Understanding teacher communication patterns: Case studies of talk in new teachers' science classrooms

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A research report submitted for the partial fulfilment of the requirements for the degree
Master of Science (Science Education)
to the Faculty of Science, University of the Witwatersrand,
JOHANNESBURG, 1 SEPTEMBER 2014

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Abstract

Very little is known about new teachers' practice in relation to elicitation of learners' ideas in South African secondary science classrooms. Learners' ideas are important to elicit because learning occurs best when connections are made between them and new knowledge. The purpose of this study was to understand the communication patterns of new teachers and determine whether they were consistent with the aim in CAPS which encourages teaching from a constructivist view of learning. Constructivist view of learning involves creating opportunities for learners to make connections between their existing ideas and new concepts. These connections are best made through talk. Thus, teacher talk in teacher-learner interactions formed the basis of the investigation because it is the primary source of information. This study follows findings that experienced teachers often resort to knowledge transmission methods despite development programmes aimed at encouraging them to consider other alternatives. New teachers were of interest because they provided hope to change the status quo since teaching from constructivist perspectives was encouraged in their university modules. The study took place in two schools in Johannesburg where cases of two science teachers were investigated. Approximately 81 learners participated. Audio recorded data of classroom interactions and semistructured interviews were transcribed verbatim. Mortimer and Scott's analytical framework formed the basis for analysing teacher communication patterns, and Anne Raymond's model was used to thematically analyse interview data. The findings were that new teachers pose questions to elicit learners' ideas as encouraged in CAPS and that science beliefs, teacher education programmes, social teaching norms, and immediate classroom situation influence their practice. These findings were congruent with outcomes of other studies. The recommendation is that new teachers may need to be skilled in curricular saliency so that they engage with learners' ideas at high level of interanimation while covering curriculum content. The significance of the study is that it contributes to the understanding of new teachers' communication patterns in relation to the aim of CAPS.

Keywords

Learners' ideas; constructivist view of learning; communication patterns; teacher talk; analytical framework; thematic analysis; factors; and, curricular saliency

Acknowledgement & dedication

Acknowledgement

I would like to express my greatest appreciation to: Dr Audrey Msimanga, my supervisor, for her impeccable, professional and technical guidance, support and encouragement that enabled me to complete this research report; the two schools and the new science teachers as well as their learners who were involved in this study for their willingness to participate; my mother Thembane, and daughter Charmaine, for their moral support; my wife Precious for her witty suggestions as well as her courage to read the entire report aloud to me and keeping the fire burning at home.

Dedication

In loving memory of my late: father, Alfred; brother, Vusi; mother- and sister-in-law, Christina and Portia, respectively.

Notation and conventions

The following notation and conventions are used in transcripts:

- commas (,) indicate places where there is a pause in the speaker’s utterances
- comments in italics in square brackets, [ ], provide additional contextual information for the reader
- three dots (...) indicate that a section of transcript has been omitted. Three dots at the start of a new speaker's utterance indicates that the transcription presented is not taken from the start of the utterance
- underlining (surely) is used to demonstrate special emphasis by the speaker
- throughout, the original spoken language are retained with English interpretation in () brackets

Declaration

I, Benjamin Shongwe, declare that this report entitled **Understanding teacher communication patterns: Case studies of talk in new science teachers' classrooms** is my own unaided work except where I have explicitly indicated otherwise. This report is submitted in partial fulfilment of the requirements of the degree of Master of Science in Science Education at the University of the Witwatersrand. I also declare that this research report has not been submitted before, in part or in full, for any degree or examination to any other university.

Signature: BShongwe   Date: 1 September 2014

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List of acronyms

B Ed	Bachelor of Education
CAPS	Curriculum and Assessment Policy Statement
DBE	Department of Basic Education
FET	Further Education and Training
GDE	Gauteng Department of Education
GET	General Education and Training
HREC	Human Research Ethics Committee
IRE	Initiation–Response–Evaluation
TE	Teaching Experience
WITS	University of the Witwatersrand
ZPD	Zone of Proximal Development

Chapter 1: Introduction to the study

1.1 Introduction

Very little is known about new science teachers' classroom practices internationally (Brickhouse, 1990; Luft, 2007; Luft & Patterson, 2002). For the South African context, a Google Scholar search using the key words "new science teacher", and "beginning science teacher" on elicitation of learners' ideas yielded no results, including a search for induction programmes for new teachers. In this study, learners' ideas refer to both correct and counter-intuitive science understandings. Most studies in South Africa focused on practices of preservice and experienced teachers in the science classroom (e.g., Mji & Makgato, 2006; Kriek & Grayson, 2009). This implies that there are few studies that look at teacher talk with a particular focus on new teachers' elicitation of learners' ideas. "New teachers" in this case refers to teachers with less than five years of teaching experience after completing the Bachelor of Education (B Ed) degree. Thus, the significance of the study is to contribute to the understanding of new teachers' communication patterns in the science classroom. To do this, two case studies were undertaken to investigate how new science teachers elicit learners' ideas in the classroom through talk and what they do with those ideas. I also concur with Dana (1990), and Wang, Haertel, and Walberg's (1993) assertion that learners' ideas are important because they provide the learner with a framework for interpreting and understanding new scientific knowledge. However, I chose to focus on teacher communication patterns because, as suggested by Chin (2006), when learning takes place in a classroom setting, the primary source of information input comes from two areas: teacher's talk and teacher-learner interactions.

My interest was to understand whether new teachers teach science from constructivist perspectives of learning as encouraged by both teacher education programmes (see, e.g., Smeaton & Waters, 2013) and the science Curriculum and Assessment Policy Statement (CAPS) document at secondary schools (see, e.g., Department of Basic Education (DBE) – Natural & Physical Sciences CAPS document, 2011). Constructivist perspectives of learning refer to the importance of gaining an understanding of learners' thinking about scientific concepts and introducing new complex scientific concepts through building from their ideas. The study draws from Vygotsky's (1978) sociocultural perspectives of learning. In terms of the sociocultural theory, learning takes place when the learner is able to perform tasks, after assistance, in novel contexts or use scientific words to explain other concepts or phenomena. Thus, effective learning is viewed as a social activity which takes place between the teacher and learners or amongst learners themselves. For this study, teacher-led classroom interactions were examined to understand communicative patterns of new teachers as they attempted to elicit learners' ideas. I needed to examine whether new teachers in the science classroom operate within sociocultural parameters as envisaged in the science curriculum.

