, 2012).

To begin with, Siemon and Virgona (2003) conducted a study involving groups of teachers in an activity known as ‘Behind the Screen’ which identified and described scaffolding practices in mathematics in Australia. The findings were that learners tended to emulate the modelling and noticing practices demonstrated by the teachers. Teachers also seemed to learn how to scaffold effectively through observing and being observed by their colleagues. This implies that both learners and teachers benefit from a properly modelled practice. It is necessary for teachers therefore, to always carefully model scaffolding practices so that learners and colleagues who are willing to learn can follow their example.

Siemon’s et al (2003) study indicates that scaffolding in education is of importance. Their focus was on modelling which is one aspect of scaffolding strategy without paying attention to other practices. My study focused on diverse scaffolding practices that teachers used in their classrooms and their lesson delivery.

Casem (2013) carried out a study to determine the effectiveness of scaffolding and traditional practices in selected topics in high school mathematics. The findings were that the use of scaffolding practices improves mathematics performance through the creation of meaningful connections, boosting of confidence, and the reduction of frustration and anxiety. The implication is that effective scaffolding bolsters the learners' construction of their own knowledge through linking the known to unknown concepts. As the ability to make connections increases, learners' frustrations and worries begin to give way to self-confidence.

Casem's study focused on high school mathematics whilst mine focuses on primary school mathematics. His study recommended that teachers should start encouraging more student-centred learning in their teaching methodologies such as scaffolding teaching strategy. The study also highly recommended further studies to be conducted on scaffolding which involves intensive and extensive use of the strategy. Hence, the thrust of this study being on the scaffolding practices in primary school mathematics.

Jbeili (2012) investigated the effect of metacognitive embedded in co-operative learning on fifth graders' mathematics conceptual understanding and procedural fluency in learning and solving problems and tasks involving the addition and subtraction of fractions. He found out that co-operative learning with metacognitive scaffolding not only improves their traditional mathematics performance, but also improved their conceptual understanding and procedural fluency. In other words, cooperative learning facilitated learning. However, Jbeili (2012) indicated that "co-perative learning alone is insufficient as a form of scaffolding" (p. 66). This gave the researcher the impetus to explore the scaffolding practices that are used in the teaching of mathematics in primary schools.

Ferguson and McDonough (2010) carried out a study on two teachers using scaffolding conversation and manipulatives and how these impacted on low attaining learners in upper primary mathematics classes. Learners were observed doing tasks involving discussions and manipulatives. The researchers found that both of the teachers used conversations and manipulatives to enhance understanding. One of the teachers supported learners' understanding through adroit questioning which responded to the learners' line of thinking (McCosker & Diezmann, 2009). Despite this study being conducted with slow learners, it has far-reaching implications for all teachers because what is good for learners with disabilities could also be beneficial to those without disabilities. The teacher would be required to adjust the complexity of the task to suit the level of understanding of the learners.

Ferguson (2012) conducted a study on the use of scaffolding practices with a group of low attaining learners, through discussion, manipulatives and explicit attention paid to concepts. The findings included among others, the ineffectiveness of whole class discussion and manipulatives to low attaining learners. In a similar study in Australia, McCosker and Diezmann (2009) found that teachers needed to press for meaningful explanations, support learners' understanding of the problem and provide clear task instructions, as well as differentiate positive encouragement from cognitive scaffolding. Research has shown that often teachers fail to provide the support that is required, leading to learners' failure despite their potential to do well in those tasks (Denhere et al., 2013)

The two studies of Ferguson (2012) and McCosker and Diezmann (2009) encourage teachers to always consider the level of understanding of their learners before using scaffolding practices. The implication of their studies is that what works for one group of learners may not necessarily work for the other. McCosker and Diezmann (2009) caution teachers not to accept learners' responses without probing for justification. Equally important is the supporting of learners' way of thinking rather than imposing teachers' rules and formulae on the learners. Failure to follow learners' thinking could result in the imposition of teachers' methods and rules which may not mean much to them. This could end up weakening their zeal to learn.

McCosker et al (2009) focused on operating from the reasoning of the learners in Mathematics learning. On the contrary, this study looked at various scaffolding strategies that teachers use in the teaching and learning of mathematics in primary schools. While Ferguson (2012) and Casem (2013) studied scaffolding with low attaining learners in mathematics and the effects of scaffolding practices on high school learners in Australia respectively, this study focused on scaffolding practices in an urban primary school in Swaziland. The current study is different considering that while the former studies were conducted with high school low attaining learners, used a few scaffolding practices and their effects, this study involved primary school teachers and a host of scaffolding practices they used in their mathematics lessons.

Research shows that studies on scaffolding practices have been conducted globally but not many have been conducted at a primary school within a Swazi context. The thrust of the current study therefore is on the scaffolding practices that are used by primary school teachers in the teaching of mathematics in a developing country, which may not have the same amenities as schools in developed countries.

2.10 Theoretical framework and its significance

In the exploration of participants' scaffolding practices, the researcher was informed by the zone of proximal development (ZPD) as espoused in Vygotsky's (1978) social constructivist epistemology. Ennis (1999) defines a theoretical framework as a structure for identification and description of a study. Sinclair (2007, p. 39) posits that "a theoretical framework can be thought of as a map or travel plan" that keeps the researcher focused on the study. A theoretical framework guides researchers as they conduct and interpret generated data.

The theoretical framework of this study set parameters where scaffolding practices could be used in the teaching of primary mathematics. According to Vygotsky (1978), scaffolding should be employed in the zone of proximal (ZPD) and notin the zone of actual development (ZAD) or the zone of potential development (ZPoD). The ZAD can only be used as a transtional zone to the ZPD where all the scaffolding takes place. All this understanding helped the researcher in the analysis of the data. The knowledge helped the researcher identify what to look out for in the interpretation of data that emerged from the study.

The formulation and the compilation of the research instruments were all informed by the theoretical framework which served as the "driving force and as the jumping off point" for the study (Ridley, 2008, p. 2). The theoretical framework guided the researcher in the identification of relevant literature for the study. Consequently, the literature proved helpful in providinga deeper understanding of the concept of scaffolding as the researcher interpreted the data that was collected. The theoretical framework also assistedthe researcherin keepingto the objectives of the study.

In conclusion, Ennis (1999, p. 133) postulates that theoretical frameworks are “powerful organisers of ideas that structure our thinking in ways rarely approached in work with single, isolated variables”. The author argues that it is difficult to come up with credible “research without a strong theoretical framework” (Ennis, 1999, p. 134). This implies that without the theoretical framework it may be difficult to compile a convincing scholarly write up of the research project.

2.11 Zone of actual development (ZAD)

According to Lui (2012), this level is also known as the independent level because it signifies the knowledge a learner has already mastered. Vygotsky (1978) calls it the zone of actual development (ZAD). Vygotsky believes that instructions located below or at the learner’s current level of understanding do not promote further development. Verenikina (2008, p. 4) concurs with Vygotsky in saying that the ZAD does not sufficiently describe development but indicates what is already achieved which she termed “a yesterday of development” and therefore any instruction focused on this zone would not pose an adequate challenge to the learners.

2.12 Zone of proximal development (ZPD)

According to Vygotsky (1978, p. 86), the ZPD is “the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or collaboration with more capable peers”. Lui (2012, p. 1) defines ZPD as the difference between what a learner is capable of achieving independently and what she can accomplish with help from the MKO. Lui (2012) describes this gap as a “sweet spot” because this is where the learning takes place. Accordng to Lui (2012), the ZPD is instructional; the most productive and constructive zone where an appropriate amount of assistance helps the learners to successfully complete tasks. Learners within their ZPD continue to receive assistance from the MKO until they show mastery of the task.

Verenikina (2008) says teaching is a perpetual cycle which involves the continuous expansion of this ZPD until it becomes the learner's ZAD.

Learning is believed to be in the ZPD if the learner demonstrates mastery of concepts (Denhere et al., 2013). Conversely, boredom, frustration and inability to solve problems are indicative of tasks far beyond the learners' ZPD (Lui, 2012). According to Lui (2012), instructions provided within the ZPD should not be too easy or too difficult, but challenging enough to assist in developing new ideas. In the same vein, Van Der Veer (2007, p. 79) argues that instructions should provide "tasks that are above the child's intellectual level but not too far above it". The ZPD is fundamental to mathematical instruction because it offers a window through which teachers can find an entry point into learners' learning needs for the development of their potential (Lui, 2012).

2.13 Zone of potential development

This level is beyond the learners' understanding even with assistance from the MKO. Assigning tasks within this level leads to failure and frustration. Denhere et al. (2013) argue convincingly that once a learner shows boredom, frustration and fails to solve a problem even with meaningful assistance, then an inference can be made that they are in the zone of confusion. Lui (2012) cautions that learning should not and cannot take place in this zone. Figure 2 illustrates the theoretical framework as postulated by Lui (2012).

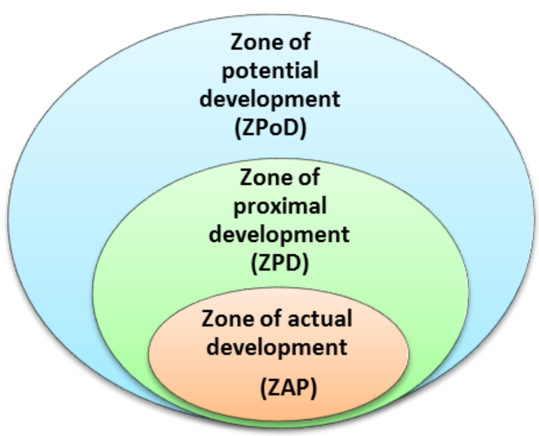

Figure 2: Illustration of ZAD, ZPD and ZPoD (Adapted from Lui, 2012)

Figure 2 illustrates the symbolic gaps in a child's mind as he/she learns new concepts. Effective learning occurs in the ZPD while scaffolding anywhere outside this zone would be either too complex or too simple to trigger learning.

2.14 The relationship between the ZPD and scaffolding

Scaffolding is closely linked with the ZPD and any suitable scaffolding for learners should target this zone (Denhere et al., 2013). According to Denhere et al. (2013), scaffolding within the learners' ZPD is one way of enhancing performance in mathematics as it allows mastery of new concepts within the ZPD through the guidance of the MKO (Wood et al., 1976) .

To successfully scaffold within the ZPD, it is crucial to know where the learner functions, where he/she would be in terms of knowledge retention and the type of scaffolding to be used in the learning process (Denhere et al., 2013). Scholars like Palincsar (1998) believe that without this knowledge, no matter how advanced the scaffolding practices are or how passionate the teacher may be, their effort would be in vain since the scaffolding practices would either be below or beyond the learners' capabilities. Palincsar (1998) posits that optimal learning is achieved when the scaffolding is consistent with the learner's ZPD.

Scaffolding is as dynamic as the ZPD, that is, once a good scaffolding practice is provided, the ZPD shifts while practices change too (Lepper et al., 1997). The onus is on the scaffolder to attune their assistance to the learner's ever changing ZPD. Wells (1999, p.319) describes this as "aiming at a moving object" because of the ZPD's dynamic nature.

Vygotsky asserts that once the learner's ZPD is identified, the MKO should provide suitable scaffolding for learners to reconcile their current knowledge with new concepts. Fago (1995) underscores the need to marry ZPD with appropriate scaffolding practices in order to ensure the quality of the knowledge gained.

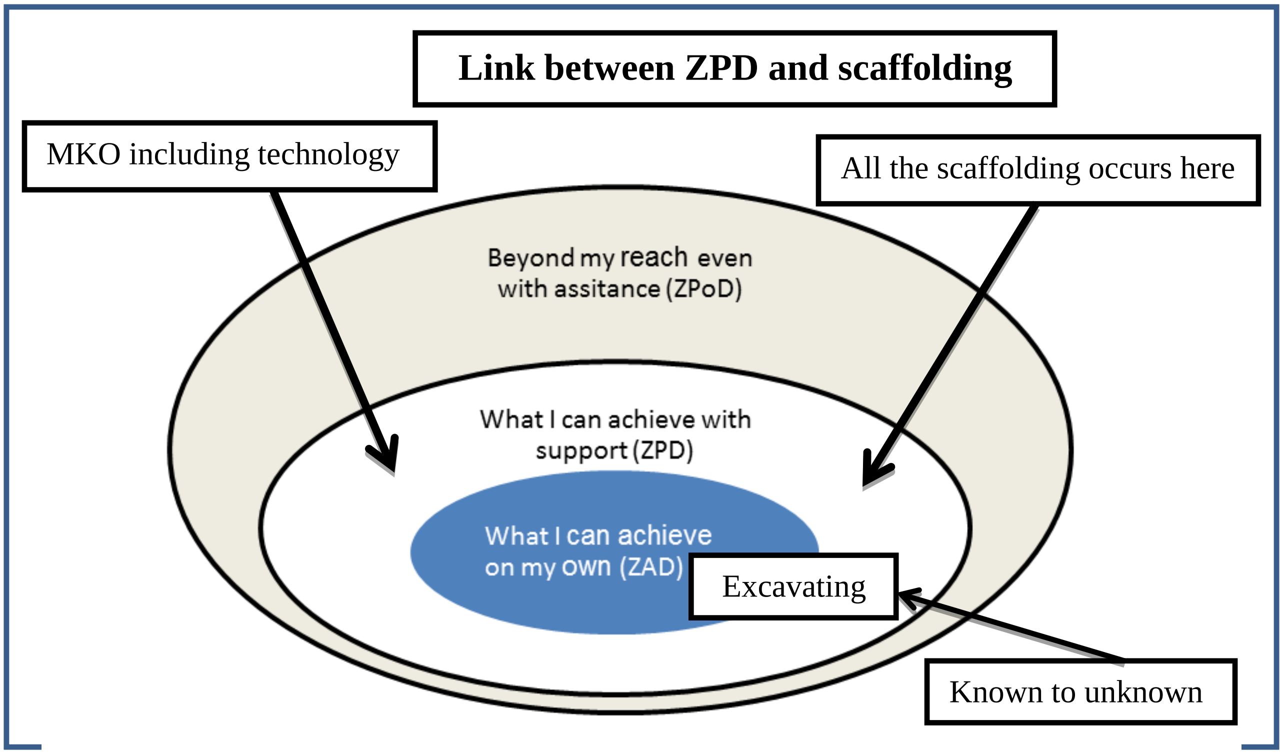

Figure 3 diagrammatically shows how the zone of proximal development and the concept of scaffolding are intertwined. These two, like the blades of a pair of scissors, are inseparable and complementary. They operate in tandem to achieve the grasping of concepts by the learners. It is therefore imperative that teachers have a sound knowledge about how and why scaffolding practices can be used in the teaching of primary school mathematics.

2.15 Conclusion

This chapter has reviewed the relevant literature underpinning the focus of this study. From the literature it is evident that scaffolding is the backbone of teaching. Salient features of scaffolding, types of scaffolding practices, the role of the scaffolded, limitations of scaffolding, and the merits and demerits of other studies of this pedagogical concept have been highlighted. In addition, the theoretical framework that undergirds the study was presented. The next chapter is on the paradigm, the methodology and the design adopted in this study.

CHAPTER 3
RESEARCH METHODOLOGY AND DESIGN

This chapter outlines in detail the research paradigm, methodology and research design employed in order to answer the three research questions for the study which are: What are the teachers' understanding of scaffolding practices in the teaching of primary school mathematics? How do teachers use scaffolding practices in the teaching of primary school mathematics? Why do the teachers implement scaffolding the way that they do? The three research questions are key in that they inform both the methodology and the data collection instruments. An interpretive paradigm approach and qualitative methodology are used in conducting this study. These guide the researcher's philosophical framework throughout this study. The case study method proves helpful in conducting an in-depth study of the scaffolding practices used in the teaching of primary school mathematics. The case study also supports the methodological approach adopted in this study. Lastly, issues related to validity, ethical issues and limitations will be presented.

3.1 Research paradigm

A research paradigm is a set of assumptions and beliefs on how people view the world (Jonker & Pennink, 2010). In other words, a paradigm is "a basic set of beliefs that guides action" (Sikes, 2004, p. 4). These beliefs serve as a philosophical framework that consciously influences researchers. This study adopts an interpretive paradigm which subscribes to the view that reality is socially constructed and that there is no single correct route or particular method to knowledge (Singleton & Straits, 2009). However, McMillan and Schumacher (2006) posit that interpretivism is diametrically opposed to positivism which subscribes to the viewpoint that reality is objective and quantifiable. To this end, interpretivism is concerned with people's interpretation of reality rather than reality itself (Jonker & Pennink, 2010). This study therefore adopts an interpretive paradigm in attempting to make sense of the participants' experiences based on their worldview.

The study subscribes to a subjective ontology and a constructivist epistemology based on the social constructionist view which assumes that “the interactions and beliefs of people create reality” and that there is neither a single nor an objective reality waiting to be discovered and replicated by others (Neuman, 2003, p. 51). The study focuses on the lived experiences of what the participants understand about scaffolding in the field of education, because what people believe to be the truth has a great influence on their practices and behaviours (McMillan & Schumacher, 2006).

The study therefore aims to understand the concept of scaffolding in education “from the point of view of those in it” (Neuman, 2003, p. 6). To this end, two teachers participated in the study, in order to embrace the multiplicity of reality which is one of the chief tenets of the interpretivist paradigm (Hennink, Hutter, & Bailey, 2011). In addition, the study was guided by the interpretivist epistemological view in the collection of data that is deemed valid and acceptable (Wahyuni, 2012). The thinking was that documentary analysis, lesson observations and one-on-one interviews would glean more textured data. It would also help to understand the participants’ experiences and the meanings they attach to scaffolding in the teaching of mathematics at primary level.

Interpretivism assumes that access to knowledge is maximised through increasing proximity between the researcher and the researched (Neuman, 2011). Hence, the use of a case study in this research was deemed more appropriate. Some data for this study was generated in the participants’ natural settings such as classrooms in order to establish a deeper understanding of the interactions that occurred within them (Cohen et al., 2011).

While conducting this study, the participants’ understandings of scaffolding in the teaching of primary school mathematics were investigated. The participants’ responses to the questions asked during the data collection were key in answering the research questions of the study.

There is a link between an interpretive paradigm and qualitative methodology (Merriam, 2009). This is because qualitative research is interpretive of reality and is based on a philosophy that subscribes to the notion that reality is multi-layered as well as interactive (Merriam, 2009). According to McGregor and Murnane (2010), the interpretive paradigm refers to the lens through which a phenomenon is viewed whilst qualitative methodology refers to the strategy that underpins the way in which the research is conducted. This relationship is so strong that without first selecting a paradigm, there would not be a basis for the choice of the methodology (McKenzie, 1999). In brief, the research questions influenced the choice of the paradigm and methodology that were adopted in this study (McKenzie, 1999).

3.2 Research methodology

The study employed qualitative methodology because it "examines individuals and phenomena within the context in which they occur" (Salkind, 2012, p. 11). The research questions influenced the choice of this methodology and the research design adopted in this study. The study sought to answer three questions determined to explore teachers' understanding of what scaffolding is in the teaching of primary school mathematics and how and why they used scaffolding in the way that they did. The idea was to establish what was going on in their day-to-day teaching of primary school mathematics. According to Creswell (2009), a good qualitative research question should be exploratory and stir enthusiasm to discover what occurs in a setting. Research questions should influence the methodology employed in a study.

The identification of research questions is the starting point of a robust study. The questions spell out the thrust of the study and its theoretical framework.

3.3 Research design

A research design and methodology are the exposition and overall plan or strategy of how the researcher executes the study in order to ensure its justification and validity (Tuckman, 1999). To support this point, Yin (2009), argues that "colloquially a research design is an action plan for getting from here to there" (p. 19). It can also be viewed as the master plan of research which sheds light on how the research is to be conducted (Myers, 2009).

In an attempt to have a deeper understanding of the participants' experiences with scaffolding practices, the researcher used a case study. Robson (2002, p. 146) defines a case study as “a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence”. This is in agreement with McMillan and Schumacher (2006) who argue that a case study examines a system or case over a period of time in detail employing multiple sources of data embedded in that particular setting. The researcher used a case of two teachers at a primary school in Swaziland. This was helpful in understanding why these practitioners would choose certain scaffolding practices in their day-to-day teaching of primary school mathematics.

According to Ferguson (2013, p. 23), a case study puts a human face on the data as it offers the researcher an opportunity to observe in detail the lived experiences of a case or cases so as to develop a “clearer picture of the larger field”. Hence, the researcher’s continued observation and interpretation of the participants’ practices in order to give a thick description of the phenomenon. Stark and Torrance (2005, p. 115) say that the case study approach results in “a rich description of a phenomenon in order to represent it from the participant’s perspectives”. In light of this, detailed attention to the participants’ subtle cues that include covert and overt practices must be taken into consideration (Santrock, 2004).