In the rest of this chapter I give an overview of the problem which is that teachers tend to transmit school science knowledge to learners rather than elicit their ideas to build new knowledge (Mji & Makgato, 2006; Ogunniyi, 2007; Kriek & Grayson, 2009; Bantwini, 2010). For science, this practice is incongruent with the specific aim of developers of the science in CAPS who encourage teaching from constructivist perspectives. For example, at General Education and Training (GET) level, the main aim of science teaching in the science classroom is to:

> build a framework of knowledge for learners and to help them make connections between the ideas and concepts in their minds – this is different to learners just knowing facts. When learners do an activity, questions and discussion must follow and relate to previously acquired knowledge and experience, and connections must be made. (Department of Basic Education (DBE), 2011, p. 10)

At Further Education and Training (FET) level the specific aim of science is to 'promote knowledge and skills in scientific inquiry and problem solving' (Department of Basic Education (DBE), 2011, p. 8). Erduran and Msimanga (2014) point out that CAPS underscores inquiry. According to Eick and Reed (2002), in scientific inquiry and problem solving, prior knowledge and ideas must be accessed and addressed in order to build new and deeper scientific understandings through inquiry. Elicitation of learners' ideas in the science classroom is one of the features of teaching from constructivist perspectives (Brooks & Brooks, 1999). Thus, constructivist learning theory supports inquiry by placing the focus of learning on learners' ideas, questions, and understanding (Fosnot & Perry, 1996). Therefore, at both GET and FET levels CAPS emphasizes the importance of collecting learners' ideas in the classroom by the science teacher. New teachers have been exposed to this constructivist learning perspective at university during their training (Smeaton & Waters, 2013). That said, I am mindful of the view that learning to teach is a continuum, as opposed to a set of distinct chapters in a teacher's life (Davis, Petish, & Smithey, 2006). Since new teachers have been exposed to constructivist learning perspectives, I hoped they were better positioned to change the status quo in the science classroom. Hence, I investigated their classroom practice.

First, I begin the task by considering the context in which the study is situated. I present a review of the elements that influenced this study followed by a justification of why the study was undertaken. Then, next I look at the objective of the study. Next, I outline the problem and research questions follow. Then arguments are presented as to why the study is significant. Delimitations showing how the scope of this study was narrowed conclude the chapter.

1.2 Background

In this section I contextualise the problem through providing a general review of diagnostic analysis of Grade 12 Physical Sciences results (2012) in South Africa. I chose to use this analysis because bias was minimised in that the question papers were the same throughout the country and the results were examined and moderated by an external quality assurance body, Umalusi. Then, I consider the current classroom practice. I do the review to argue that knowledge transmission practices of experienced teachers are incompatible with the constructivist view of learning encouraged in CAPS. Therefore, the idea I present here is that viewing learning from constructivist perspectives could provide an improvement in learner performance. New teachers offer a glimmer of hope in improving learner performance because they have been encouraged to teach from the constructivist view of learning in their teacher training modules.

Generally, the learning of school science is regarded as a difficult task (Hewson & Hewson, 1983; Mortimer & Scott, 2003) primarily because of the differences between everyday and school science languages (Mortimer & Scott, 2003). Hence, teachers should pay enough attention to the language of science (Department of Basic Education (DBE), 2013). According to a diagnostic report by the Department of Basic Education (2013) which was intended to provide feedback to teaching and learning, in the 2012 Grade 12 final examinations many learners performed poorly in science due to lack of knowledge of basic concepts. For example, misconceptions and errors in chemical bonding demonstrated that learners did not understand the difference between intermolecular and intramolecular forces. The report exemplified the problems using learners' answers such as "hydrogen bonds exist between alkane molecules", "intermolecular forces hold the atoms together in the chain", and that "there are intermolecular forces between carbon atoms". These errors illustrated that very little learning took place in most science classrooms. Although teaching and learning is a process involving both teacher and learner, the focus of attention in this study is teacher classroom practice – teacher communication patterns, in particular.

As I mentioned earlier, knowledge transmission is reported as the most dominant practice in science teaching in South Africa. Transmission view of learning relates to the notion that the "expert" (teacher) is required to fill learners' minds with information to be memorised and regurgitated when required (Thomas & Pedersen, 2003). A study conducted at South African historically "white" as well as "African" schools by Nakabugo and Siebörger (2001) found that teachers do not abandon one teaching strategy for another nor do they consistently use strategies which are viewed as better ones. An action research study by Aldridge, Fraser, and Sebela (2004), designed to monitor the development of constructivist learning environments in intermediate and secondary schools in South Africa, found that teachers implemented sizeable changes in their teaching strategies as they incorporated more constructivist teaching methods. However, Aldridge, Fraser and Sebela (2004) acknowledged that to sustain the new strategy, they had to be at hand to encourage teachers to keep trying because teachers who have taught for a number of years often resort to their old ways of teaching. Additionally, following a study on how South African science teachers perceived new curriculum reforms in the Eastern Cape, Bantwini (2010) aptly sums up the situation in most South African classrooms:

> … teachers were still using traditional teaching approaches where they wrote notes on the chalkboard and then required learners to copy and memorize them. This practice was followed despite the introduction of Curriculum 2005, which required a fundamental change from a teacher-centered to a learner-centered teaching approach. The new teaching approaches encourage the use of inquiry-based learning and also promote elements of the constructivist approach. (p. 86)

The studies above seem to suggest that experienced teachers struggle to view learning from constructivist perspectives. In fact, according to Mji and Makgato (2006), one of the factors responsible for poor learner performance is that teachers do not use learner-centred approaches in the science classroom. This is at variance with the aim of science teaching in the new CAPS document (see, Department of Basic Education (DBE), 2011). The expressed aim of the science curriculum is to encourage teachers to create teaching and learning situations in their classrooms that enable learners to construct their own scientific knowledge. This curricular aim provides an alternative view of science – as a social activity undertaken to make sense of the world rather than as an infallible body of knowledge. In essence, the aim is that teaching of science needs to be approached from a constructivist perspective.

Returning to the DBE's report, the suggestion intended to improve poor performance in science education was that more emphasis needed to be placed on learners being able to explain their answers. Mortimer and Scott (2003) argue that in terms of the sociocultural perspective, it is through examining the ways in which learners talk about the natural world that their ideas may be investigated. Therefore, classroom talk warranted an investigation, particularly new teacher's communication patterns in the elicitation of learners' ideas. Therefore, I investigated teacher communication patterns in the teaching of the topics (see, Table 5) to determine whether and how learners were afforded the chance to make sense of concepts as encouraged in CAPS.

Thus, there appears to be a gap between actual classroom practice and the constructivist principles of learning (Loyens & Gijbels, 2008) which are envisaged in CAPS. This implies that teachers may need to be persuaded to view teaching from another perspective. Understandably, university teacher education programmes advocate for teaching of science from constructivist perspectives. It is against this background that I examined whether new science teachers conduct their lessons in accordance with these constructivist views which is also part of the aim of CAPS.

1.3 Rationale

South African curriculum planning and implementation have undergone major transformations since 1994 (Lelliott, et al., 2009) and in the past decade for science curriculum in particular (Erduran & Msimanga, 2014). My own take on the reason for the changes is that they are endeavours to give our learners the edge. The most recent change is CAPS which is principally a response to confusion caused by previous curricular policies (Nakedi, Taylor, Mundalamo, Rollnick, & Mokeleche, 2012). For Natural Sciences, CAPS specifies three aims: *doing science*; *knowing the subject content and making connections*; and, *understanding the uses of science*. This study focused on the second aim as it related to teacher's use of classroom talk to construct scientific understanding. In constructivist perspectives of learning, the key emphasis is that learners relate the school science concepts to be learned to their previous knowledge (Matthews, 2002). However, the actual practice in the science classroom is different.