This study selected two participants according to convenience sampling (Neuman, 2007). The use of more than one case was to help compare and contrast the participants’ practices in order to have a detailed picture of what was going on in their classrooms. Multiple data collection methods were adopted in order to generate an in-depth understanding of the participants’ perspectives of scaffolding practices through triangulation (Yin, 2009). Figure 4 shows the relationship among the factors that make up a research design.

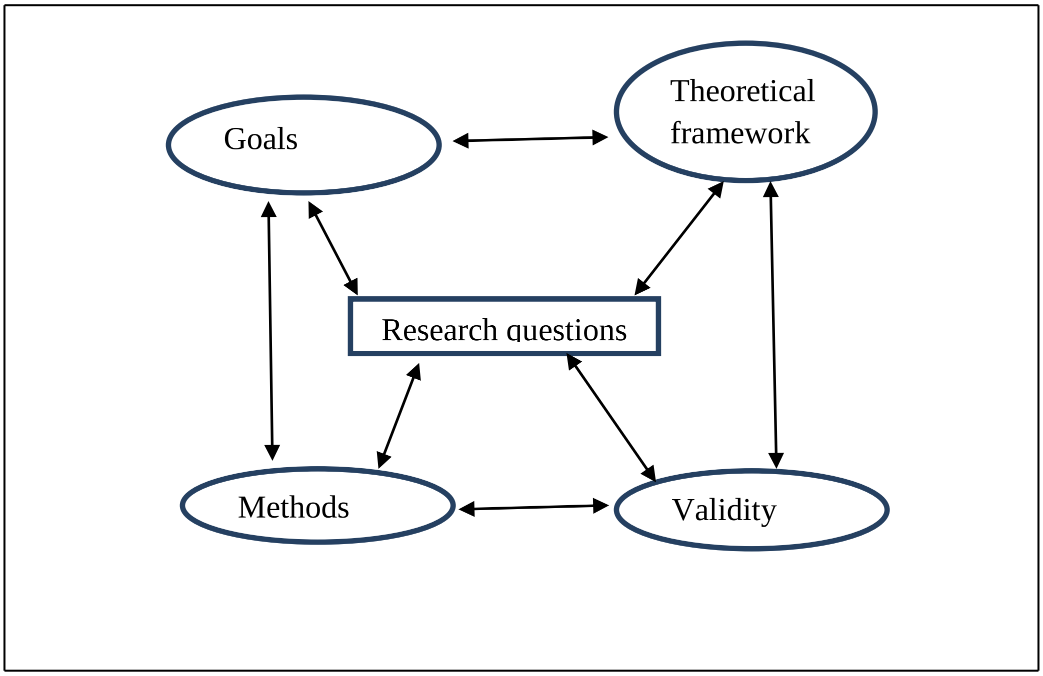

Figure 4: An interplay of factors that constitute a research design
(Adapted from Maxwell, 2005)

Figure 4 shows the interplay of diverse factors that constitute a research design. All the factors revolved around the research questions. In other words, research questions formed the basis for the justification of the choice of all other factors that were used to conduct this study. In short, they determined the methodology, the methods, the aims as well as the theoretical framework of the study. The researcher was aware of these interwoven factors in the implementation of the study.

3.4 Selection of cases

Qualitative methodologies use nonprobability selection methods that are totally different from those used in quantitative methodologies. This means that all the mathematics teachers at the school did not stand equal chances of being selected because the researcher used his discretion to select the participants (Lucas, 2014).

Convenience sampling was used as the principal method of choosing informants (Creswell, 2009). According to Maree (2007, p. 117), convenience sampling refers to "situations when participants are selected based on the fact that they are easily and conveniently available". At the end, two participants whose pseudonyms were Peter and

Sam were selected on the basis of their proximity and accessibility, given that the researcher was a colleague of the participants (Lucas, 2014). This method proved very helpful in collecting data as the informants were easily reachable.

There were two reasons for selecting the participants. Firstly, it was based on their mathematics teaching prowess and secondly, their wide teaching experience spanning over seven years for Peter and twenty years for Sam. Gender could not be a factor in the choice of participants because there were no female mathematics teachers in the middle and upper classes of the school where the research was conducted.

3.5 Data collection methods

Qualitative methodologies utilise an array of different methods in collecting data in order to provide a ledger of evidence that gives credibility, trustworthiness, honesty, dependability and authenticity to the study (Bogdan & Biklen, 2013; Yin, 2009). In conducting this study, four data collection methods were used: a questionnaire, document analysis, lesson observations and interviews (Merriam, 2009). The use of these four data collection methods enhanced the validity of the study. Marshall and Rossman (2011, p. 141) posit that data collection methods are “the staples of the diet” for without them qualitative research may be a non-starter. Before the commencement of the actual data collection was done, a pilot study was carried out for the purpose of checking the strength of the instruments.

3.6 Pilot Study

A pilot study is a miniature version of a real study that is run in preparation for an impending main study (Polit, Beck, & Hungler, 2001). A pilot study was undertaken to find out if the research instruments would collect the necessary data. It was intended to ascertain the level of clarity, the length of time suitable for the interviews and to improve other research instruments’ credibility (Opie, 2004). These pilot studies offered signals regarding the suitability of the methods and instruments to be used in the final study. Through this, the instruments were improved in such a way that they collected the requisite data. The researcher looked out for the respondents’ failure to answer specific questions, and any comments they made were written in the margin in order to improve the interview guide questions (Simon, 2004).

Two colleagues, who are also primary school mathematics teachers, were selected and agreed to participate in the pilot study out of their free will. Interviews were conducted and a questionnaire was given to the participants and their plan books were checked.

On the observation schedule, the researcher's observational skills in detailed note-taking and the identification of the requisite scaffolding practices that could be used to answer the questions of the study were sharpened. This pilot study alerted the researcher to the fact that answers to Research Question Three were not as easily identifiable as the others since the question sought far more than what met the eye.

Through pilot testing, a discovery was made that the questionnaire contained jargon that was beyond the comprehension of the participants. The term scaffolding was not familiar, and were neither term such as excavating, parallel modelling, reciprocal or convince me. To address this hurdle, the researcher had to add some explanatory phrases and use words that were within the scope of knowledge of the participants. These were written with bracketed explanatory notes as follows:

Scaffolding practices (*teaching* practices)
Convince me (*justification of answers)*
Parallel modeling (*demonstrations*)
Excavating (*finding what children already know*)

The pilot study also checked the strength of the data collection instruments. Through the pilot study the reliability of the research questions was validated. Initially the question in the interview guide read as: *What is scaffolding in the teaching and learning of mathematics?* The participants were not familiar with the word scaffolding yet it was the gist of the study. The question did not generate the requisite responses to the research questions. It was later changed to: *What is scaffolding (teaching* practices*) in the teaching of primary school mathematics?*

The pilot study interviews lasted for about twenty-five minutes each. The pilot study helped the researcher to improve on data collection techniques in the field, for example how to make the participants to open up and speak as well as giving the researcher access to their plan books and their classrooms. Interviews were conducted with two participants that had working experiences similar to the participants in the main study. During the course of the interview the researcher noted that he was not being assertive in the way he asked the questions. His voice was jerky and he tended to explain points unnecessarily, thereby making the questions long and vague. This made it difficult for the participants to get the sense of the question. One participant felt the time taken was too long and he kept on signalling for the interview to end saying he had other school commitments. The pilot study helped in reducing interview times to about twenty minutes each. Through the pilot study, the researcher was able to envision the type of responses that were likely to emerge from the main study.

The pilot study was an eye opener and offered a mosaic of experiences pertaining to the study. It offered the researcher an opportunity to improve on research instruments in such a way that they collected necessary data.

In conclusion, Creswell and Plano Clark (2011), highlights the significance of a pilot study by categorically stating that pilot testing enables a researcher to avert problems of ambiguity that arise from equivocal procedures. True to Creswell and Plano Clark (2011) words, the research instruments, by means of the pilot study, were greatly improved such that the responses given answered the research questions.

3.7 Questionnaire

Robson (2002) defines a questionnaire or a social survey as a method researchers use to collect data from people which comprises a set of questions asked in the same manner so as to gather the same information. According to McLeod (2014), a questionnaire can be thought of as a kind of a written interview which can be carried out face to face, by telephone or by post. Put simply, it is a list of written questions that are supposed to be answered by the respondents (McLeod, 2014).

The researcher administered a questionnaire in order to obtain in-depth information (Gall, Borg, & Gall, 1996). Questions were limited to nine so as to avoid falling into the trap of respondent fatigue (Bryman, 2008). This qualitative questionnaire was a prelude to the other data collection methods that were to be used in this study. The rationale for using a questionnaire was due to its convenience for the respondents (Bryman, 2008).

The questionnaire instrument sought to gather demographic information, academic and professional qualifications as well as participants' mathematical teaching experience. The researcher considered it imperative to collect demographic data from the participants so as to substantiate the other data collected (Bryman, 2008). This information was vital as it could have a bearing on the manner in which participants discharged their duties.

The questionnaire had closed and open-ended questions on scaffolding practices in the teaching of primary mathematics. The closed questions were structured in a way that elicited quick responses to research questions 1 and 2. However, they limited the respondents to the set of options provided to them. Nonetheless, this was compensated for in the other open-ended questions in the questionnaire. The open-ended questions (also known as unstructured or qualitative questions) were tailored to generate data from participants in a way that reflected their views without being swayed by the researcher's viewpoint (Berk & Winsler, 2002). They were in sharp contrast with closed-ended questions where a limited amount of categories of responses were provided to choose from. However, they can help in eliciting quick responses from the respondents. The questionnaire helped to address all three research questions.

3.8 Documentary Analysis

The study used documentary analysis as a data collection tool to obtain information that was related to participants' scaffolding practices and their implementation. McMillan and Schumacher (2006 p. 145) describe documents as "records of past events" which could be "printed materials that may be official or unofficial, public or private, published or unpublished, or prepared intentionally". The documents were useful in producing a ledger of information that helped to address second research question of the study (McMillan & Schumacher, 2006).

To gain an in-depth understanding of what was going on in their classes the researcher had access to the participants' lesson plans. Wood and Wood (1996) hint that researchers should not take documentary analysis at face value, but scrutinise them for an in-depth understanding. The rationale behind was to develop an understanding of how the participants used scaffolding in the teaching of mathematics at primary level.

3.9 Observations

Johnson and Cristensen (2012, p. 206) define observation as "the watching of behavioural patterns of people in certain situations to obtain information about the phenomenon of interest". This is because "the researchers have to know what they are looking for, whom they are observing, where they will observe, how the observations will be made and in what form they will be recorded" (Santrock, 2004, p. 58). Marshall and Rossman (2011) suggest that observation in its different forms is the mainstay of all qualitative studies. The researcher made six lesson observations per participant. The participants' lessons were observed in relation to the scaffolding practices they used and these were checked against the observation guide, which enabled the researcher to easily read into the participants' scaffolding practices and the relationships between factors (Santrock, 2004) (See Appendix 6).

Lesson observations for Peter and Sam were done in their classes within a period of three months. During the data collection period, nuances and dynamics of participants' scaffolding practices were taken into consideration in order to grasp their understanding of scaffolding how and why they used scaffolding in the way that they did. Observations were used in collaboration with interviews, a questionnaire and document analysis. The investigator in the process of collecting primary data, was as unobtrusive as possible so that neither his presence on the scene nor the method disturbed what was going on (Maxwell, 2005). Against this backdrop, the researcher adopted the role of an overt observer within the classroom, observing every detail in the teaching process. In this way, the researcher managed to gain an understanding of the participants' understanding of the concept of scaffolding in the teaching of primary school mathematics. Classroom observations helped to answer the second and third research questions whose focus was on how and why the participants used scaffolding practices the way that they did.

3.10 One-on-one interviews

Interviews are crucial in conducting qualitative research in that they help to source significant information from the participants. Klave and Brinkman (2009, p. 2) state that an interview is “a construction site of knowledge” where two or more people discuss a “theme of mutual interest”. Supporting this assertion, Lankshear and Knobel (2007) say that an interview is a planned, pre-arranged interaction between two or more people where one person asks questions related to the research while the other person or people respond to the questions asked.

In view of the above assertions, the researcher employed semi-structured interviews so as to solicit insights into the interviewees’ views. Semi-structured interviews had the advantage that they allowed the researcher to collect rich qualitative data on the topic under exploration (Hinds, 2000).

Interviews with the two participants were conducted on the same premises but separately. These interviews were voice recorded with the permission of the participants, then transcribed by the researcher (See Appendix 7). This helped him to simultaneously transcribe and analyse the captured detail of the recordings. The researcher chose audio recording as he did not want to disturb the smooth flow of the interview through asking the interviewee to repeat or slowdown in order to allow note taking. Voice recording was advantageous in that it allowed the researcher to concentrate on the interview and later play it repeatedly in order to gain the full import of the participants’ responses (Klave & Brinkman, 2009).

Cohen et al. (2011) assert that interviews not only have the ability to gather rich data, but also allow the researcher to get clarification on vague responses through probing. The researcher probed the interviewees for clarity and depth on questions that showed conflicting ideas, like the one on parallel modelling and conducive environments.

The major aim of this schedule was to collect complementary data to observations, questionnaire and document analysis. The interviews sought to address all the three research questions.

Triangulation

Klave and Brinkman (2009, p. 141) define triangulation as "the use of two or more methods of data collection in the study of some aspect of human behaviour". Creswell (2012, p. 259) concurs with these assertions by saying that "triangulation is the process of corroborating evidence from different individuals, types of data or methods of data collection in description and themes in qualitative research". In other words, triangulation is the merging of data from different data collection methods (McMillan & Schumacher, 2010).

Triangulation was addressed through the use of a questionnaire, observation, interviews, document analysis and field notes. The use of multiple data collection methods allowed "diverse viewpoints or standpoints to cast light" upon the topic (Olsen, 2004, p. 3). The data that emerged from each of these methods were cross-examined in light of the other methods as a way of checking their trustworthiness, credibility and dependability. Figure 5 summarises the triangulation procedures.

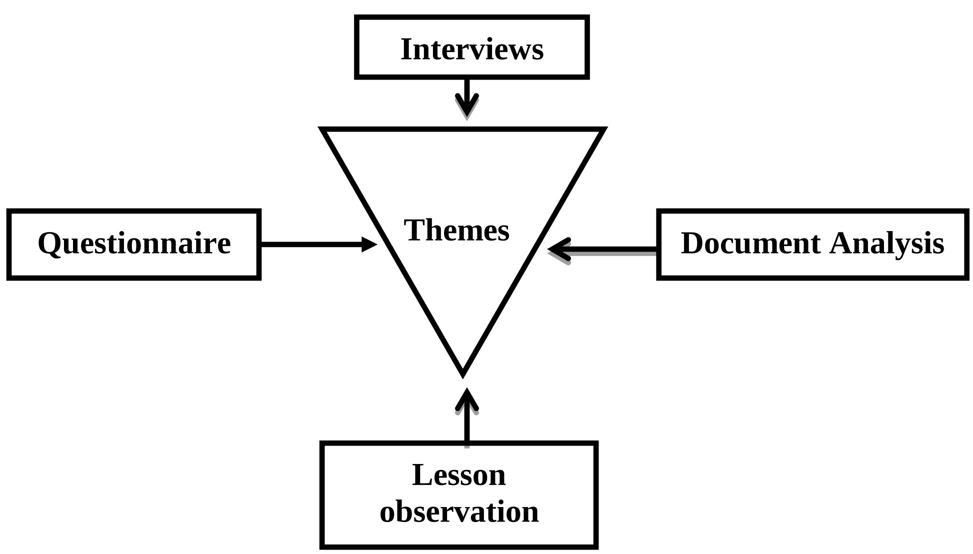

Figure 5: Diagrammatic representation of the data collection

3.11 Qualitative data analysis

Qualitative data analysis entails the organisation, accounting and interpretation of data in which large amounts of information is collated into patterns, categories and themes to generate meaning which is later interpreted using some schema (Creswell, 2009). It involves making sense of data in view of the participants' definitions of the situation through noting salient features, patterns, themes, categories and regularities (Cohen, Manion, & Morrison, 2007). According to Bogdan and Biklen (2013, p. 145), "analysis involves working with data, organising it, breaking it into manageable units, synthesising it, searching for patterns, discovering what is important and what is to be learned, and deciding what you will tell others". They further posit that data analysis entails the arrangement of data, writing in codes and themes in order to develop some outcomes (Bogdan & Biklen, 2013). According to Lofland, Snow, Anderson, and Lofland (2006), qualitative data analysis is inductive in nature.

Bryman (2008, p. 539) asserts that an analytic induction is "an approach to the analysis of data in which the researcher seeks universal explanations of phenomena by pursuing data collection until no cases that are inconsistent with a hypothetical explanation (deviant or negative) of phenomenon are found". In the same vein, Patton (2002) explains that inductive analysis means that the patterns, themes and categories emerge from the data, rather than imposing them prior to data gathering and analysis.

Bryman (2008, p. 541) further posits that "data collection and analysis proceed in tandem repeatedly referring back to each other". In other words, data analysis occurs simultaneously with data collection, data interpretation and narrative reporting writing through iterative, recursive and dynamic processes.

For the purpose of qualitative data analysis three critical features emerged, namely familiarisation and organisation, coding and recording, then summarising and interpreting. The researcher had to ensure that all data collection procedures were meticulously followed before doing the data analysis. This is because "researchers are the central agents in the analysis process "and as such they have to be familiar with the stages of data analysis, developing categories as well as drawing comparisons and contrasts

(Lofland et al., 2006, p. 195). Data were analysed using the constant comparative method (Strauss & Corbin, 1990) whereby line by line, sentences and paragraph segments of the transcribed interviews were reviewed to decide what codes fit the concepts suggested by the data. Data interpretation is one of the key components of data analysis process (Miles & Huberman, 1994).

All the collected data were compared, analysed and classified in order to establish similarities and differences. The data were further reviewed, organised and made sense of, resulting in the emergence of themes and patterns (Bryman, 2008). Both the relevant data and that which seemed irrelevant were documented. The latter was not discarded immediately but was kept for future consideration should any need arise (Burch, 2007). To guard against the study going astray through collection and analysis of irrelevant information, research questions were used as a roadmap to guide data collection and data analysis**.**

Transcription of data came after data collection. The researcher developed codes, patterns, connections and interpretations for each participant's responses. Figure 6 shows data analysis procedures.

Qualitative data analysis

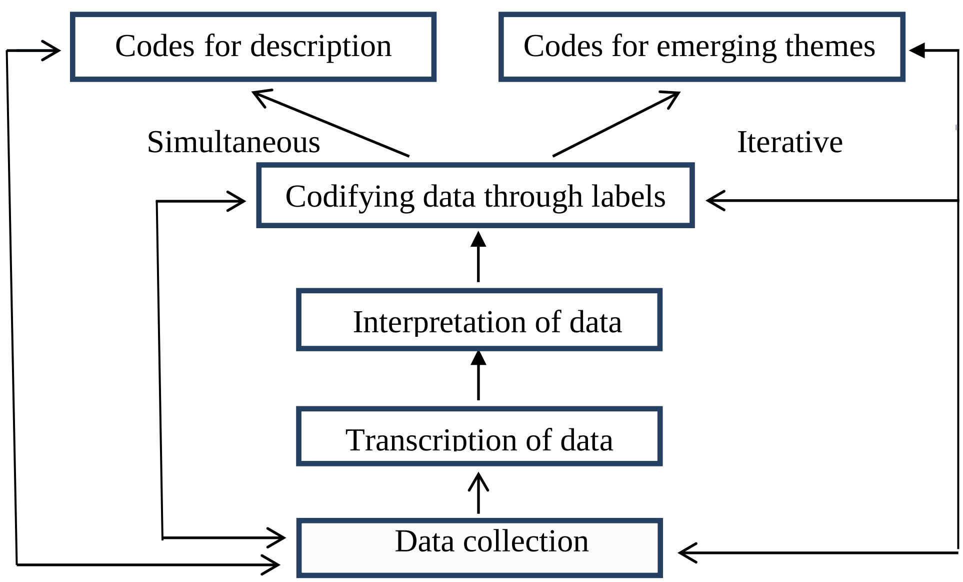

Figure 6: Diagrammatic representation of data analysis (Adapted from Creswell, 2012)

Figure 6 illustrates that data analysis does not flow in one direction, rather it is iterative in order to establish a credible study. Creswell (2012, p. 236) describes this process as "inductive, eclectic and interpretive". Analysis of data was achievable through the generation of codes and patterns from the data collected by the researcher.

3.12 Content Analysis

The researcher used content analysis as a technique of analysing the data. Content analysis entails "the categorisation of verbal or behavioural data for the purpose of classification, summarisation and tabulation" (Krippendorff, 2013, p. 40). It is a process that identifies consistent as well as repeated themes, and other meaningful traits within the data for the purpose of interpretation. According to Krippendorff (2013), analysis of content can be accomplished through the interpretation of the content, establishing frequencies, and coding to develop themes. Multiple methods of data collection were used in the generation of data and written in text form that could be verified by the participants, thus offering flexibility for re-analysis should the need arise.