International and local research shows near unanimity that experienced science teachers' beliefs about the teaching and learning of science are resistant to constructivist learning perspectives (Aldridge, Fraser, & Sebela, 2004; Brooks & Brooks, 1999; Kriek & Grayson, 2009; Matthews, 2002; Mji & Makgato, 2006; Taylor & Vinjevold, 1999). Literature suggests that teacher development programmes designed to present the constructivist perspectives on learning to experienced science teachers as an alternative to transmission-type teaching have had very little success (see, for example, Mji & Makgato, 2006; Kriek & Grayson, 2009). Hence, I envisaged that new teachers may change the situation because they are trained in and are encouraged to use constructivist practices in the classroom in South Africa (see, for example, Wits School of Education, 2012).

Most universities require their educators to teach from constructivist perspectives of learning (Coll & Taylor, 2001) and some educational organisations are in favour of this approach to learning (Brooks & Brooks, 1999; Keys & Bryan, 2001). Thomas and Pedersen (2003) point out that teacher educators currently design teacher preparation programmes largely according to constructivist perspectives. Alexander (2000) claims that constructivist-based perspectives on learning can yield the best educational results if dialogic talk is sustained in the science classroom. Dialogic talk involves meaning making process in which the teacher collects and explores different learners' ideas about a scientific concept or phenomenon. A discussion of dialogic talk follows in Chapter 2 and I return to the argument on why constructivist approach to learning is favoured.

In light of poor science results, Hewson and Hewson's (1984) argument that the constructivist view of learning holds considerable promise for a radical improvement in science teaching and learning warrants attention. They, however, point out that the view is not yet reflected in most science teaching. However, studies show that teachers who are exposed to the constructivist view of learning may express this view in interviews but they do not necessarily act according to it in classroom situations (see, e.g., Boulton-Lewis, Smith, McCrindle, Burnett, & Campbell, 2001; Kriek & Grayson, 2009). Hence, I intended not only to interview, but also to conduct classroom observation to gain a better understanding on whether new teachers elicit learners' ideas as encouraged in CAPS.

Mortimer and Scott's (2003) analytical framework (see, Table 2) provided a lens to conduct the observation. I used this model to determine how new teachers work with learners to elicit their ideas in the science classroom. Since talk can be used to elicit learners' ideas, it would be a useful teaching practice for implementation of CAPS. Consequently, I needed to investigate whether new teachers' classroom practice in relation to elicitation of learners' ideas was in accordance with aim in CAPS. My desire to see the quality of science results improve as a result of meaningful learning inspired me to pursue the study.

1.4 Objective of the study

The objective of this study was to investigate how new teachers work with science learners to elicit their ideas and address the divergent ideas that emanate from classroom interactions, through talk. This objective is important in light of Mortimer and Scott's (2003) claim that talk is key. However, they assert talk is rare in secondary science classrooms. Consequently, this study was intended to make a contribution to the characterisation and better understanding of teacher communication patterns in the science classroom, particularly with regard to new teachers' elicitation of learners' ideas through talk. Thus, it is hoped that this study can inform teacher education programmes such that they consider including modules on how teachers can work with learners' ideas in developing school science concepts through dialogic talk. The possible practical relevance of this investigation is that science implementation and evaluation programmes may be geared toward seeking closer alignment between the aim of CAPS and actual classroom practice. To realise the objective and contribute to a better understanding of classroom practice in relation to CAPS, I identified the problem and refined the objective into a set of research questions which were answered through the analysis of results obtained from data.

1.5 Research problem

According to both the Natural Sciences (GET level) and the Physical Sciences (FET level) CAPS documents, elicitation of learners' ideas is important to facilitate building of new knowledge in the science classroom. However, the reality is that science classroom practices have been found to be inconsistent with this aim – they are still characterised by knowledge-transmission practices (Kriek & Grayson, 2009; Mji & Makgato, 2006; Ogunniyi, 2007). These practices involve situations in which the teacher tells the scientific story while the learners listen for recalling the “facts” later because they are regarded as empty vessels to be filled with knowledge.

1.6 Research questions

This study in an attempt to understand the communication strategies that new teachers use to collect learners’ ideas in science classrooms. To do this I analysed classroom talk and interview data of two new science teachers to answer the following research question: *how do new teachers use talk as a teaching and learning strategy in a science classroom*? The question is divided into the following sub-questions for data collection purposes:

- *How do new teachers elicit learners’ ideas about science concepts in the classrooms*?
- *What do the teachers do with these ideas once they have been suggested in the classroom*?
- *What do teachers say influences the nature of their classroom talk?*

1.7 Significance of the study

Research studies show that numerous teacher development programmes have had little impact on sustaining teacher’s interest in and practice of constructivist approach to learning (see, for example, Brooks & Brooks, 1999; Loucks-Horsley, Stiles, Mundry, Love, & Hewson, 2010; Mji & Makgato, 2006; Thomas & Pedersen, 2003). This means that many teachers are unaware of or unable to embrace a constructivist approach to learning. If they did, their classroom talk would be directed towards working from learners’ prior knowledge. Prior knowledge in this study refers to learners’ ideas which are consistent with the scientifically accepted perspectives as well as alternative conceptions of the natural world. In this study, I refer to learners’ naïve or common sense ideas as misconceptions. That is, misconceptions are alternative ideas that learners hold to be true but do not necessarily match conventional scientific explanations (Driver, Asoko, Leach, Mortimer, & Scott, 1994; Missouri Department of Elementary and Secondary Education, 2005). Studies by Ausubel, Novak, and Hanesian (1978), Piaget (1964), and Vygotsky (1978) have shown that learners’ ideas are crucial in understanding new knowledge. However, very little is known about ways in which new teachers support learners’ meaning making in science classroom (Mortimer & Scott, 2003). Thus, this study is intended to shed light on how new teachers work with learners’ ideas in developing school science concepts in the classroom through talk. In doing this, I narrowed the scope of the study.

1.8 Delimitation of the study

The study was conducted at two secondary schools in the Johannesburg area. Two new teachers of both Natural and Physical Sciences together with their learners participated in the study. New teachers were chosen because they inspire hope. In their training, they were encouraged to teach science from constructivist view of learning in line with the aim in CAPS. I observed them teaching science topics. The topics taught were: *Reproduction; Balancing Chemical Reactions; The periodic table of the elements; The particulate model of matter; and, Electricity*. These concepts had the potential to provide interesting opportunities for teacher talk to explore learners' ideas and misconceptions about human reproduction (see, for example, Berthelsen, 1999), solids, liquids and gases (see, for example, Arizona State University, 2001), and how electrical circuits work (see, for example, Driver, Squires, Rushworth, & Wood-Robinson, 1985; Mackay & Hobden, 2012). Concepts, in this study, refer to scientific ideas we use to make sense of the world. In this qualitative study, excerpts of teacher-learner interactions were identified and coded for analysis with a view to understand teacher communication patterns.

1.9 Conclusion

In this chapter I provided the background to my study, articulated the problem and advanced a rationale. I argued that the study was important because it shed light into classroom practice of new teachers since much is known about preservice and experienced science teacher talk and very little about new teachers. I pointed out that constructivist ways of learning involve talk to create opportunities for learners to build school science knowledge in dialogic interactions as ideas are explored on the social classroom space. In light of research studies, I presented arguments that experienced teachers' knowledge transmission practices were resistant to constructivist ways of learning in the science classroom while policy recommended that the curriculum needed to be delivered from constructivist views of learning. However, new teachers, by virtue of having undergone through modules on constructivist perspectives of learning in their preparation programmes, provided solace and encouragement that their classrooms were different from the knowledge transmission classes of experienced teachers. I confined the study to two new secondary school science teachers and to the science topics I regarded as providing fertile ground for classroom talk.

The following chapter is meant to pick up on the form of classroom talk that new teachers need to consider when eliciting learners' views. Thus, the chapter synthesises arguments in literature about new teachers' responsibilities in engaging learners' ideas in dialogic interactions. Next, in Chapter 3, I will explain in detail how the research unfolded, taking into consideration factors such as sampling, instruments, rigour, and ethics. Presentation, analysis, and description of the results will be done in Chapter 4. The chapter ends with a discussion of the results in relation to the sociocultural theory of learning. In Chapter 5, I review the results in relation to previous studies and acknowledge the shortcomings of the study. Then I make recommendations and suggestions for future research studies. Finally, I present a reference list and appendices.

Chapter 2: Literature review and theoretical framework

2.1 Introduction

In this chapter, I intend to give a summary of literature on the constructivist perspective in relation to elicitation of learners' ideas in the science classroom. The purpose is to synthesize and provide a critical overview of knowledge and ideas established on this topic. To do this, I describe what it means to teach from constructivist perspectives of learning. Constructivism in this study is used in the same sense as in science education – to imply construction of understanding of school science and not the constructivism paradigm (Cakir, 2008) as a philosophy. In terms of constructivism, 'learning occurs best when students use past experiences, peer interactions, and/or personalized constructs to internalize and expand upon their knowledge' (Wright, 2008, p. 325). Literature on constructivist classroom practice and dialogic talk in relation to new teachers was considered – as guided by the research problem and questions of this study. Constructivist ways of learning involve talk aimed at inquiring about learners' ideas in dialogic interactions to build school science knowledge. As pointed out in Chapter 1, dialogic talk involves meaning making process in which the teacher collects and explores different learners' ideas about scientific concepts. Thus, in both constructivist ways of learning and dialogic talk, the common denominator is that learners' ideas count and talk is used to collect them. This literature review helped in identifying gaps through seeking answers to questions that have not been asked so as to understand the problem.

This review of literature is in five sections. The first section looks at sociocultural theory of learning which formed the basis of this study. The second section considers the aspects of the analytical tools employed in this study. The third section focuses on classroom talk in science lessons. The fourth section traces the arguments on the constructivist approaches to science teaching. Then, lastly, follows a discussion of the factors known to influence teacher talk.

2.2 The sociocultural theory of learning

The common factor among the Piagetian, Ausubelian and Vygotskian learning theories is that they all underscore the importance of learners' prior knowledge or ideas. The Russian psychologist Lev Vygotsky (1896-1934) emphasized the influence of society and culture on learning, particularly his suggestion that language is the driving force behind meaning making. Vygotsky's sociocultural theory of learning has contributed enormously to recent understanding of how learners make sense of the world (Lyle, 2008). In terms of the sociocultural theory, the role of the teacher is to facilitate learning by guiding meaning making interactions on the social plane of the science classroom such that learners internalise the school science view. Internalisation is described as a process in which learners can describe a scientific view and apply it to novel situations without assistance (Vygotsky, 1978). According to this theory, learners can move to new concept learning slightly above their current knowledge, which Vygotsky refers to as the zone of proximal development (ZPD), with scaffolding from the teacher or more experienced learners.

Thus, from a sociocultural view, learning takes place when the learner can act independently on scientific concepts and activities. That is, learning is an activity that takes place in social situations entailing active construction of meaning by the learner through communication rather than as something that is imparted by the teacher. This mode of teacher-learner interaction in constructing scientific understanding is consistent with a socioculturalist conception of learning – that knowledge is constructed collectively in the interaction between the learners and the teacher. Morge (2005) claims that the interaction is a process which facilitates learners' individual construction of understanding. This also allows the learner to gain insight into, if any, differences between their preconceived ideas and school science view. The ultimate aim is to hand over the ownership of school science ideas to learners so that they make them their own (Mortimer & Scott, 2003).

Against this background, construction of learner understandings in science takes place in dialogue with others (Perkins, 1999). Viewing learning as a social activity allows the learner to play an active role in developing a personally constructed understanding of science through a process of dialogic interchanges (Lyle, 2008). Thus, dialogic talk is central in enabling learners' construction of understanding in science classrooms, in general, and teacher talk is of primary importance, in particular (Chin, 2006). Hence teaching from constructivist perspectives of learning is characterised by dialogic talk which begins with elicitation of learners' ideas to build new knowledge. Thus, teacher-learner interactions related to elicitation of prior knowledge in the social environment are important for construction of new knowledge. These interactions reveal learners' thinking as they talk about science ideas. They enable leaners' construction of knowledge for themselves.

2.3 The analytical frameworks

2.3.1 Classroom observation – communicative approach

To capture and characterise teacher talk in the science classroom, I used part of Mortimer and Scott's (2003) model. They identified the following five linked aspects to analyse the role of the teacher in supporting learners in meaning making in the science classroom: *teaching purpose; content; communicative approach; patterns of discourse, and; teacher interventions*. For this study, the communicative approach aspect of the framework was used to analyse new teachers' lessons.

2.3.1.1 Interactive and non-interactive classrooms

Drawing on the work of Mortimer and Scott (2003), teacher-learner interactions may be interactive and non-interactive. That is, teacher communication patterns in the science classroom may invite learners to express their views on school science concepts and phenomena. In this case, the teacher interacts with the learners by inviting them to make their views available on the social plane in the classroom environment. These views may be judged as correct or incorrect – at least they are expressed. The fact that there is exchange of ideas between teacher and learners implies that the classroom is interactive. However, in contrast, if the teacher merely presents the scientific story without inviting learners' ideas the classroom is deemed to be non-interactive. In classroom interaction, the talk is referred to as dialogic if learners' ideas are taken into account even to the exclusion of their input at the moment the teacher reviews them. In contrast, when the talk takes a different character such that the teacher disregards learners' views and only focuses on one point of view – school science – the approach is deemed to be authoritative.

Table 1. Communicative approach tool (Mortimer & Scott, 2003)

	INTERACTIVE	NON-INTERACTIVE
Dialogic	*Interactive/Dialogic*	*Non-interactive/Dialogic*
Authoritative	*Interactive/Authoritative*	*Non-interactive/Authoritative*

Taking the discussion above into consideration, Mortimer and Scott (2003) identified four communicative approaches (Table 1) which I used to characterise teacher communication patterns. First, they point out that an approach is interactive/dialogic if the teacher encourages learners to put forward their ideas including those that are quite different from the school science view. Second, they argue that an approach is non-interactive/dialogic if teacher considers learners' ideas without inviting any input from learners. Third, they point out that an approach is deemed interactive/authoritative if the teacher uses a question-and-answer session to convey and consolidate the school science view though more than one view may be heard – alternative views are discounted. The teacher's sole aim in this case is to focus on the single view, the school science view. Fourth, an approach is considered non-interactive/authoritative when, in delivering of a lecture, the teacher presents the school science view only in a monologue. They argue that this is a "closed" teaching situation in that new voices are not entertained by the teacher. However, a dialogic interaction can be played out with different levels of interanimation of ideas: low or high.