According to Lankshear and Knobel (2007), before the data that is gathered from the interview is analysed, it should be turned into written text or transcripts. Data from the interviews were analysed using a thematic analysis approach. According to Dally, Kellehear, and Gliksman (1997, p. 306), a thematic analysis is a process of searching, identifying and exploring codes and themes that emerged as "important to the description of the phenomenon". This was achieved through "careful reading and re-reading of the data" (Rice & Ezzy, 1999, p. 258). For the purpose of this study, the participants' responses were recorded and the transcripts were then shown to the participants for verification. The researcher allowed two weeks for feedback from the participants.

The next stage of data analysis was the summarising and interpretation of data. The former involved making connections between ideas that ultimately made up the study. The researcher used constant comparison as a strategy for interpreting the data (Lofland et al., 2006; Patton, 2002). The researcher went on to reflect on the words and actions of the participants in order to have the full import of the participants' understanding of scaffolding in the field of education. To this effect, the quality of the interpretation is dependent on the researcher's skills to interpret the study. For this reason, analysis of data was carefully conducted by means of organisation, coding, and generation of themes and patterns formed from the data collected**.**

3.13 The coding process

Having read the data to 'get the story behind the story' of the participants, the researcher then proceeded to data coding. (Miles & Huberman, 1994) describe coding as a process that enables the researcher to identify meaningful data that sets the stage for the interpretation and drawing of conclusions within qualitative research settings. A coding system is a way of distinguishing the "content from the medium through for example, underlining, marking in different shades, numbering or using brackets with textual codes" (Bryman, 2008). Coding helps in to organise piles of data and to label different aspects of the study. Bryman (2008, p. 550) cautions that coding ought to be executed as soon as possible as it "sharpens your understanding of your data". The emerging categories enabled items with similar coding to be grouped together.

In accordance with the foregoing assertions, the researcher went on to read and re-read the data, categorising and interpreting every sentence and every phrase in order to understand the emerging themes. The researcher commenced the process of coding after data collection when events were still fresh in his memory, as per Bryman (2008). The researcher read through line by line carefully in order to identify similarities and differences, attaching some labels and categories or themes for the final write up. Figure 7 shows a diagrammatical representation of the process of coding.

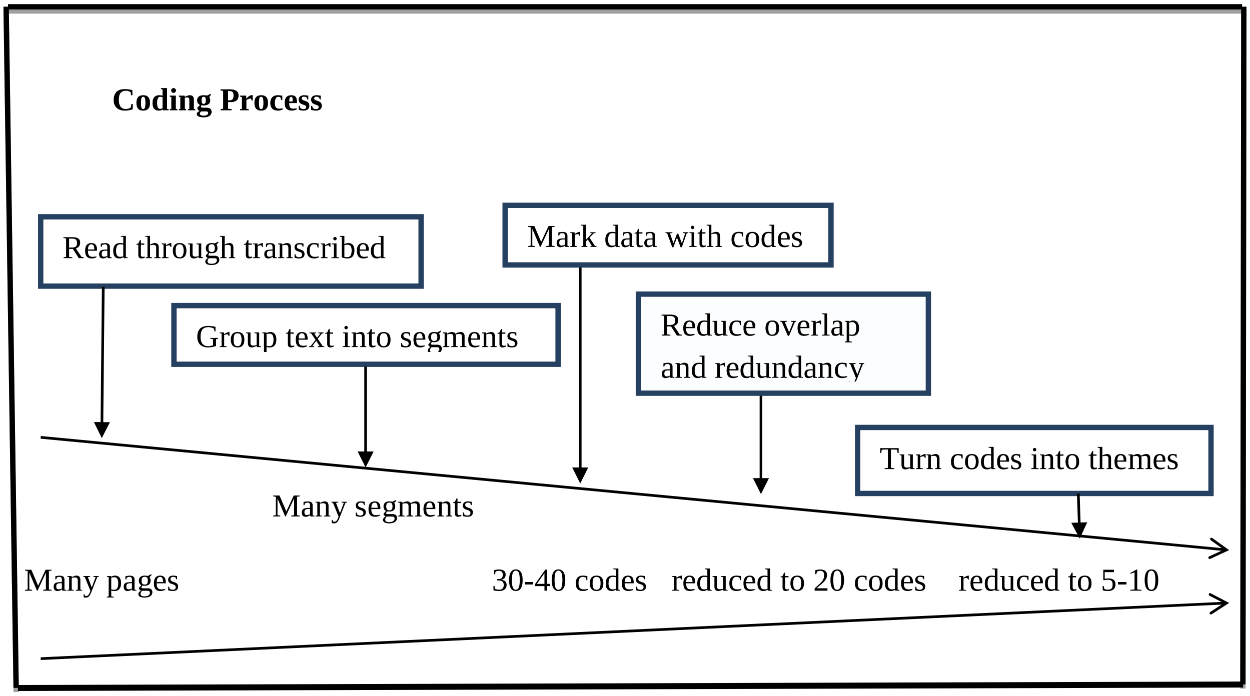

Figure 7: Diagrammatic representation of coding process

(Adapted from EDUC 7741, unpublished)

Figure 7 shows that the coding process starts from general to specific as signified by horizontal open arrows that reduce as the process gets to the end. This iterative process of coding and re-coding of incoming data continued until all the points were exhausted. After this, themes emerged and were noted.

3.14 Research rigour

Central to the quality of this qualitative study is rigour. Creswell (2012) postulates that, rigour refers to the extent to which research responds to the demands of a qualitative case study. It entails the use of appropriate data collection methods, exhaustive data collection, checking the accuracy of data transcripts through member checks, thorough and critical data analysis, as well as making the final draft accessible to participants (Creswell, 2012). Debriefing, which entails discussing the study and ethical issues with the participants, was used to authenticate the findings presented in this write-up (Singleton & Straits, 2009).

3.15 Validity issues

McMillan and Schumacher (2010, p. 330) define validity as the "degree of congruence between the explanations of the phenomena and the realities of the world". According to Jenkins (2010, p. 1), reliability in qualitative research "is challenging to demonstrate because, data is based on interviews, personal accounts, real life experiences and face to face encounters". Guba and Lincoln (1994) cite the following criteria that can be used to determine reliability in a qualitative study: credibility, transferability, dependability, confirmability, honesty, fidelity to participants, rigour, trustworthiness, depth, richness, scope of the data collected and its uniqueness. Creswell (2009) goes onto say that the credibility and accuracy of the research is achieved by way of triangulation through validation techniques such as member checking and multiple data collection methods.

In this study, triangulation was achieved through the use of diverse data collection methods, namely, a questionnaire, document analysis, lesson observation and individual interviews. Member checking entails making transcripts available to participants so that they can check their accuracy and to ensure an accurate capture of the views of the participants (Cohen et al., 2011; Merriam, 2009). The researcher re-visited the participants to allow them to read the transcripts so that they could elaborate, clarify, confirm or refute certain aspects of the interview (Cohen et al., 2011). The significance of validity in a research cannot be overemphasised because if one section is neglected, then the whole study is rendered irrelevant and may be unacceptable (Cohen et al., 2011)

The researcher ensured there was clarity in individual interview questions through interview schedules and observation schedules, which were pilot tested to eliminate any element of ambiguity. Further, the researcher was involved in a prolonged period of three months where the participants were observed going about their day-to-day activities. Carefully crafted research questions, meticulous data analysis and a thick description of the phenomenon enhanced the validity of the study.

Data obtained through multiple methods were carefully and systematically analysed in relation to the theoretical framework of the study embedded in the zone of proximal development espoused by (Vygotsky, 1978).

3.16 Ethical issues

According to McMillan and Schumacher (2006) ethics form the standards that govern professional behaviour. Marshall and Rossman (2011, p. 39) assert that research ought to be "well thought out and should be carried out with an ethical mindfulness" because that helps to avoid sensitive aspects that may emanate from the interaction between the gatekeepers, participants and the researcher. The researcher considered the following main issues: recognition, respect, maintaining informed consent and the right of information dissemination (Saunders, Lewis, & Thornhill, 2003).

Permission to carry out the study

Firstly, the nature of the study required permission from the Ministry of Education (MoE). Ethical clearance was obtained from the (MoE) in Swaziland (See Appendix 1). The researcher also wrote a letter to the gatekeeper of the primary school who granted permission to carry out the study at the school. This resonates with the assertion of Wiersma and Jurs (2009, p. 436) that it is critical to "obtain permission from the sites' gatekeeper". Denzin and Lincoln (2011, p. 154) argue that "qualitative researchers are guests in the private spaces of the world and being in pursuit of a scholarly ambition does not warrant the invasion of other people's privacy". To this effect, the researcher ensured participants' rights were not infringed through seeking their consent.

Informed consent

Informed consent has everything to do with an individual's free will to participate in a study. Drew, Hardman, and Hosp (2008, p. 57) clearly state that, "consent involves the procedure by which an individual may choose whether or not to participate in a study". The researcher fully informed the participants the nature of the study and the study proceeded only after they had consented. He also explained that their involvement was voluntary and they were at liberty to withdraw their services whenever they considered it necessary without fear of any consequences. The researcher explained that the participants were free to refuse to answer any question they deemed unfair to them and still remain in the study. The researcher then gave each participant a letter with a declaration form. They both signed the declaration form as a way of showing their willingness to participate in the study.

Confidentiality and anonymity

Maintenance of confidentiality of data provided by participants and their anonymity are crucial in research (McMillan & Schumacher, 2010). The researcher assured participants of the maintenance of their privacy, confidentiality and anonymity during and after the study. Neville (2007, p. 40) asserts that all participants need to be assured of anonymity and that "any direct quotes used need to remain anonymous unless the interviewee wishes otherwise". This study kept the participants anonymous through the use of pseudonyms as this allowed them to freely and willingly participate in the study.

Marshall and Rossman (2011, p. 47) sum up by saying, "respect for persons captures the notion that we do not use the people who participate in our studies as a means to an end (often our own) and that we do respect their privacy, their anonymity and their right to participate".

Data safe-keeping and disposal

The researcher will securely keep the data used for the purpose of this study for a period of at least five years in a place accessible to the supervisor and the researcher only. Transcripts as well as audiotapes will be disposed of after five years. This promise was conveyed in writing to both the gatekeeper and the participants.

3.17 Conclusion

This chapter presented the research methodology used in this study. It also highlighted the interpretive research paradigm, case study approach, selection of multiple cases and data collection techniques adopted in the study. Triangulation through data collection methods, data analysis and rigour of the research were also explicitly discussed. Lastly and equally importantly, ethical issues and limitations of the study were accounted for. The next chapter highlights the details of data presentation and analysis of the data which were obtained through a questionnaire, document analysis, lesson observations and one-on-one interviews.

CHAPTER 4
PRESENTATION AND DISCUSSION OF FINDINGS

The preceding chapter highlighted the paradigm, the methodology, research design, and the data collection methods used in the study. This chapter presents participants' demographic data, the teaching environment in which the study was conducted and the key pedagogical approaches used in their day-to-day teaching of primary school mathematics. The researcher included these characteristics so that he could determine how and why participants used scaffolding practices in the way that they did. In this study, data were firstly, coded, analysed inductively and presented according to emerging themes. According to Bryman (2008), inductive analysis involves generating themes from the data collected rather than imposing hypotheses prior to the collection of data. This approach was useful in that it helped in presenting rich and thick description of the participants' understanding of the scaffolding practices used in this study Bryman (2008). Participants' responses were presented as direct quotations in order to substantiate the emerging themes.

Lastly, relevant literature was used to consolidate the themes as they emerged. Classification of the unfolding themes was accomplished in accordance with the three research questions that were used as a roadmap for the completion of the study.

4.1 An overview of the cases

Two primary school teachers namely Peter and Sam (pseudonyms) were selected by means of convenience sampling for the purpose of this study. Their demographic data, classroom environment, and pedagogical practices are highlighted. This background information is presented because it might have had a bearing on the way they used scaffolding in their mathematics lessons.

4.2 Case 1: Peter

Peter is a 29 year-old man with teaching experience spanning over eight years. He holds an ordinary level certificate and a Secondary Teaching Certificate (STD) obtained from a school and university of the country of his origin. He has taught for five years in high school and three years in primary school in Swaziland. As an expatriate, his contract is based on performance and has been renewed for two years on the basis of good performance as per school policy.

Peter's classroom environment

The classrooms Peter teaches in are about 35 square metres. The researcher's focus was on one of the classrooms in order to develop a deep understanding of the way he used scaffolding in the teaching of mathematics. The classroom is separated from adjoining classrooms with timber partitions. The photos in figure 8 are representative of the three classrooms Peter teaches in.

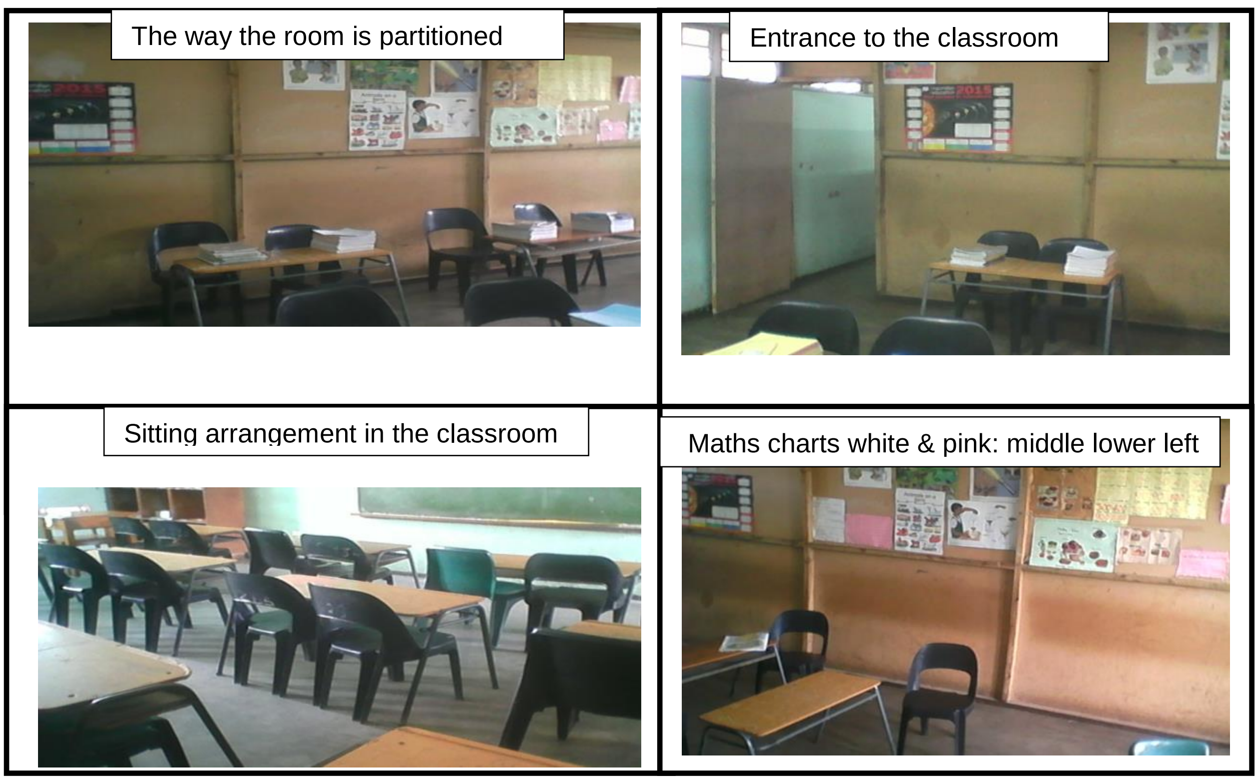

Figure 8: One of the classrooms Peter teaches in

Learners sit on plastic chairs in pairs sharing a wooden desk. On the walls were some displays of various teaching and learning aids. However, there were few charts displayed in mathematics than in the other subjects.

Peter's load and pedagogical practices regarding the teaching of primary school mathematics

Peter teaches mathematics to three classes each with an average of 28 learners. He is not a class teacher of any of the classes he teaches but of another grade. In addition to mathematics, he teaches other related subjects. The lessons are one hour long and they are spread over three days per week. Overall, Peter teaches nine hours per week to his three classes between eight in the morning and two in the afternoon. The school requires the teachers to do weekly planning. They do not plan for the whole term. In each plan they are required to give learners activities and make individual evaluation. Peter has to compact all his mathematics lessons within the stipulated hour and move on to the next class before the coming of another teacher. He needs to ensure he covers the syllabus. For each lesson, he has to administer an assessment task (written exercise), mark and give feedback to the learners immediately or on the following day, before commencing a new lesson.

4.3 Case 2: Sam

The other teacher interviewed and observed was Sam. Sam is 49 years old and like Peter, is an expatriate as well. He has been a primary school teacher for 29 years. He holds an ordinary level certificate and a Diploma in Education (DE), which he obtained in his country. He started teaching in 1986 as a temporary teacher before studying for a diploma and becoming a qualified teacher in 1994. His teaching experience as a qualified teacher spans over 20 years. He has been teaching at this particular school for the past 9 years and has not taught at any other school in the country.

Sam's classroom environment

The classrooms Sam teaches in are approximately 35 square metres in size. Each of the three classes has an average of twenty-nine learners. The writer focused on one of the classes and classrooms in order to have an in-depth understanding of the teacher's scaffolding practices. The learners sit on plastic chairs in pairs sharing a desk. The classroom had some charts on display mainly for other subjects but one for mathematics. Figure 9 represents Sam's classrooms, the sitting arrangement, the partitioning and the way the classrooms are dressed.

Figure 9: One of the classrooms Sam teaches in

Sam's load and pedagogical practices regarding the teaching of primary school mathematics

Sam was the class teacher for one of the three classes he taught mathematics to. Each of the classes had an average of 29 learners. Sam, just like Peter, was a subject specialist at grade level. According to the school policy, a teacher only prepared and taught lessons for specific subjects for which they were specialists. With this kind of arrangement, some teachers like Sam and Peter are itinerant, that is, they move from one class to another. He is required to plan for his lessons on weekly basis, giving learners some work on each topic taught, mark it and return the work before the commencement of each new lesson. Table 2 summarises Peter and Sam's demographic data.

Table 2: A summary of Peter and Sam's demographic data

Participant's name	Sex	Age/in Years	Academic qualification	Professional qualification	Teaching experience	Employment status
Peter	male	29	'O' level	Secondary Teaching Diploma (STD)	8 years	2 years
Sam	male	49	'O' level	Diploma in Education (DE)	29 years	2 years

An understanding of the participants and their context helped to lay a basis for the discussion of findings used to answer the three research questions of the study.

4.4 Participants' understanding of scaffolding as a teaching strategy

This section describes the participants' understanding of scaffolding in education with respect to Research Question One: What is the teachers' understanding of scaffolding in the teaching of primary school mathematics? As indicated in Chapter 2, scaffolding is central to the teaching of primary school mathematics and competent teachers cannot do without it. This is because "scaffolding is a teaching strategy that can enhance mathematics learning" and if effectively utilised, it can bolster children's understanding of the subject (Kiong & Yong, 2001, p. 14). This means that what the teachers know about scaffolding may determine how, where, when and why they use the pedagogy. A point was made in Chapter 1 that the performance of learners falls as they proceed to upper grades and it is for this reason that the researcher made the teacher's understanding of scaffolding in the teaching of primary school mathematics a focal point of the study. In addressing the research question, one broad theme and three subthemes emerged from the data collected.

Theme 1: The participants understood scaffolding in the teaching of primary school mathematics to be diverse, developmental, fostering learning processes as well as being mediated in the zone of proximal development

The following subthemes emerged from the responses to the questionnaire and one-on-one interviews, highlighting the participants' understanding of scaffolding in the teaching of primary school mathematics.

***Subtheme 1a:* Participants understood scaffolding in the teaching and learning of primary school mathematics to be diverse**.

Through a questionnaire, participants were given three options of definitions of scaffolding to choose from. They were to choose the one they felt best described scaffolding in the teaching of primary school mathematics. The options are shown in Table 3.

Table 3: Participants' responses to scaffolding definitions

Participant	Option a	Option b	Option c
	Scaffolding is assistance in the form of rules and methods so that learners have knowledge of mathematics to pass examinations.	Scaffolding is all the assistance used to help learners understand and ultimately become independent learners.	Scaffolding entails showing and telling learners all the necessary rules and methods so as to do well in mathematics.
Peter	X	X	X
Sam	X	✓	X

Key: ✓ Aware of X Unaware of

The participants were asked to indicate their answer with a tick to show that they agreed and with an 'x' to show that they did not agree with the definition. From the table above, Sam's response showed that he knew what this strategy entails. This is because, scaffolding, in essence, is a "process of setting up the situation to make the child's entry easy and successful and then gradually pulling back and handing the role to the child as he becomes skilled enough to manage it" (Bruner, 1983, p. 60). In addition, it is a bridge used to build upon what learners already know to arrive at something they do not know**.** If scaffolding is properly administered it acts as "an enabler, not as a disabler" (Benson, 1997, p. 126). Peter on the other hand, did not complete the questionnaire but he had his own view of scaffolding. His response during the interview showed that he understood scaffolding to be the support given to learners to help them pass examinations. According to Peter, "scaffolding is help in the form of roles and methods so that learners have knowledge of mathematics to pass examinations" (Interview, June 25, 2015).

This view does not fully explain all what scaffolding is because scaffolding is not only about passing examinations but its main thrust is on the learners' meaningful construction of their own knowledge. Furthermore, Peter's omission of other scaffolding practices is explained by Robson (2002) who asserts that in the completion of a questionnaire, participants can omit some questions, take several sessions to complete and can write their own comments.

The findings showed that participants viewed scaffolding as consisting of diverse practices. This is similar to Jacobs' (2012) findings that the interpretation of scaffolding is extremely diverse and serves as a generic term for any form of teacher support. Peter and Sam indicated that they knew 7 and 13 scaffolding practices in the teaching of primary school mathematics respectively. Table 4 indicates the number of scaffolding practices which both respondents were aware of and those they were unaware of.

Table 4: A summary of the participants' choices

	Peter	**Sam**
Scaffolding practice		
questioning	✓	✓
excavation	✓	✓
collaboration	✓	✓
guiding	✓	✓
orienting	✓	✓
reflecting/reviewing	✓	✓
focusing	✓	✓
conducive environments	x	✓
extending	x	✓
reciprocal	x	✓
apprenticing	x	✓
parallel modelling	x	✓
convince me	x	✓

Key

✓ Aware of

X Unaware of

Sam indicated that he knew all the 13 given practices while Peter indicated awareness of 7 scaffolding practices. While both participants indicated that they knew a number of practices, Peter showed that he was not informed of the concepts parallel modelling, convince me, apprenticing, reciprocal, extending and conducive environments. This is similar to Verekinina and Chinnappan (2006) finding that student teachers were having difficulty in understanding scaffolding strategies.

Although Sam ticked all 13 options provided, there were indications that he did not know all of them. In the subsequent question (on the same questionnaire) he explained only 6, namely: excavating, questioning, parallel modelling extending and guiding out of the 13 scaffolding practices he claimed to know. Sam might have taken the route of social desirability in which "most people want to present a positive image of themselves and so may lie or bend the truth to look good" (McLeod, 2014, p. 1).

Both participants indicated that scaffolding in education has an array of practices that aim at bolstering the understanding of mathematical concepts. Sam's enumeration of different scaffolding practices is an attestation to this as he said, "Hmm. The scaffolding practices I am aware of in the teaching of primary mathematics include excavating, explanation by the teacher, demonstration, group work, individual written work, pair work, field trips, role play, guiding, and discussion between the learners" (Interview, June 25, 2015).

Their understanding of scaffolding as having an array of practices is in harmony with the Researching Numeracy Project Team's (2004, p. 1) assertion that "effective teachers use a range of scaffolding practices that support the learners in their learning process". It further says that, "teachers can select from and use twelve scaffolding practices, appropriate to purpose, throughout the five phases of instruction". The scaffolding practices provided by the Researching Numeracy Project Team (2004) include (but are not limited to) the following list: excavating, modelling, collaborating, guiding, convince me, noticing, focusing, probing, orienting, reflecting/reviewing, extending and apprenticing.

***Subtheme 1b:* Participants understood scaffolding to be developmental and fostering teaching and learning process in primary school mathematics**

Participants' responses indicated that scaffolding is developmental, that is, building on prior learnt concepts. To this effect, Sam said, "Ahaa-a, okay for example excavating I usually pose questions to learners to find out what they already know so that I can teach from known to unknown". (Interview, June 25, 2015)

> Mostly like I said earlier that I prefer excavating that is finding out what learners already know because when you know – I find it easy to help a child when I know where he or she stands, what he or she already knows. .... something they have done maybe in the previous grades you bring out the topic, let us do this again just to build up their abilities maybe they might have forgotten about what they did in the previous grades. You will try to warm them up so as to get ready for the new concept where they are now. (Peter, Interview, June 25, 2015)

The participants' views of scaffolding resonate with that postulated by Konieczka (2013, p. 1) that "the teacher explicitly describes how the new lesson builds on the knowledge and skills learners were taught in a previous lesson". Greenfield (1984) explains that teachers can structure an interactional pattern in class through building on what they know the learners can do. The author further describes such a strategy as building on or connecting to learners' prior knowledge. Linking a newly learnt idea to a previously learnt concept shows learners how the concepts and skills they already know help them in tackling new tasks (Greenfield, 1984). What it means is that the teacher should be cognizant of previous knowledge and build on that knowledge.

Walqui (2002, p. 13) posits that "learners will only be able to learn new concepts … if these are firmly built on previous knowledge and understanding". This entails the weaving of new information into the learner's prior knowledge (Walqui, 2002). In the same vein, Kiong and Yong (2001, p. 4) posit that, "learning activity should be to the student's prior knowledge and interests". The thinking is that "the task should be related to learners' everyday experiences so that they have something they are familiar with to reflect on" and it is imperative therefore that teachers tap into the learner's prior knowledge (2001, p. 6).

Kiong and Yong (2001, p. 4) argue that "one of the problems that contribute to poor performance in mathematics by learners is lack of continuity in their learning". Therefore, to successfully apply scaffolding in a classroom, it is important to know not only where a child is functioning now and where that child will be tomorrow, but also his/her prior knowledge (Kiong & Yong, 2001). To emphasise the centrality of linking new to old knowledge, Alber (2011, p. 1) points out that, “launching the learning in your classroom from the prior knowledge of your learners, and using this as a framework for future lessons is not only a scaffolding technique, many would agree it’s just plain good teaching”. This means that if teachers do not take into consideration the previous knowledge and build upon it, this may contribute to low and/or poor performance by the learners. In essence, it is fundamental that teachers take seriously learners’ prior knowledge in their teaching of primary school mathematics.

Findings from the interviews support the emerging theme that scaffolding is a method that enhances understanding of concepts through the presentation of opportunities for learners to develop understanding of concepts before venturing into unknown territories (Larkin, 2002). This correlates with Hunter's (2012) findings that when scaffolding is used effectively it enhances learning. In concurrence, Peter said, “… scaffolding is help in form of roles and methods so that learners have knowledge of mathematics” (Interview, June 25, 2015).

Peter’s view, though contradictory to the previous one from the questionnaire, resonates with the ideas of Rojas-Drummond and Mercer (2003) who define scaffolding as a method of teaching in which the adult adjusts the level of help provided in relation to the child’s level of performance. This is also in harmony with Mercer and Littleton (2007, p. 18) who describe scaffolding as “the active and sensitive involvement of a teacher in students’ learning”. Wood et al. (1976) say scaffolding is a process that enables a child or a novice to solve a problem that is, achieving a goal which would be beyond his or her unassisted effort. The participants acknowledged that scaffolding has the potential to foster the understanding of new concepts in the learning process. This is why Wood et al. (1976, p. 90) postulate that scaffolding “enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted effort”. The following data from the interviews attest to this assertion:

> "There is also pair or group work. In this method I usually give some learners more practice in pairs or groups in what I would have explained to them so that they can consolidate their understanding of the concept. And this is usually followed by a report back. I prefer these methods because they usually make my teaching easy and they help the learners to understand the concepts" (Sam, Interview, June 25, 2015).

Peter defined scaffolding as "all the assistance used to help learners understand… since I started these practices have been giving me positive results" (Interview, June 25, 2015). In his definition, he alluded to the efficacy of scaffolding practices in the teaching process.

The participants' understanding showed that scaffolding practices are teaching practices employed by the MKO to facilitate the learner's understanding of concepts. Their constructs indicated that they viewed scaffolding as a strategy that enhances understanding of mathematical concepts. Their understanding of scaffolding is in harmony with Kiong and Yong (2001, p. 8) who posit that, "scaffolding has the capacity to enhance the potential of an individual within his ZPD". They further postulate that, "scaffolding is a strategy that can enhance mathematics learning" (2001, p.14). Greenfield (1984, p. 118) makes an analogy between building construction and scaffolding as a concept in education. In reference to the former, the author says, "scaffolding as it is known in building has five characteristics: It provides a support, it functions as a tool; it extends the range of work; it allows the worker to accomplish the task not otherwise possible; and it is used selectively to aid the worker where needed". This is why educationists like Greenfield (1984, p. 118) coined the following ideas of scaffolding in education, "… the teacher's selective intervention provides a supportive tool for the learner, which extends his or her skills, thereby allowing the learner to successfully accomplish a task not otherwise possible."

From what the participants said, scaffolding is a temporary guidance offered to the learners by more knowledgeable others such as a teacher or student to another less capable (Boblett, 2012).

The participants' understanding of scaffolding was that it has the potential to inculcate academic independence in learners. This finding was not unique to this study since it correlates with Lipscomb, Swanson, and West (2004) who found that scaffolding helps students to master skills resulting in the achievement of independence. The point made is that any effective teaching, should ultimately offer its recipients the confidence to do tasks on their own. They alluded to the key attributes of scaffolding which are to support the learners and inculcate self-efficacy so that they can become independent thinkers. Excerpts from the interviews confirm this as Peter said, "So, this scaffolding is all the activities used to help learners understand in such a way that they can at least have their own free time where they can practice without the teachers being there to supervise them (Interview, June 25, 2015). In the same vein, Sam explained that scaffolding is "… used in the teaching of mathematics to enable the learners to understand some mathematics concepts and apply what they learn in mathematics in real life situations" (Interview, June 25, 2015).

Their submissions are in line with Lee's (2012) assertion that a person using scaffolding should facilitate the transfer of responsibilities resulting in self-regulation (control of subject matter) and independence (self-efficacy). Puntambekar (2009, p. 24) postulates that successful scaffolding occurs when a student is now able to perform tasks on their own and there is a transfer of responsibility from "the scaffolder" to the "scaffoldee". The participants' views of scaffolding are in concurrence with the notion that it enhances independence and self-efficacy in the learning process.

***Subtheme 1c:* Scaffolding is mediated in the ZPD**

Despite the fact that the participants did not directly mention mediation as an important aspect of scaffolding, their views indicated that they consciously or unconsciously appreciated the role of the mediator in the teaching and learning of mathematics. The point made is that scaffolding is very important in all learning activities. Their submissions revealed that scaffolding is dependent on the presence of more knowledgeable others and the novice. The participants' responses are in agreement with the above insights. This is evident in Peter's assertion that "… this scaffolding is all the activities used to help learners understand" (Interview, June 25, 2015). Sam agrees with Peter when he says,

> Hmm scaffolding practices in the teaching and learning of mathematics are teaching methods that are used in the teaching of mathematics to enable the learners to understand some mathematics concepts and apply what they learn in mathematics in real life situations (Sam, Interview, June 25, 2015).

The thinking is that this pedagogical strategy is critical in the teaching and learning of mathematics. For this to take place, it is necessary for an individual to connect to and learn "from the surrounding social and cultural environment" (Boblett, 2012, p. 4). This is in agreement with Walqui (2002, p. 3) who says that "the concept of mediation is generally regarded as the centre piece of Vygotsky's theory of learning". His argument is that, the "basis of all learning is social interaction" and that social interaction precedes the development of knowledge and ability" (2006, p. 4). This supports Vygotsky's view that learning first takes place at the social or inter-individual level before it is internalised by the individual (Puntambekar, 2009).

From what the participants said, it becomes notable that scaffolding practices are the means by which the MKO guides the learner within the learner's own zone to reach a greater understanding and mastery of the task. According to Peter, "This helps you to know where you should help them" (Interview, June 25, 2015).

Peter's submission points to the key role played by the teacher whom he refers to as 'you' and the learner as 'them'. This view certainly agrees with Vygotsky's (1978) submission that mediation plays a significant role in the learner's own knowledge construction within the ZPD. The point made is that the ZPD describes the area between a child's level of independent performance, that is, what he/she can do on their own and the child's level of aided performance (what they can achieve with assistance) (Vygotsky, 1978). It is important for teachers therefore to take into consideration the ZPD in their day-to-day teaching activities. The reason being that mediation is directly linked to ZPD in that, it is the support mechanism that helps learners successfully perform a task within that area (Hurst, 2013). In other words, it enhances the learners' understanding of the subject.

This process is achievable through mediation by a more knowledgeable other (Hurst, 2013). Berk and Winsler (2002) assert that for this reason, effective scaffolding helps to keep learners within their ZPD and this is achievable through assigning tasks that are slightly above those they can perform on their own. In brief, Lee (2012, p. 1) says that employing scaffolding practices within their ZPD helps learners "achieve heights they otherwise could not reach" on their own. To this end, it is important for MKO to know where, when and how to use scaffolding in their daily teaching activities.

The participants' submissions showed that they understood the concept of scaffolding to be a diverse teaching method that is developmental, fostering learning as well as being mediated in the ZPD.

4.5 How participants used scaffolding practices

This part of the study addressed the second research question which is: How do teachers use scaffolding in the teaching of primary school mathematics? Findings concerning this research question were outlined in one broad theme and two subthemes that emerged from the data collected.

Theme 2: Participants used scaffolding practices such as excavating, questioning, explaining, parallel modelling and collaboration. They sometimes used scaffolding practices haphazardly and unconsciously.

Participants used a limited number of scaffolding practices haphazardly and subconsciously due to their hazy understanding of scaffolding in the teaching of primary school mathematics. All these practices are discussed in detail in the subthemes below.

Subtheme 2a: Scaffolding was done through indirect practices such as excavating, questioning, explaining, parallel modelling and collaboration

In an attempt to address Research Question Two, the participants were asked to answer an open-ended question on how they used scaffolding practices they had previously chosen (See Appendix 4, question 3, p. 112). They were to explain how they used the scaffolding practices they had chosen from the previous question. Their choice converged on two scaffolding practices namely, excavating and questioning. When they were asked to explain how they used these practices, two scaffolding practices appeared to be the most commonly used as shown in Table 5.

Table 5: How Sam and Peter used scaffolding practices

Scaffolding strategy	How Sam uses them	How Peter uses them
Parallel modelling	By giving children some explanation	X
Extending	By giving them a lot of work to do	X
Guiding	By allowing other learners to help and correct them.	X
Questioning	Through asking guiding questions	By asking learners leading questions
Excavating	Teaching from known to unknown	By teaching from what they already know to what they do not know

'X' – means did not use the scaffolding practice

As mentioned earlier, Sam explained 5 of the 13 he had professed knowledge of while Peter only explained two. To authenticate their submissions, their plan books were consulted to find out how they planned in order to enhance the use of scaffolding practices. Table 6 summarises the practices they intended to use or the ones they had already used in their lessons.

Table 6: How participants used or intended to use scaffolding practices

Scaffolding practices in both plan books	Activities
Excavating	Linking known to unknown e.g. estimating masses of objects (Peter); Asking pupils shapes they already know (Sam)
Parallel modelling	Through demonstrations e.g. drawing of rectangles on chalkboard (Sam); interpretation of tables (Peter)
Collaboration	Pair work and group work e.g. identifying triangular objects in the classroom (Sam)
Guiding	Through asking guiding questions e.g. Through asking questions on properties of triangles; helping pupils to interpret tables (Peter)
Questioning	Asking questions e.g. questions on properties of triangles (Sam)
Conducive environment	Use of teaching and learning aids e.g. use of teaching aids such as geoboards,
Focusing and noticing	Explaining concepts e.g. asking pupils to focus on triangles and not rectangles (Sam)

As Table 6 indicates, these were the scaffolding practices used and their associated class activities. From the plan books, it is evident that the participants used seven scaffolding practices. However, when they were interviewed, both Peter and Sam were able to explain only a few of these scaffolding practices namely: excavating, reflection, guiding and parallel modelling. Both participants indicated in their plan books that in the teaching process they commenced by recapping of the previous lessons, reviewing of the previous lesson and/or asking questions concerning the previous lesson- excavating. This strategy was the most common since it appeared five and four times in Sam's and Peter's different introductory stages respectively (See Appendix 9).

Findings from interviews revealed that the participants practiced scaffolding through the use of indirect whole class practices such as excavating, questioning, parallel modelling in conjunction with explaining. Excavating as a scaffolding strategy involves establishing the learners' prior knowledge and capabilities in solving mathematical concepts, which is critical in the learning process. This is in line with the findings by Kiong and Yong (2001) that teachers assessed students' understanding before employing other scaffolding practices. To stress the significance of prior knowledge, Ausubel, Novak, and Hanesian (1978, p. iv) categorically state that, "if I had to reduce all educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly". This scaffolding strategy entails the teacher ascertaining what the learner already knows in order to connect it to the new body of knowledge. The participants' responses showed that they agreed with these assertions as shown by the response from Peter who said," … by asking some oral questions to find out what they already know and it is always good to find out what children already know" (Questionnaire, June, 2015).

During the face-to-face interview, Peter explained the concept of excavating by saying that "Sometimes to go back on what children have already learnt is helpful. I usually do this by a way of giving them some revision exercises on what they have covered" (Interview, June 25, 2015). In view of these assertions, excavating is one of the most important scaffolding practices because it progresses from simple to complex concepts. In other words, it bridges the gap between what the learner is about to learn and what he or she has mastered (Anghileri, 2006).

This strategy is directly linked to the ZPD since it seeks to establish familiar territories for the learners before venturing into the unknown (Vygotsky, 1978). It appears that this is one of the principal practices used by Sam because it featured five times in the lesson plans checked by the researcher (See Appendix 8). In response to interview questions, Peter stated that,

> Yes, one like I said earlier, excavating –I like most. In scaffolding in the teaching of mathematics I use mostly excavating like I said earlier –talking about what they already know. It is always good to revise with learners what they have learnt in the previous grade (Peter, Interview, June 25, 2015).

He further explained that ": … when you use excavating that is finding what learners already know you find out that maybe 15 are good and the other 10 are missing" (Interview, June 25, 2015). In agreement to Peter's submissions Sam also said, "Ahaa-a, okay for example excavating I usually pose questions to the learners to find out what they already know so that I can teach from known to unknown" (Interview, June 25, 2015).

These views resonate with Lipscomb et al. (2004) who postulate that scaffolding should lead learners from what they already know to a clear understanding of new material. The participants' repeated references to excavating indicate that these participants frequently used excavating in the teaching of primary school mathematics.

In addition to excavating, questioning emerged as one of the principal scaffolding practices used by these practitioners. This is because this method featured in most of the lesson plans checked by the researcher. These participants appeared to be informed of this scaffolding strategy as some scholars have observed that "questions play a role in the placement and use of direct instructions" (Brown, 2006, p. 59). In addition, Bain (2004) asserts that in any teaching and learning endeavour, an effective questioning technique is the mainstay of the learning process. This is because questioning is critical in helping "learners see problems with their current conceptions and build more ideas" (Lehman, Ertmer, Keck, & Steele, 2001, p. 6). Participants understood the use of questioning as a scaffolding strategy as it permeated all the data collection instruments namely: a questionnaire, documentary analysis, lesson observations and one-on-one interviews. Their responses to the interview questions showed that they were versed with questioning as a strategy in the teaching of primary school mathematics. The following excerpts from the Peter attest to this as he said,

> In general I think is eh, most teachers use the questioning and probing maybe where they ask questions to learners and can write their sum on chalk board and ask one or two to go and solve this. There is, eeh, one can just decide maybe work on multiplication and asking learners questions and they answer just to assess whether they are really mastering what you are teaching them (Peter, Interview, June 25, 2015)

Furthermore, Peter explained that "I do this by asking them questions and from the answers they give, I know how to help them" (Questionnaire, June, 2015). In the same vein Sam explained that,"... I use in the teaching of mathematics are excavating, explanation, demonstration and asking questions. I usually pose questions to the learners …" (Interview, June 25, 2015).

The participants' views of questioning in scaffolding are in harmony with the findings by Hmelo and Day (1999, p. 73) that questions "can also focus learners' attention, activate prior knowledge, make thinking explicit, encourage reflection and elaboration, and even act as model questions that learners should ask themselves in future studies". It is therefore, the prerogative of a teacher to carefully phrase his/her questions in order to scaffold effectively during the teaching and learning process (Hmelo & Day, 1999).