2.3.1.2 Low and high interanimation of ideas

An interactive/dialogic approach may take one of two forms: dialogic at low interanimation of ideas or dialogic at high interanimation of ideas (Aguiar, Mortimer, & Scott, 2010; Scott, Mortimer, & Aguiar, 2006). If the teacher simply asks for the learners' different points of view and even list them on the board without making an attempt to work on those views through comparing and contrasting (Scott, Mortimer, & Aguiar, 2006), the dialogic interaction is at low interanimation of ideas. Table 2 below summarises the arguments provided, here.

Table 2. Description of interanimation of ideas in dialogic discourse (Scott, Mortimer, & Aguiar, 2006, p. 611)

Discourse	Level	Description
Interactive/dialogic	LOW interanimation of ideas	Teacher and learners simply make different ideas available
	HIGH interanimation of ideas	Teacher and learners explore and work on different points of view by comparing, contrasting, and developing ideas

In contrast, communicative approaches at high interanimation level are interactive/dialogic instances in which the teacher collects learners' ideas and creates opportunities for their interrogation through contrasting and comparing. Exploration of learners' ideas, therefore, other than the "What is … ?" questioning line, may involve teachers' and learners' probing questions that sustain the discussion and may include questions like "Why makes you think so?", "How?", "What if …?" or "Give an example …", "Do you agree with …", "How do you know that?", "Can you elaborate on why …","Sipho thinks that …, what do you think?", and so on (Chin, 2006; Mortimer & Scott, 2003). These questions need to come from both teacher and learners for meaningful learning to take place (Chin & Brown, 2002; Dori & Herscovitz, 1999) because 'they are a potential resource for both teaching and learning science' (Chin & Osborne, 2008, p. 1). There is another form of classroom interaction in science lessons, learner-learner (see, for example, Howe, Tolmie, & Rodgers, 1990).

This study was confined to interactions between the teacher and learners with a focus on teacher talk. The particular focus on what the teacher says to elicit learners' ideas is important for my study because 'teacher talk is designed to support learning' (Dawes, 2004, p. 680) and there is very little known about how new teachers work with learners ideas through talk. In particular, my study investigated ways in which teacher talk was used to elicit learners' prior knowledge in science lessons. Thus, learner talk was not the focus of my study and hence the audio recorder was carried by the teacher and no effort was made to audio record learner-learner exchanges during the science lessons. This should not be construed as discounting learner-learner talk in the learning of science. I was, in the main, interested in teacher talk to examine what the teacher says to work with learners' ideas. This is done, eventually, to discern whether talk by new teachers is consistent with the avowed aim of Natural and Physical Sciences in CAPS. To better understand teacher talk, I conducted interviews.

2.3.2 Semistructured interviews – Raymond's model

Raymond's (1997) study involved six new teachers and spent a ten-month period collecting data. These teachers were, like in my case, graduates of the same teacher education programme at a state university. While in my study I analysed interview data to determine the factors influencing teachers' practices, she used concept mapping activity as a key source of information.

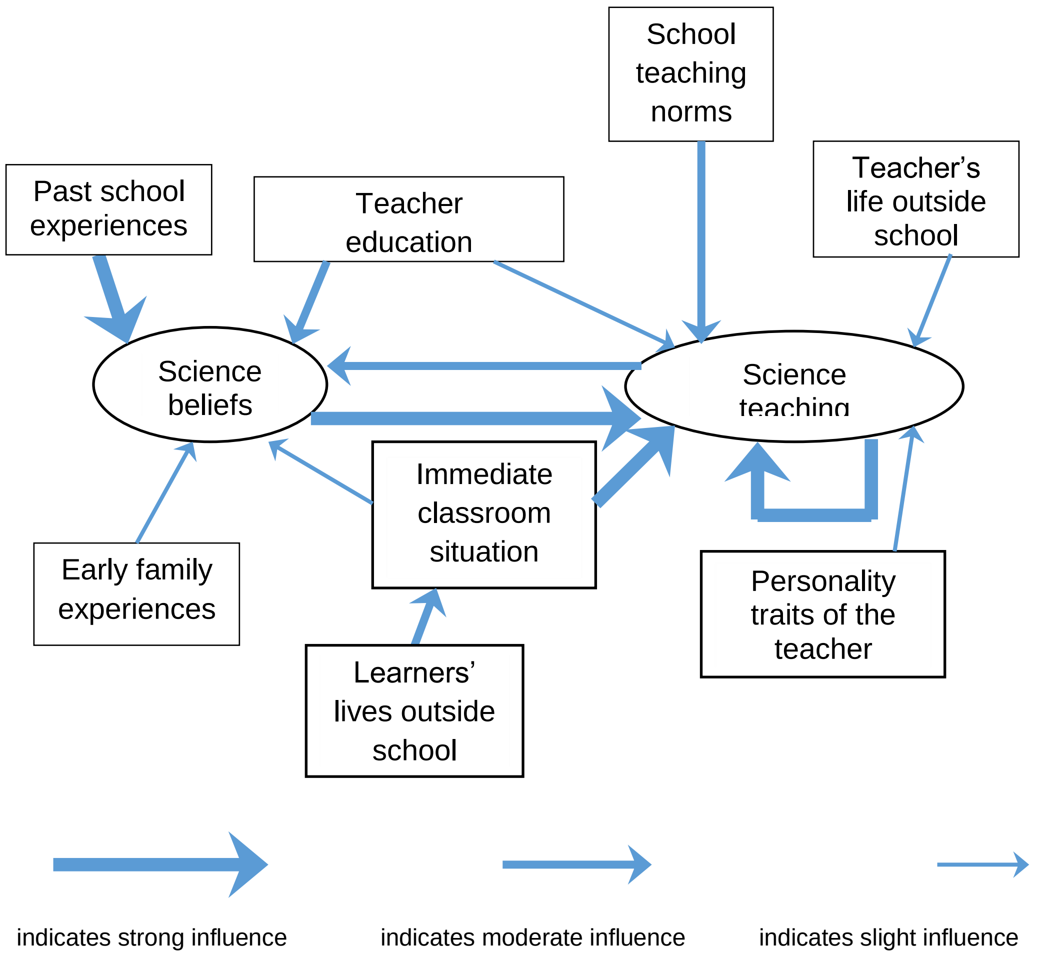

Figure 1: A model of the relationships between factors influencing teaching practices of new teachers

The model provides a framework to characterise the factors that influence new teachers' practice (Raymond, 1997). Table 3, below, describes the categories of factors influencing the way new teachers talk in the science classroom. I drew upon the work of Anne Raymond (1997) since 'there is no virtue in re-inventing wheels' (Mercer, 2010, p. 9). She proposed a model for the examination of new teachers' factors that influence beliefs, practice, and the level of inconsistency between these factors. I slightly adapted the tool by replacing "mathematics" with "science". There were two particular reasons for the choice of this model. First, this analytic tool was appropriate for determining the answer to the third research question because it took into account my interest in also determining whether new teachers' practice enacted what they said in the interviews. Second, possibility of links between teacher beliefs and classroom practice was taken at face value in Chapter 2.