Hammond and Gibbons (2001, p. 52) stress the point that, by asking a probing question, "the teacher opens the door to elaboration – a kind of 'upping the ante' which demands the learners extend their thinking in order to make a response". Without using the questioning technique, teachers may not know what the learners have mastered and what they have not. For this reason, Hersh (1997) states that questions are the ones that drive mathematics. However, in the lesson observation it was noted that the translation of this knowledge into the classroom situation did not take place. Further, the questions the participants asked were of a lower order. The following excerpt from one of Peter's lessons illustrates this:

Peter:	Name the shapes you know
Learners:	(Answering individually) square, rectangles, diamonds, triangles, circles, cubes
Peter:	Quadrilaterals are all shapes with four sides and four angles. Okay! Now choose quadrilaterals from the list you gave me
Learners:	Square, rectangles (then another one said) triangle!
Peter:	No! Not a triangle because it does not have four sides and four angles Remember what I said, quadrilaterals have?
Learners:	Four sides (chorus)
Peter:	And?
Learners:	Four angles (chorus)
Peter:	Good (Peter, Lesson Observation, July 20, 2015)

Although the questions were important, they were of lower order since they only helped the pupils to recall facts as opposed to higher order questions that seek for clarification and justification (Khan & Inamullah, 2011). According Bloom's taxonomy, lower order questions check for recognition of facts. What obtained in the lessons was in harmony with the findings by Wilen (1991) that the majority of questions that teachers asked were low-level cognitive questions aiming at memorisation and recalling factual information rather than questions that enhance a deeper understanding of concepts. A similar study by (Khan & Inamullah, 2011), found out that although teachers spent a lot of time asking questions, their questions were mostly of lower order with few of higher order cognitive level. They found out that 67% of the questions were knowledge based while other types of questions constituted 33%. However, it is noteworthy that lower order questions are important because they set a foundation for higher order thinking (Khan & Inamullah, 2011). The best practice in scaffolding is to allow learners to express themselves in order to determine what they already know. The teacher should not only ask simple questions but varied questions that elicit divergent answers from the learners. Peter, for example, began by defining quadrilaterals and moved on to ask learners to identify quadrilaterals from a list of examples given by the learners. To make his lesson more effective, perhaps, he could have begun asking them what a quadrilateral is. Peter could also have made it livelier by asking learners for justification of their answers through asking probing questions which provide the teacher an opportunity to guide them through refining and expanding their responses. Probing is key to eliciting responses from the learners since it helps to get the deeper understanding of the learners' answers. Such an approach is child-centred because it facilitates knowledge construction by the learners without largely relying on the teacher.

In one of the lessons observed, Sam used parallel modelling in conjunction with other practices such as explaining and questioning. He demonstrated how to draw rectangles and triangles on the chalkboard. When the researcher asked him during the interviews to explain how parallel modelling is used in the teaching of mathematics, he said "Aaah! I don't know how they are used" (Interview, June 25, 2015). However, Peter explained how he used parallel modelling by saying that:

> I usually use different teaching aids such as rulers charts and so on mostly in some topics that involve money where there is buying and selling. There I use notes and coins. In geometry I use diagrams. I draw diagrams on the chalkboard (Peter, Interview, June 25, 2015).

When the researcher probed on how he used notes and coins in parallel modelling, Peter said, "Hmm, I use them to show the learners real objects so that they understand what they are learning about. This will help them grasp the concepts we are dealing with" (Interview, June 25, 2015).

This, in essence, reveals that both participants used parallel modelling as a scaffolding practice. In the teaching process, parallel modelling forms one of the key scaffolding practices in primary school mathematics that gives learners clear examples of what is expected of them for imitation (Walqui, 2002). According to Walqui (2002, p. 12), "learners should be able to see or hear, by walking learners through an interaction by first doing it together as a class activity" and later allow them to individually do the task. This entails "learning by observing the master weaver" as this involves the teacher firstly providing clues on how to proceed with the problem and later encouraging learners to imitate the teacher's problem solving skills (Greenfield, 1999, cited in Puntambekar, 2005, p. 27; Hurst, 2013). The teacher then gradually withdraws these hints as the learners become competent – a process known as fading (Hurst, 2013). From the observations made above, one can conclude that the participants used scaffolding practices but had difficulty explaining them or effectively exploit them in their day-to-day teaching process. This is because in some lessons they did not follow the requisite steps for example, in parallel modelling where they took long to withdraw their assistance. The general observation was that, in as much as participants applied some of the scaffolding practices, they were not conversant with how to effectively appropriate them.

However, participants were not aware of the technical words in the field of education. The implication of these findings is that teachers seemed to lack sufficient knowledge about scaffolding. This explains why they found it difficult to explain scaffolding practices even though they were using them. To this end, the participants used these and other scaffolding practices such as hard scaffolding and reflection unknowingly probably through trial and error methods. It is noteworthy that participants were failing to explain some of the scaffolding practices they were using in their lessons. This shows that participants were using some scaffolding practices such as parallel modelling, conducive environments and hard scaffolding unknowingly at times. Their responses were inconsistent as Sam explained parallel modelling on the questionnaire which he could not explain during the interview. On the other hand, Peter did not explain it on the questionnaire but explained it during the interview. What this probably means is that they, as seen in their lesson plans and observations, applied scaffolding practices, as stated earlier, without due knowledge of step-by-step techniques used in these pedagogical practices.

As explained before, participants had time to consult with the internet since there was a period of three weeks between the questionnaire and the interviews. Probably by the time interviews were held, they had forgotten about other scaffolding practices which they indicated in the questionnaire. This explains the inconsistencies in their responses to the questionnaire and one-on-one interviews. Such inconsistencies may be attributed to people who are not sure of what they are explaining about.

Other scaffolding practices that were evident in their lessons, but not explained during the interviews by both participants, were hard scaffolding, conducive environment, showing and telling. An analysis of the data generated showed that in spite of an array of practices used by the participants, they did not fully exploit all the opportunities available to practise scaffolding in their classrooms.

One of the key methods into the teaching of mathematics is collaborative work in which the teacher asks learners to work in pairs or in groups. This is why Rojas-Drummond and Mercer (2003) argue that scaffolding as pedagogical strategy has been broadened so as to include collaborative work. Bruner (1983) asserts that the process of learning is social and learners develop into the intellectual life of those who surround them. Data showed that Sam acknowledged the fact that a collective view in the form of collaboration was key to the teaching and learning of mathematics. However, he did not expound on how he employed collaboration as a teaching strategy. Sam was able to mention it as one of the crucial techniques. This is evident in his response when he said, "The scaffolding practices used …include: excavating, explanation by the teacher, demonstration, group work, individual written work, pair work, role play, discussion between the learners.…" (Interview, June 25, 2015).

The findings by Ding, Piccolo, and Kulm (2007) show that group or pair work not only enhance engagement but also fosters the exchange of ideas thereby eliciting a higher level of thinking. Anthony and Walshaw (2003) also found that students need time to work collaboratively as well as independently as these two help them to share ideas and think quietly respectively. The above views are supported by Dillenbourg and Jermann (2007, p. 1) who say, "collaborative learning is a situation in which two or more people learn or attempt to learn something together". The same observation was made by Vygotsky (1978) who postulates that the ZPD is the area between a child's current development level determined by independent problem solving and the level of development a child can achieve "through adult guidance or in collaboration with more capable peers". This is also true for Hammond and Gibbons (2001, p. 24) who affirm that, "knowledge is constructed in and through joint participation in activities where all participants are actively involved in negotiating meanings. To this end, learning takes place as people interact with their environment.

Hammond and Gibbons (2001) argue that learning is a social process rather than an individual one, and occurs in the interaction between individuals. Lui (2012, p. 3) says "learning can be envisioned as a journey – aided by the support of peers, participants, and family through the constantly evolving ZPD". This means that learning is not a solitary activity but depends on the input from the MKO through the use of effective scaffolding practices. Sam appeared to be aware of this when he says, "... in this method I usually give some learners more practice in pairs or groups in what I would have demonstrated to them so that they can consolidate their understanding of the concept" (Interview, June 25, 2015).

Despite knowledge of the significance of collaboration, observation of Sam's lesson revealed very little collaborative work between the learners (See Appendix 9). This is because, for example, he spent most of the time talking without giving learners enough time to collaborate. The participants' lessons followed a somewhat predictable pattern in the sense that in each lesson observed the teacher would introduce the lesson, present key concepts, ask a few questions before giving them some practical work to write in their exercise books in class or at home. They hardly gave learners collaborative work and by so doing limited the learners' creativity. The methods they preferred promoted individualism. Instead of using this method, they engaged in mass lectures bordering on explanation, questioning, showing and telling, drilling as well as repeated demonstrations. The following example highlights this:

Peter: Today's topic is about interpreting information tables. What is to interpret?

Learner: To try to understand something.

Peter: Yes, you have tried. To interpret is to make sense of a given thing, okay? For example the table we have here you should be able to study and find out how many balloons there, eeeeh, you see there are 264 in the first column 49 in the second and 150 in the third. To find the sum you put them together. You arrange them vertically before you add them. (Peter, Lesson observation, July 20, 2015)

Peter then proceeded to show the learners how to arrange the numbers vertically before adding them.

Peter: The answer to the first question is 463. Is that right?

Class: Yees! (See Appendix 9)

Unlike Sam who knew and attempted to employ the strategy of collaboration, Peter preferred other whole class indirect practices like demonstrations, explaining and questioning. As can be seen from the excerpt above, much of the talking was done by the teacher as he explained, illustrated, showed and told the learners what they were supposed to do. Kiong and Yong (2001, p. 4) warn against such approaches because they project learners as ‘empty vessels’ or ‘blank slates’. Kiong and Yong (2001) found out that teachers presented learners all the step-by-step instructions making themselves the sole source of information in the classroom. For this reason, participants should advocate an interactive classroom context by encouraging group work or whole class student –teacher discussion.

Vygotsky (1978, p. 4) in support of collaboration as a scaffolding strategy, postulates that “children who by themselves are able to perform a task at a particular cognitive level, in cooperation with others and with adults will be able to perform at a higher level”. The main argument is that collaborative is critical in the day to day teaching of primary school mathematics as it helps learners to “explain and justify the legitimacy of their solution” to their peers and classmates Kiong and Yong (2001, p. 4). In addition, it gives them responsibility over their learning (Kiong & Yong, 2001).

In spite of the indications in the plan books that the participants would give learners work to do in pairs or in groups, in some of the lessons observed this was not followed. In follow up interviews on why these practitioners hardly gave collaborative work, the general response was that it was both daunting and time consuming.

***Subtheme 2b:* Participants sometimes used scaffolding practices haphazardly and subconsciously.**

The participants’ responses indicated that they haphazardly and subconsciously scaffolded through a limited number of scaffolding practices such as excavating, questioning, parallel modelling and collaboration. They did not fully exploit all the opportunities available in the implementation of scaffolding in their classrooms. While the participants used other scaffolding practices like questioning and explaining, it was evident that they did not utilise the sitting arrangement of the learners which augured well for collaboration and other scaffolding practices. The researcher observed that learners sat alongside each other yet some of them solved the supposedly pair work individually and in cases where they tried to employ collaboration, this was done haphazardly with the teachers asking learners to work out tasks that they had earlier worked out during demonstrations. This scenario could possibly be attributed to, inadequate knowledge of the tenets of scaffolding in the teaching of primary mathematics.

4.6 Why participants used scaffolding the way they did

The third and last research question of this study sought to understand why teachers used scaffolding the way they did. Data to address this question were extracted from the questionnaire (section C, question 4), lesson observations as well as one-on-one interviews. A single theme and three subthemes emerged from the data collected as the researcher addressed this last but equally important question.

Theme 3: The participants' implementation of scaffolding was because of their personal conceptual understanding and contextual factors such as time, class sizes, availability of resources, school's expectations and individual attitude

The participants' use of scaffolding practices was mainly influenced by their own conceptual perception of the concept of scaffolding in education and contextual factors. These, had an effect in the way they used scaffolding as can be seen in the subsequent subthemes.

***Subtheme 3a:* Use of scaffolding was because of participants' personal conceptual understanding**

Anthony and Walshaw (2003) posit that the way teachers organise classroom instructions is very much influenced by what they know and believe about mathematics and what they understand about mathematics teaching and learning. This is true of the participants when one looks at their demographic data as well as their responses to questions.

The participants' demographic data in Table 2 shows that Peter and Sam hold a Secondary Teaching Diploma (STD) and a Diploma in Education respectively. Peter completed his training 8 years ago while Sam completed his training over 20 years ago.

This possibly explains why these participants (especially Sam) were not versed in the most recent scaffolding practices. It is also possible that Peter's secondary training did not suit the teaching of mathematics at primary school level. To this end, the Swaziland Ministry of Education and Training (2015) states that, "the deployment of irrelevantly qualified participants into the primary level, mainly participants qualified for secondary level" compromises the quality of education in Swaziland.

Both participants' responses from the questionnaire showed that there were reasons why they used scaffolding practices in their classes. The table shows reasons for which they used the scaffolding practices.

Table 7: Summary of reasons for using scaffolding practices

Reasons for using the scaffolding practice	Peter	Sam
Effective	x	✓
So children can understand the concepts	✓	✓
For children to become independent thinkers	✓	x
So that children to pass tests and examinations.	✓	x
To complete the syllabus	✓	✓
To get 100 per cent pass rate	✓	✓

Peter and Sam indicated that it was very important to scaffold since this strategy is effective and enhances the understanding of mathematical concepts. Casem (2013) found that scaffolding strategies improves mathematics performance. Their responses indicated that they used scaffolding in the way they did because of the understanding of the concept they had. Peter, for example, indicated that the use of effective scaffolding helps learners to pass tests and examinations which is not the main reason participants stated for why scaffolding is important. Both participants' responses showed that their main objectives for using scaffolding practices in mathematics lessons were to attain a hundred percent pass rate and to complete the syllabi. This kind of understanding could potentially have influenced the way the participants used scaffolding in their mathematics lessons.

As pointed out earlier, the participants' use of scaffolding as a pedagogical strategy was being affected by their understanding of the concept. It emerged during the in-depth interviews that participants were not abreast of the changing paradigms in the teaching and learning of primary school mathematics. Their responses during one-on-one interviews support this view. This is evident in Peter's explanation that "we also have topics like maybe symmetry in mathematics where reflection is very important where we bring equipment and everything to class so that the learner will understand better" (Interview, June 25, 2015). He further explained the complexity of using scaffolding practices by saying that "it gives me problems to notice when learners are getting correct answers yet they don't really get into it. That is the problem. And focusing, which I don't understand" (Interview, June 25, 2015). In concurrence, Sam said, "and this is usually followed by a report back. Then the other one is the individual written work. This one I give individual written exercise to assess whether they can apply what they learnt through writing individually" (Interview, June 25, 2015).

Although the participants were familiar with some of the scaffolding practices, they arguably do not have the full import of what they entail in the teaching and learning process. In of this, Bliss et al. (as cited in Denhere et al., 2012, p.34) assert that "despite the importance of scaffolding within the ZPD, research indicates that it is a concept which is difficult to master". This is true because the way Peter described reflection in the teaching of symmetry shows that he is not conversant with the concept as it did not constitute a scaffolding strategy. Possibly, this kind of conception heavily influenced the way he used scaffolding in his lessons.

The participants' understanding of scaffolding was not conventional. That is why Hu (2006, p. 44) postulates that, "although the metaphor helps us understand the basic elements of scaffolding, it also causes confusion". Scaffolding does not give educators clear and definite guidelines on the way it should be used to achieve successful learning (Verenikina, 2008). Peter, as mentioned before, gave contradictory views about scaffolding practices such as 'conducive environment' that confirm Hu (2006) assertions that scaffolding is not easy to understand. Peter's submissions showed that in spite of the awareness of some scaffolding practices, he did not have a sound understanding of other practices used in the teaching of primary school mathematics.

In their study of the teaching of mathematics, Bliss' et al. findings (1996, cited in Denhere et al., 2013, p. 374) "demonstrated that school participants experience difficulties in using scaffolding in their teaching". While they reported a relative absence of scaffolding in most of the lessons they observed, the current study found that though teachers could enumerate some scaffolding practices, it was not easy for them to explain, let alone, use them in the teaching process. This is in harmony with Verenikina's (2006) findings that scaffolding does not give educators clear and definite guidelines on the way it should be used to achieve successful learning. When Peter was asked on how he used conducive environment as a scaffolding practice, he indicated that he had no idea of what this strategy was all about. He clearly said, "I do not know conducive environment. I am still yet to master it but not yet" (Interview, June 25, 2015).

Peter's statement reveals that possibly he chose the scaffolding practices he was familiar with over the ones he did not know. Verenikina (2008) found that difficult scaffolding did not receive much attention from the student teachers because teachers lacked clear understanding of scaffolding practices.

According to Peter's lesson plans and lesson observations, this strategy was being employed unknowingly. From the above assertions, the researcher concluded that the participants used scaffolding in the manner in which they did because they had insufficient understanding of scaffolding as a teaching strategy in primary school mathematics.

***Subtheme 3b:* The implementation of scaffolding was because of various contextual factors**

The participants' use of scaffolding practices was influenced by contextual factors such as the classroom setup, time, class size, availability of resources, attitude towards learners and the desire to meet school expectations.

The environment in which the scaffolding practices take places is critical in providing learners "with active hands-on- learning and authentic tasks and audiences" (Hammond & Gibbons, 2001, p. 11). In support of this, Lee (2012, p. 7) posits that "how we prepare our classrooms helps promote student success by supporting their independent functioning through interacting with their surroundings, the material and solve their own problems as well as making their own choices". Sam showed an awareness of the significance of the environment in the teaching and learning process when he said, "The environment must be suitable for the level of understanding of the children and the concept I am dealing with" (Interview, June 25, 2015).

Sam's submission is in harmony with (Hammond & Gibbons, 2001) who found that people learn through the interpretation of the environment and the stimuli that surround them. This is so because greater learning happens in environments that are rich with stimuli (Hammond & Gibbons, 2001). In the same vein, Puntambekar (2009) postulates that the environment, if carefully attended to, has the advantage of providing motivation and support to the learners. Although the participants understood the centrality of a conducive environment in the scaffolding process, their awareness did not coincide with how they utilised the environment as a scaffolding strategy. Probably they were compelled to scaffold in that way due to the setup of their classrooms.

As stated earlier, the classrooms were small. Perhaps the participants avoided certain scaffolding practices such as conducive environments (encouragements) like clapping of hands and loud verbal complements because this could be interpreted as noise by adjoining classroom or they had forgotten the significance of using these reinforcements considering that Sam left college more than 20 years ago. The timber classroom walls may have allowed sounds from one classroom to be clearly heard by other classrooms (See Appendix 10). Probably because of this, participants had to resort to scaffolding practices that ensured silence. This is perhaps why they chose teacher-centeredness as opposed to learner-centeredness in their lessons.

Scaffolding also includes the use of classroom displays such as charts, class mobiles, etc. which are important because they offer visual motivation to the learners (Anghileri, 2006). Anghileri (2006, p. 8) says "walls puzzles, tools, are some of the obvious examples of environmental provisions" which teachers can use to decorate their classes with. In addition, findings by Ferguson and McDonough (2010) indicated that manipulatives and visual representations were as important to the junior classes just as they were to the upper classes. The researcher observed that while there were many charts for other subjects, in all the classrooms there were few charts and no mobiles on displays for mathematics.

When the researcher asked the participants about the charts and displays in their classroom environments, during one-on-one interviews, Sam, on one hand explained that, “I used to have them hung there but they keep on falling and I have stopped displaying them”, while Peter, on the other hand said, “Eeeh, some fell from the walls as you saw the kind of walls in the classrooms. The walls are slippery” (Interview, June 25, 2015).

When the researcher probed on the number of charts that fell from the wall, Peter said, “Not so many because it takes a lot of time to write them so I choose to draw diagrams on the chalkboard” (Interview, June 25, 2015).

The participants were not keen to display their charts probably because they were discouraged by the demands of chart making such as the handwritings and periodically changing them. Their failure to display charts can also be attributed to the fact that the school engaged in specialisation of subjects where teachers did not have ownership of the rooms but rather moved from one classroom to another thereby, presumably, affecting the way they dressed their classrooms. Probably, collective ownership made them to carry their charts along to different classes. Furthermore, making of charts meant painstakingly doing them in triplicate since all the classrooms needed the same charts for teaching as well as for displaying on the walls. For this reason, may be, carrying them from one room to the other was a better option rather than displaying them in one or two classrooms. Nonetheless, Sam might have been influenced by the long time he has spent in the teaching field to the point that he has missed out on the most recent pedagogical practices. However, it was noted that there were charts for other subjects which probably were made by the class teachers or by other subject teachers. Figure 10 is a representation of how the different classrooms in which the two cases teach are dressed.