Table 3. Categorization of the factors influencing new teachers' talk (Raymond, 1997)

Science teaching practice	Science tasks, discourse, environment, evaluation
Science beliefs	About the nature of science and science pedagogy
Immediate classroom situation	The learners (abilities, attitudes, and behaviour), time constraints, the science topic at hand
Social teaching norms	The school philosophy, administrators, standardised tests, curriculum, textbook, other teachers, resources
Teacher's life	Day-to-day occurrences, other sources of stress
Learners' lives	Home environment, parents' beliefs (about children, school, and science)
Teacher education programme	Science content course, methods courses, field experiences, student teaching
Past school experiences	Successes in science as a learner, past teachers
Early family experiences	Parents' view of science, parents' educational background, interaction with parents (particularly regarding science)
Personality traits	Confidence, creativity, humour, openness to change

Raymond's (1997) theory confirms existence and significance of the link. Raymond (1997) and Bryan (2003) assert that belief about teaching and learning of science are well established by the time new teachers start their teacher preparation studies. Further, consistent with the findings of Kember (1997), Mellado (1997), Bryan, (2003), she found that, oftentimes, there is inconsistency between new teachers' beliefs about the teaching and learning of science and their actual teaching practice. In the final analysis, I take the view that 'beginning teachers reveal much about their beliefs as they struggle to develop their teaching practice' (Raymond, 1997, p. 550). Given this view, the stage was set for the investigation of the answer to the third research question using semistructured interviews of two new science teachers.

In terms of Raymond's (1997) analytic tool, new teachers' beliefs were formed from prior school experiences such as experiences as a science learner, the influence of prior teachers and of teacher preparation programmes, and prior teaching episodes. There is a direct link between science teaching practices and science beliefs. However, because science beliefs and science teaching practices are not wholly consistent, other mediating factors are involved (Raymond, 1997). Social teaching norms and the immediate classroom situation can influence the relationship between beliefs and practice of the new teacher. Thus, science teaching practices can be traced back to previous experiences of the new teacher.

2.4 Science classroom talk

In the context of the sociocultural theory of learning, the teacher's role in classroom talk involves supporting learners in making sense of school science. This means that the teacher needs to make genuine attempts to take into account learners' ideas during interactions intended to construct understanding of science perspectives of the natural world. To situate my study in the field of research on classroom teacher-learner interactions in science education is important. According to Morge (2005), studies on this theme can be put into three categories: the teacher's discourse; the teachers' and learners' verbal behaviour; and, the structure of the teacher-learner communication patterns. He describes the first category as teacher-learner interactions concerned with what the teacher says and the way in which their mastery of the science content conveys their beliefs. According to Morge (2005), the second approach takes into account what both the teacher and the learner say. I put my study in the third category as it is an investigation into the structure of teacher communication patterns in respect of elicitation of learners' ideas. In essence, the focus of this study is teacher talk.

Talk in the science classroom is key yet it has been a neglected area of interest (Mortimer & Scott, 2003). According to Fisher (2007), talk is important when it empowers learners to acquire the capacity to explain and ask different kinds of questions. Hence, talk is a tool for both teaching and learning (Edwards & Mercer, 2013). Teacher talk in relation to elicitation of learners' ideas was the focus of this study. Teacher talk is key given the fact that it is geared towards supporting learning in the science classroom (Dawes, 2004). In particular, teacher talk with respect to learners' ideas was the prime criterion for analysis of the teacher-learner interactions. Teacher talk was key because, as McComas and Almazroa (1998) argue, 'important implications for student understanding could be derived from an analysis of teachers' verbal patterns' (p. 523). Rivard and Straw's (2000) study investigated the role of talk and writing on learning science and to explore the effect talk and writing on the learning and retention of simple and integrated knowledge,. They found that that talk is important for distributing knowledge. They report that learners working individually did not learn as much working alone as those learners who discussed problems with peers. They concluded that talk was important for sharing, clarifying, and distributing knowledge among peers.

According to Mortimer and Scott (2003), teacher talk may take two forms: dialogic talk and authoritative talk. Lyle (2008) defines dialogic talk as communication in which there is genuine concern for the views of the talk partners and effort is made to make meaning collaboratively. According to Fisher (2007), dialogic talk implies listening to the voices expressed by the learner and challenging them to voice their thoughts. As alluded to in the introduction of this chapter, I define dialogic talk as the meaning making process in which the teacher collects different learners' ideas about a scientific concept or phenomenon. The teacher may decide to either explore similarities and differences among the ideas or genuinely compare and contrast these ideas with the school science perspective (Mortimer & Scott, 2003). Comparing and contrasting is typified by these hypothetical teacher's responses, 'John thinks that this might be the case, but Susan seems to be suggesting something different. Nancy what do you think?' (Scott, Mortimer, & Aguiar, 2006, p. 610).

Thus, on the one hand, in dialogic talk, different learners' points of view are recognised as important for learning. This contrasting is important because as learners compare and contrast their views with the "new" scientific perspective, they make sense of the school science view. According to Taber (2009), the teacher scaffolds learning while constantly checking for learner understanding and seeking to link teaching to learners' thinking. Scaffolding takes place when the teacher guides the learner in extending their knowledge through a series of small steps of which the student would not be independently capable (Cakir, 2008). On the other hand, in authoritative talk, communication is focused on just the school science view – there is no intention to explore different views.

It is against this background that I take the view that school science knowledge is constructed in social interaction and so learners' ideas matter in communicating about science. Put another way, learners' understanding of science is 'either facilitated by the teacher or *from a book*– never alone!' (Rowlands, 2000, p. 550, author's emphasis). According to Vygotsky's (1978) social cultural theory, learning is mediated through social interaction, mainly through talk. One way in which this happens is as the teacher engages in talk that elicits learners' ideas. That is, the focus is on how the new teacher makes talk dialogic, eliciting these learners' ideas and using them in the teaching and learning space. The study is important in view of the fact that science education research has neglected new science teachers for a long time and focused on preservice and experienced teachers (Luft, 2007). Thus, the findings from this study would contribute to understanding new science teachers' classroom practice.

2.5 Constructivist perspective and elicitation of learners' views

Constructivist theories of learning have influenced current understanding of how learning happens (see, for example, Matthews, 2002; Tobin, 1999, April). The influence of constructivism in science education is eloquently summarised by Fensham's (1992) assertion that 'the most conspicuous psychological influence on curriculum thinking in science since 1980 has been the constructivist view of learning' (p. 801). Bishop and Denley (2007) identified features of teacher practice that could be described as characteristic of constructivism: the practice of eliciting learners prior knowledge at the start of a lesson; the recognition that learners often have their own explanations for scientific phenomena which may be at variance with canonical science; and, that learner-to-learner talk is important for meaning making. While highlighting similar characteristics, Jacqueline Brooks and Martin Brooks (1999) expanded on these and developed twelve descriptors of constructivist-based teaching behaviours to highlight teacher practices that support learners' personal construction of meaning. They argued that teaching from constructivist perspectives implies that teachers:

1) encourage and accept student autonomy and initiative.
2) use raw data and primary sources, along with manipulative, interactive, and physical materials.
3) use cognitive terminology such as "classify," "analyse," "predict," and "create" when framing tasks.
4) allow student responses to drive lessons, shift instructional strategies, and alter content.
5) enquire about students' understandings of concepts before sharing their own understandings of those concepts.
6) encourage students to engage in dialogue, both with the teacher and with one another.
7) encourage student inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other.
8) seek elaboration of students' initial responses.
9) engage students in experiences that might engender contradictions to their initial hypotheses and then encourage discussion.
10) allow wait time after posing questions.
11) provide time for students to construct relationships and create metaphors.
12) nurture students' natural curiosity through frequent use of the learning cycle model.

For the purpose of this study, attention was on descriptors 5 to 10 of the constructivist teaching behaviours, above, as I find them to be directly related to the problem under investigation. I am mindful of Du Plessis's (2013) contrasting argument that CAPS is more prone to traditional teacher methods rather than constructivist approaches to learning. However, the focus of this study is to determine if new teachers elicit learners' ideas as required by the science curricular aim in CAPS. These six descriptors exemplify teachers' practice of taking into account learners' ideas.

2.5.1 Teaching from constructivist perspectives of learning implies that teachers inquire about learners' understandings of concepts before sharing their own understandings of those concepts

In terms of this descriptor, the benefit of eliciting learners' view first is that opportunities for learners to develop and question their own conceptions are enhanced. According to Bishop and Denley (2007), eliciting learners' ideas is recognition that indeed learners are not merely vessels to be filled with knowledge. Neglecting this aspect, argue Brooks and Brooks (1999), makes most learners stop thinking about a concept or theory once they hear "the correct answer" from the teacher.

2.5.2 Teaching from constructivist perspectives of learning implies that teachers encourage learners to engage in dialogue, both with the teacher and with one another.

In dialogic discourse the teacher attempts to take into account a range of learners' views (Mortimer & Scott, 2003). The teacher interacts and interacts dialogically with the existing understandings of the learners. It is the teacher and learners' talk that centrally carry the development of the scientific story. According to Brooks and Brooks (1999), teacher-guided classroom communication is vital so that quiet learners also get a chance to speak. They express this idea eloquently:

> One very powerful way students come to change or reinforce conceptions is through social discourse. Having an opportunity to present one's ideas, as well as being permitted to hear and reflect on the ideas of others, is an empowering experience. The benefit of discourse with others, particularly with peers, facilitates the meaning-making process. (p. 108)

Through dialogic interactions, ideas are made available in the learning environment. Thus, dialogic talk affords the teacher an opportunity to access and assess learners' prior conceptions. The teacher does this through probes or by requesting learners to repeat their ideas (Scott, 1998). Further, the teacher can provoke compare-and-contrast discussions that map these ideas in relation to one another (Perkins, 1999). Mercer, Dawes and Staarman (1995) suggest that involving learners in dialogic interactions helps them understand better the dialogic processes involved in studying and practicing science. In addition, Moje (1995) points out that this involvement may also help learners understand that oftentimes there is no complete consensus on scientific issues even among members of the scientific community.

2.5.3 Teaching from constructivist perspectives of learning implies that teachers encourage learner inquiry by asking thoughtful, open-ended questions and encouraging learners to ask questions of each other.

In this case, Brooks and Brooks (1999) point out that eliciting learners' views needs to demonstrate to them that there is no one correct response. They assert that communication among learners is a critical factor in learning and so schools need to create settings that foster such interaction. Kawalkar and Vijapurkar (2011) point out that teacher questioning in traditional science classes is done to evaluate what learners know and the predominant pattern of discourse is the initiation–response–evaluation (IRE) or the triadic dialogue. The triadic dialogue takes place where the teacher initiates the question, the learner responds and finally the teacher evaluates the response in terms of school science view. Teachers need to be genuinely interested in views of learners. Clearly, learner engagement does not come without effort (Bishop & Denley, 2007). However, new teachers need to make asking questions the culture of the classroom.

Learners' questions are a significant alternative to achieving meaningful learning (Dori & Herscovitz, 1999). From learners' questions, the teacher gains insight into common misconceptions and difficulties the class may be experiencing and may thus modify subsequent teaching to account for them (Chin & Brown, 2002). In addition, they argue that if learners receive responses to their contributions they tend to get encouraged to reflect on their own ideas and thus realize that they are an important element in the learning of science. On the contrary, if learners' questions receive little attention, that encourages them to abandon their curiosity for social conformity (Chin & Osborne, 2008).

2.5.4 Teaching from constructivist perspectives of learning implies that teachers seek elaboration of learners' initial responses.

According to Brooks and Brooks (1999), learners' initial responses need probing because these are just their first thoughts about issues – they are not necessarily their final thoughts nor their best thoughts. They argue that it is through probing that learners elaborate and assess their own errors. Making a similar point, Scott (1998) argues that dialogic talk affords the teacher an opportunity to assess learners' prior conceptions through probes or requests that learners repeat their ideas in order to promote shared school science meaning. Brooks and Brooks (1999) make an interesting point when they argue that probing is essential to understand more clearly the thinking of learners about scientific concepts because at times the adult filter through which teachers hear learner responses fails to capture the learners' meanings.

Kawalkar and Vijapurkar (2011) pointed out that teacher rephrasing of learners' responses may serve a variety of purposes: asking for clarification, elaboration and justification of their comments, pointing out contradictions with what has been observed or discussed in class, providing a hint to guide the learners towards the answer and, asking them if they can think of another way to find out the answer. I concur with Bishop and Denley's (2007) contention that guiding learners towards the correct answer may reduce the thinking required.

2.5.5 Teaching from constructivist perspectives of learning implies that teachers engage students in experiences that might engender contradictions to their initial hypotheses and then encourage discussion.

Learners' prior conceptions are key in acquiring understanding of new science concepts (Driver, Asoko, Leach, Mortimer, & Scott, 1994). In fact, the construction of understandings depends on learners' prior ideas (Chin, 2006). However, learners harbour a wide variety of naïve ideas about the natural world by the time they begin to receive formal instruction in science (Ausubel, Novak, & Hanesian, 1978; Cakir, 2008). Thus, learners' thinking needs to be challenged to make them build on their ideas and make connections by asking questions like "Why do you think so?" "How?", "What if …" or "Give an example …", and so on. Using dialogic talk to probe learners' thinking in this way is what Fisher (2007) refers to as "cognitive challenge".

Therefore, learners' ideas need to be collected because, as Ogunniyi (2007) argues, they are oftentimes incompatible with the scientific worldview. Shulman (1986) asserts that it is important that teachers take into account learners' ideas because they may act as a barrier to learning. Learners' ideas explicitly or explicitly indicate misconceptions.

2.5.6 Teaching from constructivist perspectives of learning implies that teachers allow wait time after posing questions

The idea of "wait time" as an instructional practice was proposed by Mary Budd Rowe (1972). She found that wait time periods rarely lasted more than 1.5 seconds in typical classrooms and showed that increasing it influences the quality and quantity of learners' responses. Wait time is defined as that time of 3-7 seconds of silence after the teacher has posed a question and before a response from either the teacher or learners (Rowe, 1972). A similar study by Tobin (1987) showed that substantial benefits accrue when the principle of wait-time is taken into consideration.

However, a widespread practice in the classroom is that teachers answer a preponderance of their own questions after a second or two of unsuccessful look for the "right" answer due to the pressure to move to the next concept or topic in order to finish the syllabus (Black & William, 1998). This leaves little opportunity to elicit and respond to learners' intuitive ideas to support meaningful learning because, as Brooks and Brooks (1993) point out, learners' initial responses to science questions are usually not their best thoughts. Therefore, if wait time principle is applied, I contend that learners' best thoughts could be captured. In this light, using wait time principle reduces the possibility of the teacher answering their own questions. Additionally, wait time produces high quality and quantity of classroom discourse (Tobin, 1987) – the quality of talk increases in the sense that instead of learners giving recall, short responses or no answer at all, learners give longer and carefully considered responses. Making judgements about the instructional quality of new teachers was not part of the purpose of this study. Rather, the concern was to explore their communication patterns in the science classroom in light of aim in CAPS. Speaking more broadly, I wanted to understand the practice of new teachers relative to learners' ideas against curricular aim.