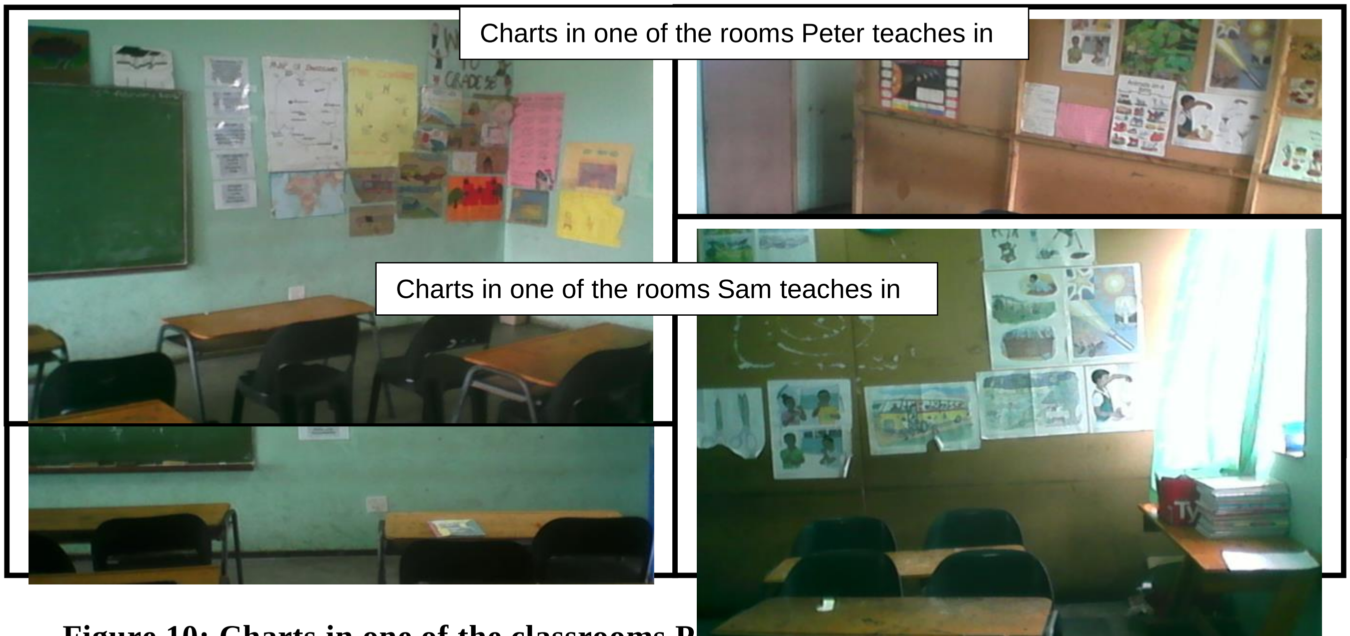

Figure 10: Charts in one of the classrooms Peter and Sam teach in respectively

Data showed that Sam and Peter did not use certain scaffolding practices like class discussion, as these took a lot of time for learners to collapse into groups. Probably they thought that learners would make a noise which would disturb not only the adjoining class but also of the whole school. Oftentimes, their lessons did not offer room for creativity as children were involved in highly controlled lessons with the participants offering almost all the steps to be followed as shown by previous examples of Peter’s lesson. Hunter's (2012) finding was that when scaffolding was used as a controlled tool it inhibited mathematical talk in the classroom.

The participants did not allow independent thought from the learners as such kind of learning was considered time wasting. They tended to use methods like drilling that ensured the completion of tasks in as little time as possible. Peter’s assertions attest to this when he says “most of the time I also go into group work although it demands a lot of time. It depends on how much time you have…” (Interview, June 25, 2015). In agreement with Peter, Sam said, “role-play – even if it can be effective, it wastes a lot of time as you try to organise the play” (Interview, June 25, 2015). Sam further explains that “discussion between learners- it can be time wasting … and even discovery method which is also time-wasting” (Interview, June 25, 2015).

Participants' responses showed that they used scaffolding in the way they did because they viewed it to be synonymous with time wasting, especially where learners were organised to collaborate or discover concepts individually, in pairs, in groups or as a whole class. The participants' responses were in harmony with Van Der Stuyf (2002, p. 12) who asserts that "scaffolding instruction is individualised so it can benefit each learner. However, this is also the biggest disadvantage for the teacher since developing the supports to meet the needs of each individual would be extremely time-consuming". Hogan and Pressley (1997) support this point when they postulate that teachers have to contend with the issue of time management when scaffolding. The participants were in agreement with the assertions that planning for and implementing scaffolds is time consuming and demanding as it entails attending to individual learners' challenges.

Verenikina (2008) found that though teachers stressed the importance of scaffolding, they still considered it to be a daunting concept and this, in a way, influenced the way they used scaffolding in their day-to-day activities. Peter's assertions from one-on-one interviews attest to this when he said, "we also have topics like maybe symmetry in mathematics where reflection is very important where we bring equipment and everything to class so that the learner will understand better" (Interview, June 25, 2015). Peter further showed his ambivalence when he said:

> I do not know conducive environment. I have tried it before. I am still yet to master it but not yet, but this is one of the things that is really troubling me but I am interested in learning it" (Peter, Interview, June 25, 2015).

> This what Sam said when he was asked about 'convince me' and parallel modelling, "Aaah! I don't know how they are used" (Interview, June 25, 2015).

The opinion that scaffolding is a daunting concept is not new to this study as Verenikina (2008) found that despite the significance of scaffolding, teachers faced difficulties in understanding the intricate techniques of scaffolding and oftentimes failed to connect theoretical explanation to practical use. To this end, Aschermann (2001) argues that while scaffolding is key to teaching, it can be both intricate and complicated since it is not just a linear process that teachers can easily follow, but are strategies or even advice offered by teachers in different teaching situations. Bliss (cited in Denhere et al. 2012, p. 34) also asserts that, "despite the importance of scaffolding within the ZPD, research indicates that it is a concept which is difficult to master". The complexity of scaffolding as a teaching strategy can be seen when Peter said, "I have tried the conducive environment … (and just as immediately, he said): I don't know conducive environment" (Interview, June 25, 2015).

Peter said he utilised conducive environment as a teaching strategy and just as suddenly spoke to the contrary of his submission. Such contradictory statements point to the fact that scaffolding as a pedagogical strategy was not so easy for the participants and that is why they viewed it as daunting as it is time wasting. The participant's ambivalence shows that he was not sure of some of the scaffolding practices. This is true, as previous studies have shown that teachers had difficulties in using scaffolding in their teaching (Bliss et al., 1996 cited in Denhere et al. 2013). However, De Villiers (1993) advises that despite being daunting and time-consuming, some scaffolding practices in education have benefits that justify the time spent on them. It follows therefore to say that the participants used scaffolding in the way they did because they considered scaffolding to be time wasting and daunting.

Findings also indicated that participants used scaffolding in the way they did because of large numbers of learners in their classes. This is in harmony with Tharp and Gallimore (1988) who found that scaffolding can only be effective when it is engaged in one-on-one since it targets the learner's ZPD. On the contrary, a study by Aschermann (2001) found that a teacher could effectively scaffold without necessarily having a one-on-one encounter. In view of this, Aschermann (2001, p. 33) asserts that "another contentious issue relating to scaffolding is the concept of a teacher being able to provide scaffolding for the many learners that they have in their classroom". In support of this, Hogan and Pressley (1997) posit that teachers who work in large class settings have to contend with large numbers of learners. This is in harmony with what the participants had to say concerning the size of their classes. Sam's response agrees with the above assertions when he said, "Eeeh, for example, on one-on-one, if you look at the size of our classes the children are many so you end up wasting a lot of time if you want to attend to them" (Interview, June 25, 2015). Peter concurred with the above submissions when he explained that, “What influences me is the size of my class …” (Interview, June 25, 2015).

It can be inferred from the submissions above that participants used scaffolding in the way they did because they faced the difficult task of attending to relatively large groups of learners who had different levels of ZPDs. Interaction between learners and a teacher ought to be one-on-one if it is to be effective (Anghileri, 2006). Nonetheless, this one-on-one encounter is often impossible considering the size of classes that teachers have to contend with. The participants’ views are in harmony with Tharp and Gallimore (1988) who postulate that oftentimes teachers have a difficult task of staffing a large class which makes it almost impossible to identify all the learners’ ZPD. This is why Hu (2006, p. 75) asserts that it is not easy for teachers to scaffold effectively in situations where they have to “work with many learners at the same time” as understanding of each of their ZPD would be daunting and time wasting. On the contrary, working with smaller groups enhances student-centred learning since it reduces incidents of non-productive class time resulting in minimal classroom management issues (Davies, 2003; Hunter, 2012).

A class of about 28 learners would sound small if in a ‘normal’ classroom. In this case, the participants’ classrooms were unique because they were small for those numbers. This could have influenced the participants’ choice of scaffolding practices since they needed more space within which to carry them out. This could have been the reason why they spent most of the time using whole class direct teaching practices such as showing and telling methods and algorithms on how to solve different mathematical problems.

The participants used scaffolding in the way they did because of unavailability of resources such as teaching aids. In most of the lessons that the researcher observed, participants were teaching without the help of a teaching aid. Peter’s remarks substantiate this as he said, “What also influences me is… the availability of teaching and learning aids (Interview, June 25, 2015). Sam also expressed the factors that influence the use of scaffolding practices by saying, “Hmm, there are some challenges for example, the unavailability of some necessary teaching resources to enable the use of these teaching practices for example, some technological gadgets like overhead projectors” (Interview, June 25, 2015). As there were not so many teaching and learning aids in their lessons, participants tended to compensate for this through a lot of explanation which could have been minimised if teaching aids were available.

It was also observed that participants' scaffolding was being influenced by the attitude that they held towards their learners as was shown by their submissions. To this effect, Sam said, "I don't use it because of the nature of the children we have here. They do not want to work on their own and they hate difficult sums" (Interview, June 25, 2015).

They tended to talk throughout the lessons maybe because they viewed their learners as being both lazy and mischievous as Peter sums it up by saying, "Another challenge is that we have learners like I mentioned before on guiding, we have these stubborn learners who will never allow you to guide them. You have to say it again and again (sic)" (Interview, June 25, 2015).

True to his views, Peter tended to dominate the lessons through his talk. As he has indicated above, he would explain a concept *'again and again'* however simple it appeared to be. Participants also indicated that they used scaffolding in the manner in which they did due to the expectations of the school. Arguably, most schools need to carve a niche for themselves and getting good exam results is one sure way of doing so.

The participants adopted teaching strategies which they believed brought them the desired results. According to Peter, "The needs of the school also influence me for example; the school would like to see learners passing so this will make me choose teaching strategies that help my learners do well in class" (Interview, June 25, 2015). In concurrence with Peter, Sam said, "I make researches and I also teach in line with the expectations of the school. As this is a private school, it expects good results for example 100% pass rate" (Interview, June 25, 2015).

The participants' assertions confirm that they could have been under pressure to teach in compliance with the expectations of the school. Sam pointed out that one of the school's expectations was that all classes should have a 100% pass rate and they were obliged to complete the syllabi at the end of each year. Probably, attaining a 100% pass rate was one sure way of guaranteeing their stay at the school considering that both were expatriates. They used scaffolding the way they did probably because they needed practices that ensured the completion of the syllabi as well as the attainment of a 100% pass rate.

In summary, participants used scaffolding in the way they did because of the way they viewed the concept of scaffolding in education. It also emerged that compelling contextual factors such as the classroom set up, time factor, class size, non-availability of resources, attitude towards the learners and the desire to meet the school's expectations were the main reasons why the participants used scaffolding the way they did in their primary school mathematics.

4.7 Conclusion

This chapter has presented a discussion of findings that emerged from participants' responses. Generation of data was achieved through a questionnaire, document analysis, lesson observations, and individual interviews.

Firstly, the participants' responses indicated that participants understood scaffolding to be a diverse teaching method that is developmental, fostering learning of concepts and mediated in the zone of proximal development. This theme was used to address Research Question One that aimed at exploring participants' understanding of scaffolding in the teaching of primary school mathematics. From this theme, three subthemes emerged which sought to answer this question.

Secondly, findings showed that participants used indirect scaffolding practices such as excavating, questioning, explaining and parallel modelling as well as collaboration. It also emerged that they sometimes used scaffolding practices unknowingly. This theme emerged in response to Research Question Two, which sought to find out how participants used scaffolding practices in the teaching of primary school mathematics. It was observed that the participants used more of other scaffolding practices than collaborative work for they considered the latter to be time consuming.

Thirdly, findings indicated that participants' implementation was because of their personal understanding of the concept of scaffolding. Additionally, the study found that they used scaffolding the way they did because of compelling contextual factors such as time factor, classroom set up, class size, availability of resources, participants' attitude, and school's expectations. These ideas emerged as the researcher sought answers to Research Question Three, which investigated why the participants used scaffolding in the way they did. Lastly, the participants alluded to the significance of the ZPD, which is the theoretical framework of this research. Their responses showed that there was a relationship between the ZPD and scaffolding that emphasises teaching from the known (ZAP) to the unknown, within the ZPD.

The following chapter provides a summary of the findings and recommendations in relation to the findings from the three research questions of this study.

CHAPTER 5

SUMMARY, RECOMMENDATIONS AND CONCLUSIONS

This chapter reviews the findings, recommendations and conclusions of this qualitative study carried out at a school in Swaziland. This study, whose focus was on the exploration of teachers' scaffolding practices in the teaching of primary Mathematics, had three research questions. The first one is: What is the teachers' understanding of scaffolding in the teaching and learning of primary Mathematics? The second is: How do the teachers use scaffolding practices in the teaching of primary Mathematics? The third and equally important one is: Why do the teachers implement scaffolding the way they do? The study generated three themes and subthemes that aimed at addressing the above stated research questions.

5.1 Summary of findings

In addressing the research questions, data were generated from a questionnaire, data analysis, lesson observations and in-depth interviews. The main findings were summarized according to the three research questions of the study.

***Research Questions One:* What do teachers understand by scaffolding in the teaching of primary school Mathematics?**

Research Question One of this study focused on what the participants' understanding of scaffolding in education was. The theme that emerged from the participants' responses indicated that they understood scaffolding to be a diverse teaching method that is developmental, fostering learning of concepts and mediated in the zone of proximal development. Findings from this study showed that participants were aware of scaffolding in education but their understanding of the strategy seemed hazy especially when they had to explain the practice.

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Research Question Two: **How do teachers use scaffolding practices in the teaching of primary school Mathematics?**

Research Question Two explored how participants used scaffolding practices in the teaching of primary mathematics. It was observed that participants used scaffolding practices such as excavating, questioning, explaining and parallel modelling as well as collaboration. It also emerged that they sometimes used scaffolding practices subconsciously and haphazardly that is, without fully exploiting the opportunities that presented themselves, for example, the sitting arrangement of the pupils. Excavating, questioning and explaining were the most popular practices. However, excavating was sometimes reduced to recapping of previous lessons, which in most cases was not related to the current lesson especially during the introduction of new topics. Findings also indicated that although the teachers used questioning as a scaffolding practice, they often used lower order questions that lacked a probing element.

Findings showed that participants did not use the tool of collaborative practices much as a scaffolding tool. Although participants alluded to the significance of collaboration in the teaching/learning process, it was evident that their knowledge of the practice was not being translated into the classroom. It emerged that participants were comfortable with a few scaffolding practices only. Consequently, their choice of class activities gravitated towards these familiar scaffolding practices which resulted in limiting the learners' creativity.

Research findings showed that participants used excavating, questioning, explaining and parallel modelling in ways that were somehow consonant with Vygotsky's (1978) ZPD. However, it was noted that they hardly ever withdrew the support of scaffolding and this could contribute towards making their pupils overly dependent upon them.

***Research Question Three:* Why do the teachers implement scaffolding the way they do?**

Research Question Three's focus was on the exploration of why participants used scaffolding in the way they did in the teaching of primary school mathematics. The research findings indicate that the participants' implementation of scaffolding was because of their personal conceptual understanding and contextual factors such as time, class sizes, availability of resources, school's expectations and individual attitude.

The findings showed that participants used scaffolding in the way they did due to contextual factors. Owing to this, their lessons tended to be conducted hurriedly without giving learners enough time to collaborate. The participants thought that the concept of scaffolding was as daunting as it was time wasting and their classes were too big. These factors probably affected the way they implemented scaffolding practices. The way the participants used scaffolding was also being influenced by the expectations of the school. The participants indicated that they were under pressure to meet the expectations of the school such as attaining a 100% pass rate and the completion of the syllabi at the end of the year. This made them use methods that ensured quick acquisition of facts, sometimes with very little learners' understanding.

Research findings also revealed that participants' flexibility and prowess were being restricted due to the classroom setup. Participants were forced to teach in the manner they did because the setup was not conducive to the use of other more active practices. Probably, participants did not employ other scaffolding practices like group discussions since they were considered that these would disturb the class in the adjoining classroom. Perhaps this made participants choose scaffolding practices that were less active and potentially noisy in order to ensure silence in their classrooms.

Figure 11 is a diagrammatic summary of the findings of the study showing the participants' responses, the themes and subthemes that emerged from the research.

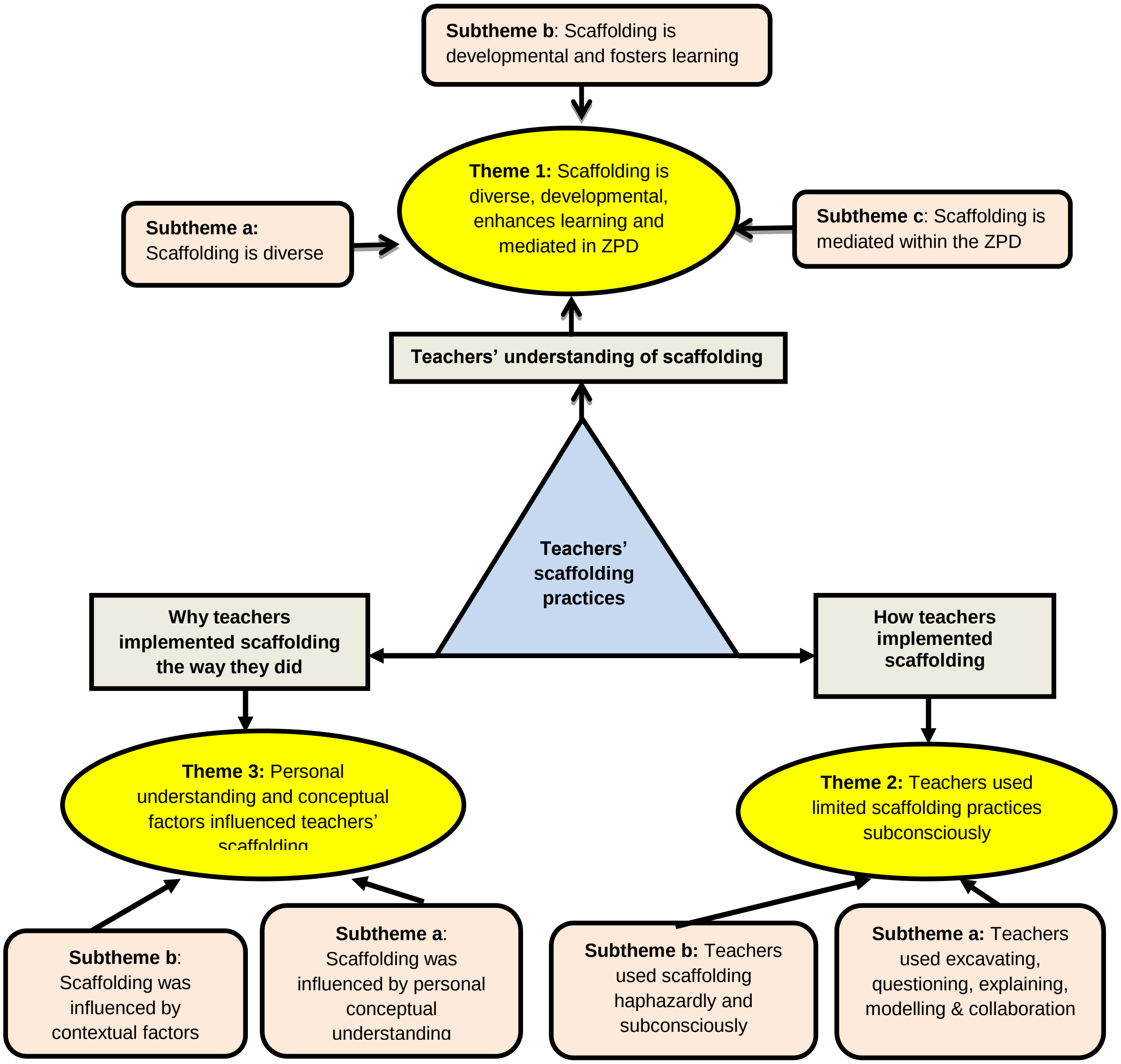

Figure 11: Summary of the participants' responses to research questions

5.2 Reflection and extension of the theoretical framework

The study sought to explore participants' understanding of scaffolding in the teaching of primary school mathematics. Apart from being a case study embedded in qualitative methodology, it is also a reflective practice that extends Vygotsky's (1978) zone of proximal development which is the theoretical framework of the study. Figure 12 incorporates in the theory zone of proximal development what has been learned throughout this study.

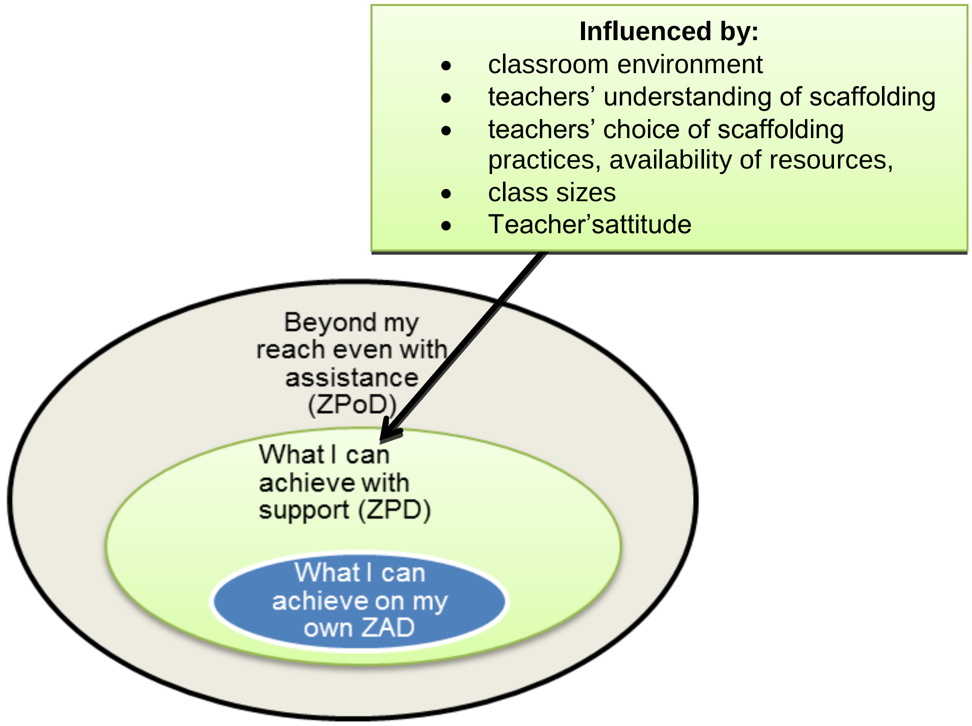

Figure 12: A summary of how the study reflectively extends the ZPD
Adapted from (Wheeler, 2013)

Reflective practice is grounded in the premise that learning entails reflection. The researcher periodically stepped "back to ponder the meaning of what" was obtaining at the school (Raelin, 2002, p. 66). The writer was challenged to stay alert, effective and professionally alive through considering how he could contribute to the institution (York-Bar, Summers, Ghere, & Montie, 2006). To this end, the current study reflectively extends the theoretical framework in that it found that scaffolding is mainly influenced by the environment in which it occurs. It therefore, follows that a conducive environment augurs well for scaffolding to take place in the teaching of primary school mathematics. The study contributes to the theoretical framework through its findings that not only teachers' understanding of scaffolding but also the choice of scaffolding practices are essential if effective learning is to take place. Without adequate knowledge, scaffolding in the ZPD though central to the pedagogy, could be difficult and time consuming. The findings also showed that implementation of scaffolding as a pedagogical strategy in primary school mathematics is influenced by the availability of resources, class sizes and the teachers' attitude towards their learners.

Findings from the study showed that support is needed in order to empower teachers on the use of scaffolding in the teaching of primary school mathematics. The teacher's concerns that emerged from the findings can be addressed through the recommendations made in this research in order to highlight the centrality of scaffolding in the teaching process to stakeholders.

Scaffolding forms the backbone of most, if not all, pedagogical processes, for it entails all the activities that occur in a class to support the learning process. Hu (2006, p. 44), posits that scaffolding is the "support that helps learners finish a complex task or achieve a goal that they could not accomplish on their own". The definition underscores the significance of scaffolding in the teaching and learning process. The recommendations below may help different people devise ways in which the use of scaffolding in the teaching of primary school mathematics can be enhanced.

5.3 Recommendations for teacher education institutions and university lecturers

Universities and all other teacher education institutions should design a curriculum that emphasises the teaching of scaffolding as a concept in education to all primary mathematics student teachers. Scaffolding forms the bedrock of teaching, so teachers should have a deep understanding of this concept in the teaching of primary school mathematics. It is also imperative for teacher education institutions to draft syllabi that place more emphasis on scaffolding practices in the teaching of mathematics. Since scaffolding is the cornerstone of teaching, it should be explained in detail so that student teachers understand the full import of the practices before leaving colleges or universities.

University lecturers should provide mentoring and demonstrations to ensure student teachers understand what this concept entails. Lecturers should ensure student teachers are involved in peer teaching in which scaffolding practices are practiced before teachers even go out to meet learners. Lecturers can also increase the number of assignments on scaffolding as a concept in education so that learners can demonstrate their understanding of the pedagogy. They can also document modules that specifically deal with scaffolding practices in the teaching of primary school mathematics. Emphasis should be placed on explaining each strategy and giving instances where it is applicable. Videos, audios and slides can be made available to student teachers so that they are better equipped to tackle the demands of teaching in this way upon leaving colleges or universities. More focus should be placed on the centrality of the ZPD since it influences the scaffolding practices teachers use in the teaching of primary school mathematics.

5.4 Recommendations for school heads and teachers

The heads of schools should ensure classrooms are spacious enough to allow the use of effective scaffolding practices by teachers. They should also ensure that their teachers have some in-service training or staff development programs so that they keep abreast of the current scaffolding practices. The heads should make an effort to recruit suitably qualified teachers because sending secondary school teachers to primary schools and/or vice-versa may not be ideal considering the different pedagogical demands of the two departments.

Teachers should continue studying so that they keep abreast of the changes in the use of scaffolding practices in the teaching and learning process. They should also interrogate their roles in the classroom and try to avoid the temptation of considering themselves as the sole source of information (Kiong & Yong, 2001). They should consider themselves as facilitators of learning rather than the sole purveyors of mathematical knowledge. Of importance is the need for teachers to create sustainable classroom environments by designing scaffolding practices that require different levels of concentration (Kiong & Yong, 2001). Teachers are also encouraged to acquaint themselves with a wide range of scaffolding practices since this will offer them options and confidence in the teaching of primary school mathematics. This can be achieved through consulting with, for example, other teachers, lecturers, the internet and attending workshops. It is also important that teachers learn to improvise where no concrete teaching/learning aids are available.

5.5 Recommendations for further studies

The findings reveal that the participants' understanding of scaffolding was not consistent with what the literature says. Therefore, similar studies on scaffolding can be conducted using larger samples, teachers from government schools or mission schools and compare results involving teachers from different settings in Swaziland in order to provide insights to various educational institutions responsible for the training of teachers. Consequently, this might enhance the use of scaffolding practices in the teaching of mathematics in Swazi primary schools.

5.6 Limitations

Marshall and Rossman (2011, p. 76) state that "all proposed research projects have limitations, none is perfectly designed". True to their observation, this study is not exceptional as it was confined to only one urban primary school in Swaziland. The study does not claim any generalisability to primary mathematics teachers at all schools in Swaziland or elsewhere. Findings may apply to teachers in a similar context only.

The participants for this study were chosen from the same school where the researcher works for logistical reasons. Having colleagues as participants has a potential to compromise the findings of the study. Both the researcher and the participants become exposed to group conformity and immersion in the norms of the institution to the extent that the former may miss the subtleties of the latter's behaviour. In other words, the researcher may be indifferent to certain behaviours of the participants because he is part of the system. The number of participants also posed a limitation to the study as the findings of the research cannot be generalised to a broader community based on this study alone. Future studies might consider carrying out studies in different locations other than the ones similar to the researcher's place of work.

5.7 Conclusion

In this chapter, a summary of the findings and recommendations pertaining to the use of scaffolding in the teaching of primary school mathematics has been presented. It has also highlighted what different stakeholders can do to ensure student teachers and qualified teachers are well equipped to face the demands of primary school mathematics classes. The study has also highlighted the limitations of this study while at the same time suggested areas that need further studies regarding scaffolding of primary school mathematics.

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APPENDICES

1. Ethical Clearance from the University of KwaZulu-Natal
2. Letter of permission from the MoE Swaziland
3. Letter to participants (informed consent)
4. Questionnaire Schedule
5. Document analysis guide
6. Lesson observation schedule
7. Interview transcripts
8. Lesson plan samples
9. Field notes
10. Professional editing approval letter
11. Turnitin Report

APPENDIX 1: ETHICAL CLEARANCE FROM THE UNIVERSITY OF KWAZULU- NATAL

UNIVERSITY OF KWAZULU-NATAL ™
INYUVESI YAKWAZULU-NATALI

3 June 2015

Mr Topu Manyuchi 214584608
School of Education
Edgewood Campus

Dear Mr Manyuchi

Protocol reference number: HSS/0521/015M
Project title: Exploribng teachers' scaffolding practices in teaching primary mathemmatics at a school in Swaziland

Full Approval – Expedited Application

In response to your application received on 27 May 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL.**

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)
Humanities & Social Sciences Research Ethics Committee

/pm

Cc Supervisor: Tamirirofa Chirikure
Cc Academic Leader Research: Professor P Morojele
Cc School Administrator: Ms Bongi Bhengu/Ms t Khumalo

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

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APPENDIX 2: LETTER OF PERMISSION FROM THE MOE SWAZILAND

The Government of the Kingdom of Swaziland

Ministry of Education & Training

Tel: (+268) 2 4042491/5
Fax: (+268) 2 404 3880

P. O. Box 39
Mbabane, SWAZILAND

27th March, 2015

Attention:
Head Teacher:
Ka-Zakhali Primary Private School

THROUGH
Manzini Regional Education Officer

Dear Colleague,

RE: REQUEST FOR PERMISSION TO COLLECT DATA FOR UNIVERSITY OF KWAZULU-NATAL STUDENT – MANYUCHI TOPU

1. Reference is made to the above mentioned subjects.
2. The Ministry of Education and Training has received a request from Mr. Manyuchi Topu, a student at the University of KwaZulu-Natal, that in order for him to fulfill his academic requirements at the University of KwaZulu-Natal, he has to collect data (conduct research) and his study or research topic is: *Exploring Teachers' Scaffolding Practices in Teaching Primary Mathematics at a School in Swaziland.* The population for his study comprises of two (2) teachers teaching mathematics at the above mentioned school. All details concerning the study are stated in the participants' consent form which will have to be signed by all participants before Mr. Topu begins his data collection. Please note that parents will have to consent for all the participants below the age of 18 years participating in this study.
3. The Ministry of Education and Training requests your office to assist Mr. Topu by allowing him to use above mentioned school in the Manzini region as his research site as well as facilitate him by giving him all the support he needs in his data collection process. Data collection period is one month.

DR. SIBONGILE M. MTSHALI-DLAMINI
DIRECTOR OF EDUCATION AND TRAINING

MINISTRY OF EDUCATION
TRAINING
2015 -03- 27
BOX 39
MBABANE
SWAZILAND

cc: Regional Education Officer – Manzini
Chief Inspector – Primary
1 Head Teacher of the above mentioned school
Mr. Tamirirofa Chirikure

Page 1

APPENDIX 3: LETTER TO PARTICIPANTS (INFORMED CONSENT)

Plot Number 323
Weeden Street
Ngwane Park
Manzini
Swaziland

04-05-2015

Dear Participant

RE: INFORMED CONSENT LETTER

I am a Master's student from the Science and mathematics Education Department, University of KwaZulu-Natal South Africa. I am conducting a research titled '**Exploring teachers' scaffolding practices in teaching primary** mathematics **at a school in Swaziland'.**

Scaffolding is a key element of any teaching and learning endeavor. The aim of my study is to explore teachers' scaffolding practices in the teaching and learning of primary mathematics.

I am kindly requesting your participation in the study. I will be collecting data using a questionnaire, observations, a semi-structured interview and document analysis. The interview will be voice-recorded. This interview will take about 30 minutes to complete. I would appreciate being able to interview you at a time that is mutually convenient. If you agree to this, I will also be asking you to sign a consent form regarding this event.

You have the right to decline taking part in this research project. If you have agreed to participate in the study, you can withdraw at any point during the process. You can also refuse to answer any particular question at any point in time. An opportunity to check the transcripts and make corrections will be given at the end of the exercise. Your identity will be kept anonymous. Neither you nor the institution will be identified in the thesis.

Please note that:

- Your participation is voluntary
- Your confidentiality is guaranteed as your input will not be attributed to your person
- Information you volunteer will not be used against you and the data collected will be used for the purposes of this research only
- All the data collected will be stored in a secure place and destroyed after five (5) years.
- You have the choice to participate, not to participate or to stop participating in the research any anytime without the risk of incurring any penalty.
- Your involvement is purely for academic purposes only. There are no financial benefits involved.
- At the end of the data collection process copies of transcripts of the interviews, audio recordings will be made available to you for cross-checking.
- If you are willing to have your lessons observed, your books to be analysed and to be interviewed, (please indicate by ticking as applicable) whether or not you are willing to allow recording by the following equipment:

	Willing	Unwilling
Audio equipment		

Thank you

Yours faithfully

Manyuchi T. (Mr)

Email: vengesaitopu@yahoo.com Cell: +268 765 398 04

If you need further information, please contact my supervisor Tamirirofa Chirikure who is a lecturer at the Science and mathematics Cluster, School of Education, College of Humanities, Edgewood Campus, University of KwaZulu-Natal.

His contact details are:

Cu 135 (Ground Floor), Main Tutorial Building, Science and Technology Education Cluster
Edgewood Campus, University of KwaZulu-Natal
Private Bag X03, Ashwood 3605
Email: chirikure@ukzn.ac.za; Telephone: +27 31 260 3470

You can also contact Research office at:

Research Office: HSSREC – Ethics
University of KwaZulu-Natal
Govan Mbeki Building
Private Bag X54001
Durban 4000
South Africa
Tel: +27 31 260 4557
Fax: +27 31 260 1609

Thank you so much. Your participation will be greatly appreciated.

DECLARATION BY PARTCIPANT

I ____ (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project and I consent to participating in the research project.

I understand that:

- I will participate voluntarily and am at liberty to withdraw from the project at any time should I so desire with no negative consequences.
- I voluntarily give permission for the study's activities to be digitally recorded.
- I give permission for my Chemistry practical work books and scripts to be used as a source of data.
- My identity will not be disclosed and that a pseudonym will be used to protect my identity.

Signature of participant ____________________ Date ____________________

APPENDIX 4: QUESTIONNAIRE

This questionnaire is designed to gather data for a thesis in fulfilment of the requirements of a Masters in mathematics Education degree course by a postgraduate student at University of KwaZulu-Natal in South Africa. Completion of this questionnaire is voluntary and the information you are going to provide remains anonymous throughout the study.

Please complete this questionnaire, seal it in the envelope provided and leave it with the receptionist.

Section A	*Demographic Information*

Please complete the table below

Gender (male or female)	....
Years of Teaching Experience	....
Highest academic qualification e.g. e.g. ‘A’ level, ‘O’ level Grade 12, BA, Bsc, Msc, etc	....
Highest Professional qualification e.g. CE, Dip. In education, BEd, MEd, BSc Education, etc	....

Section B

For number 1, please circle the letter that reflects your opinion.

1. Many educators use scaffolding (**teaching practices**) in their classrooms. Which of the following best describes your understanding of scaffolding? (Encircle the letter corresponding to your choice)
   a) Scaffolding is assistance in the form of rules and methods so that learners have knowledge of mathematics to pass examinations.
   b) Scaffolding is all the assistance used to help learners understand and ultimately become independent learners.
   c) Scaffolding entails showing and telling learners all the necessary rules and methods so as to do well in mathematics.

2. Which of the following scaffolding practices are you aware/ unaware of in the teaching of primary mathematics?

Please tick your level of awareness of scaffolding practices below.

Type of scaffolding practice	Aware and use it	Aware but do not use it	Unaware of it
Questioning & Probing			
Excavating (*Finding what children already know*)			
Parallel Modelling *demonstrations*)			
Collaborating (*teacher as part of the learning process*)			
Guiding/Focusing (*directing learners*)			
Convince Me (*justification of answers)*			
Orienting (*setting the scene, reminding, alerting, etc.*)			
Reflecting/ Reviewing			
Noticing			
Extending			
Reciprocal (*learners helping each other*)			
Conducive Environments			
Apprenticing- (*peer assistance*)			

3. Briefly describe how you use scaffolding practices you have indicated in the table in Question 2 above.

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4. Why do you use the scaffolding practices you have chosen in **3** above?
Under what circumstances do you use each of the scaffolding practices?

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Section C

Please indicate your level of agreement or disagreement on each of these statements regarding scaffolding practices (teaching practices). Place an "**X**" mark against each statement below.

QUESTION	Agree	Strongly Agree	Neutral	Disagree	Strongly Disagree
1. Scaffolding is important in the teaching of primary mathematics.					
2. Scaffolding in mathematics involves telling and showing learners formulae and rules so that they quickly get solutions to given problems.					
3. Scaffolding is done in order to help learners to be independent learners.					
4. Scaffolding is about helping learners to interpret and organise information gained from learning experiences.					
5. Allowing learners to try problems on their own is a way of scaffolding in mathematics.					
6. Teachers are the only ones who can scaffold learners.					
7. During scaffolding, a teacher's role involves the transmission of information to the learners.					
8. Scaffolding is mainly done to help learners remember rules so that they can pass exams.					
9. The school policy influences the way you scaffold in mathematics.					

Thank you so much for completing this questionnaire!

APPENDIX 5: DOCUMENT ANALYSIS CHECKLIST

Date: …………………………………..Time: ………………………………..

Scaffolding Practices	Done	Not Done	How the teacher intends to use it
Excavating			
Parallel Modelling			
Collaborating			
Guiding & Prompting			
Convince Me/ Justification			
Orienting			
Reflecting/ Reviewing			
Apprenticing & Cooperative learning			
Questioning & Probing			
Noticing Focusing			
Extending			
Soft scaffolding			
Hard scaffolding			
Reciprocal			
Conducive Environments (sitting arrangements, displays, grouping arrangements, encouragements, teaching and learning aids).			
Explaining			
Others			

APPENDIX 6: LESSON OBSERVATION SCHEDULE

Date:…………………………………..Time:………………………………..

Scaffolding Practices	Done	Not Done	How it is used
Excavating			
Parallel Modelling			
Collaborating			
Guiding & Focusing			
Explaining, Convince Me/ Justification			
Orienting			
Reflecting/ Reviewing			
Apprenticing			
Questioning & Probing			
Noticing			
Extending			
Soft scaffolding			
Hard scaffolding			
Reciprocal			
Conducive Environments			
Others			

APPENDIX 7: INTERVIEW TRANSCRIPTS

FACE-TO-FACE INTERVIEW WITH PETER

Topu: Good morning sir

Peter: Good morning. How are you?

Topu: I am fine

Topu: I would like to thank you for accepting to be interviewed for my research on scaffolding practices (teaching practices) in primary mathematics. This interview is intended to gain an understanding of your views on scaffolding and how you practice it with your mathematics classes. Your views will be valuable to me.

I had the opportunity to observe your mathematics lessons. This interview is a follow up to the questionnaire you completed and the lesson observations I did. The interview should take about 20 minutes. I will record your responses. You shall remain anonymous. Furthermore, what you say here shall be confidential.

Once more, your participation is greatly appreciated.

Participant: Thank you!

Topu: In the questionnaire you completed you indicated a number of scaffolding practices. What is scaffolding that is, teaching practices in the teaching of primary mathematics?

Peter: E-eh what I understand by scaffolding practices in teaching mathematics in primary level scaffolding is help in form of roles and methods so that learners have knowledge of mathematics to pass examinations. So, this scaffolding is all the activities used to help learners understand in such a way that they can at least have their own free time where they can practice without the teachers being there to supervise them. They can make their own study groups where they will be helping each other without maybe the need of the teacher being there to help them.

Topu: Which scaffolding practices are used in the teaching of primary mathematics in general?

Peter: In general I think is eh, most teachers mostly use the questioning and probing maybe where they ask questions to learners and can write their sum on chalk board and ask one or two to go and solve this. There is eeh one can just decide maybe work on multiplication and asking learners' questions and they answer just to assess them to see whether they are really mastering what you are teaching them. Mostly like I said earlier that I prefer excavating that is, finding out what learners already know because when you know – I find it easy to help a child when I know where he or she stands, what he or she already knows. So, I find it very easy for example maybe Grade 7 class (not really class mentioned) where I have been given a class for the first time to teach maths now, so these learners you find that they start from grade 1 up to Grade 5 for to just eeh come with anew topic and introduce it to them without knowing the performances of maybe their weaknesses there and then. That's where I use excavating.

Topu: Which scaffolding practices do you use in the teaching of mathematics?

Peter: Yes, one like I said earlier, excavating –I like most. Sometimes to go back on what children have already learnt is helpful. I usually do this by a way of giving them some revision exercises on what they have covered. I also like reflecting because in the teaching of mathematics, the learners see what you are really talking about. They understand better and reviewing also can be in the form of revision or something they have done maybe in the previous grades you bring out the topic, let us do this again just to build up their abilities maybe they might have forgotten about what they did in the previous grades. You will try to warm them up so as to get ready for the new concept where they are now.

Topu: Can you please explain how you use these scaffolding practices? I mean the ones you have mentioned.

Peter: In scaffolding in the teaching of mathematics I use mostly reflecting and excavating like I said earlier –talking about what you already know. It is always good to revise with learners what they have learnt in the previous grade. This helps you to know where you should help them. In teaching of mathematics, reflection is very important. It helps learners to understand very well. You reflect what you are saying, for example, if I talk about cost price, selling price and profit for example, if they have that topic in grade 5, sometimes it's good for learners to see where we can set a small tuck shop in class, where we can ask learners to go buy and come and do this and all that calculate profit and loss. We also have topics like maybe symmetry in mathematics where reflection is very important where we bring equipment and everything to class so that the learner will understand better.

Topu: Can we say the scaffolding practices you have mentioned namely, excavating and reflection are the only ones you use?

Peter: No there are not the only ones I know. Most of the time I also go into group work although it demands a lot of time. It depends on how much time you have with learners to the extent that in some schools we do not get more than fifty minutes. Maybe we get an hour with the learners and if you have a large number, it will be a problem. I also use orienting where I try to draw their attention to what you are saying. You can use some like I mentioned in reflecting you attract the attention of, you try to orient them. If you are talking about multiplication, is the opposite of division and vice-versa. Also guiding. I also use guiding some of the time. When I talk about guiding, it simply means that assisting learners with their work and try to make some follow up, try to check to assess through giving them homework maybe class work. I should be there to try to guide the children: you have to write here and you have to use this column the answer you have to help and guide them and not to leave them on their own but just to be there with them.

Topu: Why do you prefer these scaffolding practices?

Peter: I may say I prefer these scaffolding practices they help a lot. In profession as a teacher, I have been using them since I got this profession. I have been using these practices and I have seen the results –learners are doing well in maths. This helped me to keep on using these teaching practices. So if I stick to them and still using them today it's because since I started these practices have been giving me positive results.

Topu: Have you tried other practices apart from the ones you have mentioned?

Peter: I have tried the conducive environment though I do not have much knowledge about it and takes a lot of time. I do not know conducive environment. I have tried it before. I am still yet to master it but not yet, but this is one of the things that really confuse me. I am interested in learning

Topu: How have you used it?

Peter: I am still yet to master it but not yet, but this one of the things that is really troubling me but I am interested in learning

Topu: What influences your choice of scaffolding practices?

Peter: Like I said earlier, when we went to teaching college and finished, we had so many practices of teaching maths so I tried more than 10 practices so I could see that some of them were not working out. And I had to try this scaffolding or teaching practices. And I have seen that they are giving me positive results. What influences me is the size of my class and the availability of teaching and learning aids. When I first used these practices it is about 8 years ago when I was given a class to handle in maths. A friend tried to teach me these methods. He took his time to try and teach me this method. Ever since I said let me use these scaffolding practices.

Topu: Can you tell me those ten scaffolding practices you were using in and after college?

Peter: I was using reflecting, demonstration, questioning, role play, discussion, group work as well as hmm, I have forgotten others.

Topu: What else influences your choice?

Peter: The needs of the school also influence me for example; the school would like to see learners passing so this will make me choose teaching strategies that help my learners do well in class.

Topu: Are there any scaffolding practices that did not work for you?

Peter: Those practices that have not worked well with me, one is the noticing one. You have to notice the child and not the problem or notice everything. The noticing one is a bit hard for me because most of the time when I am explaining in class I tend to give one example and then learners, as you check the work, you find that they are getting it correctly, but it is hard for you to notice that this one got it correct. However, it does not mean that he or she really understood. I am still to understand what it means. Maybe he understood the minute you explained it but after two to three minutes, he really has problems there. It gives me problems to notice when learners are getting correct answers yet they do not really get into it. That is the problem. And focusing, which I don't understand. I am still to understand what it means.

Topu: Can there be other scaffolding practices you know but you don't use?

Peter: Yes there are some I know but I don't use them not because I don't really want to use them just because I feel as if I am still studying them. I do use them sometime but I don't use.

Topu: Which are these scaffolding practices?

Peter: Like discussions, we also have role-play. These I use them but not always.

Topu: What could be the reasons you don't use them?

Peter: The reason being that like I said, I find them a little bit taking too much of time. When I am using them I need to give too much time. They take too much of my time. You find that you have a short period of time. The periods are very short and they are not long. So you find that you have to extent the period to 2 hours or so that is why most of the time I don't use them. But I am trying to see where I can try to make time that has been given to me maybe in a short period of time.

Topu: Can you explain what you understand by parallel modelling that is, demonstration?

Peter: Parallel modelling in the teaching of mathematics is very important. I usually use different teaching aids such as rulers charts and so on mostly in some topics that involve money where there is buying and selling. There I use learners, notes and coins. In geometry, I use diagrams. I draw diagrams on the chalkboard. After this, I will then ask the learners to do group work on the sums. This helps their understanding.

Topu: Can throw some light on how you use notes and coins during parallel modelling

Peter: Hmm, I use them to show the learners real objects so that they understand what they are learning about. This will help them grasp the concepts we are dealing with.

Topu: How do you use apprenticing and reciprocal as teaching practices?

Peter: These ones, to be honest, I think I read them from the internet or from the papers you gave me to complete but I do not know how they are used but I am willing to learn.

Topu: I noticed during lesson observations that you did not have classroom displays and charts. What could be the reasons for this?

Peter: Eeeh some fell from the walls as you saw the kind of walls in the classrooms. Topu: Do you have an idea of how many fell?

Peter: Not so many because it takes a lot of time to write them so I choose to draw diagrams on the chalkboard.

Topu: In the teaching of mathematics and the use of scaffolding in particular which challenges do you face?

Peter: I usually face challenges – it depends on the learners I have in front of me because not all learners really assimilate all these practices. You find out that some go well with them and some do not go well with them. So now in a class of may be 25 learners if you have say 10 who are very good or understand better when you use excavating that is finding what learners already know you find out that maybe 15 are good and the other ten are missing. The lesson becomes more boring because they will be revising what they have already mastered. *Another challenge is that we have learners like I mentioned before on guiding, we have these stubborn learners who will never allow you to guide them. You have to say it again* *and again*. But at the end of the day we try to put everything together so that everyone is satisfied.

Topu Can you please explain how you address them?

Peter: I have tried to attend workshops, tried to approach colleagues and ask questions those who are also in the field. And I have tried to make some research on the internet. I have tried to approach my lecturers and teachers to ask them. This is how I have tried to solve this problem in the past.

Topu: It has been a pleasure finding more about your scaffolding practices (teaching practices) in mathematics. I appreciate your time and your contributions.

Peter: You are welcome!

FACE-TO-FACE INTERVIEW WITH SAM

Topu: Good morning sir
Sam: Good morning. How are you?
Topu: I am fine

Topu: Firstly, I would like to thank you for accepting to be interviewed for my research on scaffolding practices (teaching practices) in primary mathematics. This interview is intended to gain an understanding of your views on scaffolding and how you practice it with your mathematics classes. Your views will be valuable to me.

I had the opportunity to observe your mathematics lessons. This interview is a follow up to the questionnaire you completed and the lesson observations I did. The interview should take about 20 minutes. I will record your responses. You shall remain anonymous and what you say here shall be confidential.

Once more your participation is greatly appreciated.

Topu: Sir, you showed a number of scaffolding practices in the questionnaire you completed. What is scaffolding (teaching practices) in the teaching of primary mathematics?

Sam: Hmm scaffolding practices in the teaching and learning of mathematics are teaching methods that are used in the teaching of mathematics to enable the learners to understand some mathematics concepts and apply what they learn in mathematics in real life situations.

Topu: Which scaffolding practices are used in the teaching of primary mathematics in general?

Sam: Hmm. The scaffolding practices used in the teaching of primary mathematics include: excavating, explanation by the teacher, demonstration, group work, individual written work, pair work, role play, guiding, and discussion between the learners.

Topu: Which scaffolding practices do you use in the teaching of mathematics?

Sam: Hmm, the scaffolding practices I use in the teaching of mathematics are excavating, explanation, demonstration and asking questions. These are the ones I use.

Topu: Can you please explain how you use these scaffolding practices? I mean the ones you have mentioned.

Sam: Ahaa-a, okay for example excavating I usually pose questions to learners to find out what they already know so that I can teach from known to unknown and then there is explaining. I usually explain the concept to the learners so that they know exactly what we are going to learn about and there is demonstration. There is also pair or group work. In this method I usually give some learners more practice in pairs or groups in what I would have explained to them so that they can consolidate their understanding of the concept. And this is usually followed by a report back. Then the other one is the individual written work. This one I give individual written exercise to assess whether they can apply what they learnt in writing individually.

Topu: Why do you prefer these scaffolding practices?

Sam: I prefer these methods because they usually make my teaching easy and they help the learners to understand the concepts.

Topu: Are there any scaffolding practices that did not work for you?

Sam: Ya-ah there are some that did not work out for me, for example, role play, field trip, discussion between learners.

Topu: What could be the reasons you don't use them?

Sam: Ya-ah, sometimes in role-playing its time wasting. You waste a lot of time trying to organise the children to role play. And field trip: it is sometimes I –it needs close monitoring of the children because it involves moving maybe away from the school. It can be dangerous maybe we say those activities are taking place near the road so you have avoid accidents. Sometimes you find yourself –you are supposed to go to the bush where there are creatures like snakes so the children can be bitten by snakes. So that is why they are proving not to work well.

Topu: Have you tried other scaffolding practices?

Sam: Yes I have tried other scaffolding practices

Topu: Which ones have you tried?

Sam: Role-play, field trip and discussion between learners. Role-play – even if it can be effective it waists a lot of time as you try to organise the play. Field trip- it needs a lot of monitoring of learners and escorts as it can be dangerous to them for example from cars if it takes place near the road and from dangerous creatures like snakes. Discussion between learners- it can be time wasting and sometimes children end up discussing their own things instead of assigned task.

Topu: Can there be other scaffolding practices you know but you don't use?

Sam: Yes.

Topu: Would you mind listing them?

Sam: One-on- one, discovery method and extension method

Topu: What could be the reasons you do not use them?

Sam: Eeeh for example on one on one if you look at the size of our classes the children are many so you end up wasting a lot of time if you want to attend to them. And even discovery method which is also time wasting. And then there is extension whereby you have to attend to those bright ones. I don't use it because of the nature of the children we have here.

Topu: How are they?

Sam: They do not want to work on their own and they hate difficult sums.

Topu: Can you explain how you use 'convince me' and parallel modelling as scaffolding practices?

Sam: Aaah! I don't know how they are used.

Topu: Have you ever heard or read about them before?

Sam: Yes! On the internet and the questionnaire I filled in some time ago.

Topu: What influences your choice of scaffolding practices?

Sam: My choice of scaffolding practices is influenced by the environment where the learning is taking place and my learners' ability to understand concepts.

Topu: Can you please explain further on what you mean by the environment influencing your choice?

Sam: The environment must be suitable for the level of understanding of the children and the concept I am dealing with, for example if I am dealing with addition of fractions I have to come up with the scaffold that helps the children to understand better.

Topu: I noticed during lesson observations that you did not have classroom displays and charts. What could be the reasons for this?

Sam: I used to have them hung there but they keep on falling and I have stopped displaying them.

Topu: I realised that there were charts for other subjects. What can you say about that?

Sam: I think they keep on replacing them every day which is very difficult thing to do.

Topu: What are the challenges you face in using scaffolding practices in primary mathematics?

Sam: Hmm, There are some challenges for example, the unavailability of some necessary teaching resources to enable the use of these teaching practices for example, some technological gadgets like overhead projectors

Topu: Can I say these are the only challenges you face?

Sam: Hmm, yes.

Topu: Please can you explain how you address them?

Sam: In some cases I try to improvise but improvisation is not as good as the really object. Sometimes the children need to see the really because the effect of the improvisation is not going to be equal to that of the real object. Hmm, I also ask colleagues, I make researches and I also teach in line with the expectations of the school.

Topu: Maybe you could tell me the school's expectation.

Sam: As this is a private school, it expects good results for example 100 percent pass rate. The- Level of understanding the children-the concept I am dealing with e.g. if I am teaching addition of fractions I have to come up with the scaffolding that helps the children to understand.

Topu: Thank you very much. It has been a great time finding more about your scaffolding practices in mathematics. I appreciate your contributions.

Sam: You are welcome

APPENDIX 8: LESSON PLAN SAMPLES

Peter's Lesson Plan

LESSON PLAN
DATE: 20/07/15
TIME: 08.00. 9.00 — 10.30. 11.30
CLASS: Grade 8A+B (Not the real class).
SUBJECT: Mathematics.
TOPIC: Interpreting information tables.
TEACHING AIDS: No
REFERENCE: Teacher's guide.
OBJECTIVES:
At the end of the lesson pupil should be able to:

— interpret informations give in a table.

Introduction
The teacher will revise the previous lesson with pupils.

Lesson presentation:
The teacher will help pupils interpret informations in a table the teacher will allow pupils to do activity & the teacher will check their work.

Conclusion:
The teacher will summarise the lesson with the class and give them homework.

Evaluation
The lesson objectives were all achieved

Sam's Lesson Plan

SAM

SUBJECT: MATHEMATICS DATE: 14/07/15 TIME: 09 - 10 HRS GRADE [illegible]

TOPIC: TRIANGLES

OBJECTIVES: Pupils should be able to:
1) Identify a triangle 2) Construct a triangle on a geoboard using rubber bands 3) Draw triangles on squared paper.

T/L AIDS: Maths Gr 4 Ppls' book pg 81 - 82; Pictures with triangles, magazines, scissors, glue and rubber bands.

Vocabulary: Triangle.

INTRODUCTION: A recap of the previous lesson

LESSON DEV: (i) The tr draws either a square or a rectangle on the board and asks a volunteer to draw a line from one corner to the opposite corner 2) The tr asks into how many shapes the square/rectangle has been divided and ask them to give the names of these shapes. 3). Tr asks chn how they know these are triangles (3 sides & angles) 4) Tr asks chn to use rulers to mark other triangles on the shapes. 5) In groups, pupils move around the room and place rulers on objects to form triangles e.g. the corner of a table 6). Tr draws a large triangle on the board and aks pupils these questions: a) How many sides does the shape have? b) How many angles do they have? 7. Using geoboards and geobands pupils will make triangles of different sizes. 8) Pupils will go outside and find sticks to make triangles with

Written Work: Pupils will write some exercises

CONCLUSION: Tr emphasizes on the main points

EVALUATION: Children were able to draw triangles.

APPENDIX 9: FIELD NOTES

<u>Peter's demographic data</u>

Name: Peter (pseudonym) **Sex:** Male **Age:** 29 **Academic qualification:** 'O' level

Prof qualification: STD **Teaching experience:** 8 years

Lesson

Grade: Not given for ethical reasons **Date:** 20/07/15 **Time:** 1030- 1130 hours

Topic: Interpreting information tables

Introduction: Teacher asked children on the previous learnt lesson on the estimation of mass and weighing. Children were estimating masses of objects (Excavating).

Presentation:

Teacher: What is to interpret? (<u>Questioning)</u> Children answered that it was to try to understand something.

Teacher: Yees you have tried. (<u>Environment)</u> To interpret is to make sense of a given thing, okay? For example, the table we have here you should be able to study and find out how many balloons there are hmmm you see there are 264 in the first column 49 in the second and 150 in the third. To find the total, you put them together <u>(parallel modelling and explaining).</u> You arrange them vertically before you add to answer the first question. Is that right?

Teacher demonstrated how to add vertically – <u>asking questions</u> as he worked out the sum. What are we doing? What is 9 plus 4? Children were answering in chorus form "we are adding. It is 13!

When modelling the teacher took the exact sum from the textbook

The teacher - arranging the sum for children, later asked one child to demonstrate on the chalkboard which the child did silently

Teacher asked children to write questions 1a, b, c and 2. As children started writing teacher started explain the questions. Teacher worked out question 1 for the children. Teacher showed all the answers. Teacher moved trying to mark – marked few exercise books. Stopped and started explaining question two. Went back trying to mark – stopped again and began to encourage learners to write neatly. In the middle of the talk another teacher stands by the door signalling the end of his lesson. The teacher tells student to submit the books the following morning. The teacher went out and I left the room. I thanked him for allowing me to observe his lesson.

Date: 14/0715 **Topic**: Quadrilaterals **Grade**: Not given for ethical reasons

Introduction: Teacher started by asking learners some mental multiplication tables

Lesson Development

Peter: Name the shapes you know

Children: square, rectangles, diamonds, triangles, circles, cubes

Peter: Quadrilaterals are all shapes with four sides and four angles. Okay?

Peter: Now choose quadrilaterals from the list you gave me

Children: square, rectangles (then another one said) triangle!

Peter: No! Not a triangle because it does not have four sides and four angles

Remember what I said, quadrilaterals have?

Children: Four sides

Peter: And?

Children: Four angles

Peter: Good. Now we want to find the properties of some of these quadrilaterals like square. A square has four equal sides and four equal angles

Show us a square on the board

Teacher asked children to describe a rectangle, a kite and a rhombus. The teacher later asked them to draw them in their books and write their properties.

As the children were writing, another teacher appears and Peter concluded the lesson.

Field Notes

Sam's demographic data

Name: Sam (pseudonym) **Sex:** Male **Age:** 49 **Academic Qualification:** 'O' level **Prof Qualification:** DE **Teaching experience:** 29 years

Sam's Lesson

Grade: Not given for ethical reasons **Date:** 14/07 /15 **Time:**0900hrs- 1000 hours

Topic: Triangles

Introduction: What are the names of shapes you know? (Excavating)

Teacher drew rectangles and squares on the chalkboard, later asked learners to draw their diagonals.

Teacher made children to focus on the sides of the rectangles

Children were asked to identify objects that were triangles in the classroom.

The teacher demonstrated how to form triangles on the chalkboard using a metre rule to form right angled triangles

Children were asked to focus on the shapes through tracing the sides of the shapes

Teacher told children properties of triangles – triangles have 3 sides and 3 angles.

Teacher asked questions on shapes in the textbooks –How many shapes can you see? How many triangles are formed there? How many triangles are in this bigger triangle?

Teacher asked children to demonstrate how to count the number of triangles found in the bigger one.

Teacher and children were giving answers to all the questions in the textbook (showing and telling).

Teacher asked children to draw in their jotters interesting shapes using triangles

Children sitting in pairs but most of them working independently (6 out of 14 pairs) (collaboration)

Children were asked to report back. Children displayed the patterns they drew.

Children asked to write in their exercise books

Teacher attempts to mark then goes back to explain the questions

Whilst explaining another teacher appears at the door of the classroom to mark the end of Sam's lesson. Children were reminded learners to write neatly and to submit their books the following day. Children sat in pairs according to gender. One chart in mathematics could be seen on the wall (conducive environment).

APPENDIX 10: PROFESSIONAL EDITING CERTIFICATE

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EDITING CERTIFICATE

Re: Topu Manyuchi

Master's dissertation: Exploring teachers' scaffolding practices in the teaching of primary school mathematics at a school in Swaziland

I confirm that I have edited this dissertation and the references for clarity, language and layout. I am a freelance editor specialising in proofreading and editing academic documents.

I have worked as an academic librarian at the University of KwaZulu-Natal and the Durban University of Technology for the past 20 years. My academic qualifications are the following:

BA (Psychology and Sociology), University of Pretoria, 1977

Advanced University Diploma in Adult Education (AUDIS), University of KwaZulu-Natal, 1985

Advanced University Diploma in Information Science (AUDAE), University of KwaZulu-Natal, 1995

Anita Kromberg

22nd February 2016

APPENDIX 11: TURNITIN REPORT

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File size:	11.33M
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Word count:	36,476
Character count:	211,662
Submission date:	08-Mar-2016 04:14PM
Submission ID:	642466037

Exploring teachers' scaffolding practices in the teaching of primary school mathematics at a school in Swaziland

By

Topu Manyuchi

Submitted in partial fulfilment of the academic requirements for the degree of Master of Education in the School of Science, Mathematics, and Technology Education, Faculty of Education, University of KwaZulu-Natal.

March 2016

Med Thesis

ORIGINALITY REPORT

9%	8%	2%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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