2.6 Factors limiting dialogic interactions in the science classroom

Teaching from constructivist perspectives of learning encourages learners to engage in dialogue. However, several factors may impede teachers' commitment to the constructivist view of learning. These are large class sizes, language constraints, particularly in South Africa and, according to Brooks and Brooks (1999), rigid curriculums, unsupportive administrators, inadequate experience, searching for survival and teacher beliefs. Drawing on Onwu's (1999) description, in this study, by large class I mean a teaching and learning classroom environment that inhibits meaningful learning with: diminished opportunities for all learners to participate actively in the learning process; teachers resorting to predominantly demonstrations; limited opportunities for individual learner construction of knowledge; and, teacher-learner ratio of more than 1:35. Thus, large groups do not permit individual monitoring of learning and as such whole class teaching becomes the norm.

New science teachers do not get the support needed in their first years of teaching to sustain their construcivist perspectives of learning in dialogic interactions (Luft & Patterson, 2002). They point out that new science teachers, as a result, find it challenging to implement constructivist perspectives of learning in the classroom. In addition, Harlen (1997), and Luft and Patterson (2002) argue that this lack of support ultimately contributes to new teachers' adherence to knowledge transmission practices. Literature suggests that most of them learnt through knowledge transmission practices in their schooling years, particularly in the South African schooling context (see, for example, Kriek & Grayson, 2009; Mji & Makgato, 2006). Thus, they may have formed a conception of teaching and science that mirrors their schooling experiences.

Several studies have found that teacher beliefs about teaching and learning of science are very influential in guiding teaching practice (see, e.g., Bryan, 2003; Dana, 1990; Mellado, 1997; Pajares, 1992; Richardson, 2003; Savasci-Acikalin, 2009; Tsai, 2002). Even teachers with strong philosophical commitments to constructivist principles do not reflect it in their actual classroom practices (Boulton-Lewis, Smith, McCrindle, Burnett, & Campbell, 2001). Cazden (2001) raises a similar point. He argues that although teachers may want to teach from the constructivist view of learning, it is more difficult to create such a classroom than to imagine it. In this study, I considered two factors influencing classroom practice as I believed they were important for new teachers - stages of development and beliefs.

2.6.1 Stages of development for new teachers

Frances Fuller and Oliver Bown (1975) conducted ground-breaking research in developing a picture of the first years of a new teacher's career. They described two general stages of development for new teachers. The first stage is characterised by concerns about survival as a teacher and the second stage is characterised by either resistance or adaptation to changes of their practice. They find that there are discrepancies between their expectations of school life and the realities of teaching (Ballantyne, 2007). This is referred to as ''praxis shock''. It is at these stages that new teachers are confronted with the realities of being a classroom teacher that put their beliefs and ideas about teaching to the test, challenges some of them, and confirms others (Kelchtermans & Ballet, 2002). That new teachers are typically concerned with survival in the classroom is an old but still valid research finding (see, for example, Appleton, 2003; Appleton & Kindt, 1999; Brickhouse & Bodner, 1992; Raymond, 1997).

Critical issues for new teachers concern matters in both the school and the classroom in which they work. For example, resources, time constraints, teaching practices that work, curriculum and learner behaviour, are some of the complex issues confronting new teachers. Karweit and Slavin's (1982) model typifies three kinds of classroom time into: procedural time (time spent moving from one class to another, time spent on keeping order, marking attendance registers, interruptions by messengers or announcements on the intercom, late starts after lunch breaks, etc.); instructional time (subject matter related instruction); and, task time (a proportion of instructional time allocated to scaffolding and checking learning). Returning to issue of factors influencing classroom practice, Brickhouse and Bodner (1992) view these constraints in a serious light and argue that they are damaging to new teachers, because they force them to devote time to devising survival strategies rather than designing thoughtful classroom instruction. In addition, new teachers found themselves having to implement that which was generally developed by others – the curriculum. Feiman-Nemser (2003) argues that these factors seem very much as part of a personal struggle towards the development of their identity in the profession. As Davis, Petish, and Smithey (2006) point out, new teachers still need to situate their classroom instruction within the broader context of their school and the education system. Hence, they conclude that being a new teacher will always be hard. Additionally, teaching is in its nature a difficult job even for experienced teachers (Mbunyuza-de Heer Menlah, 2013).

2.6.2 Teacher beliefs

Teaching practices are strongly influenced by the underlying science teachers' conceptions of teaching, learning and science (Kember, 1997; Pajares, 1992). Most studies have tackled the issue of teacher beliefs in relation to teaching and learning of science, with a focus on new and experienced teachers (Bryan, 2003). Beliefs about teaching and learning are well established by the time new teachers begin their teacher preparation studies (Bryan, 2003) and they also bring their belief systems to their practice during the Teaching Experience (TE) periods (Eick & Reed, 2002). TE is the time in student teachers' training when they are exposed to school life under the guidance of a supervisor or a mentor (Mbunyuza-de Heer Menlah, 2013). There is, oftentimes, inconsistency between their beliefs about the teaching and learning of science and their actual teaching practice (Kember, 1997; Mellado, 1997; Bryan, 2003). In a three-year study, Simmons et al*.* (1999) found that new science teachers' classroom practices contrasted sharply with their beliefs. Benson (1989) found similarly. That is, new teachers profess beliefs which they may not enact in practice.

However, unlike experienced teachers who hold more deeply ingrained beliefs, new teachers' beliefs may be amenable to change as a result of instruction during their preparation programmes at institutions of higher learning (Bryan, 2003, citing Richardson, 1996; Tsai, 2002). Simmons et al. (1999) caution that changing one's teaching to reflect a constructivist orientation is a tall order for teachers, including new teachers. In interpreting teacher-learner classroom interactions, Morge (2005) discerned that there were hidden epistemological and pedagogical beliefs when the teacher decided whether to accept or reject learners' contributions. He described epistemological beliefs as teacher's views about the nature of science – for instance, scientists' activities, the nature of the scientific knowledge they produce, and the way in which this knowledge is produced. He described pedagogical beliefs as the teacher's views about the teaching and learning of science – for instance, how learning of school science takes place in the classroom, and the way the learners' contributions are taken into account. Then, he pointed out that the teacher's practice corresponds to a *dogmatic* view of science and its teaching if learner's answer is judged against its veracity in relation to the teacher's scientific knowledge. He described 'dogmatic' as referring to viewing science as a body of truths waiting to be discovered.

The finding by Morge (2005) is important particularly in highlighting that, according to Brickhouse (1990) and Lederman (1999), there is a gap between new teachers' actual classroom practices and views about the nature of scientific knowledge. Put another way, there is a mismatch between new teachers' pedagogical beliefs and their epistemological beliefs. In contrast, Lederman (1999) found that new teachers' conceptions of science do not necessarily influence their on-the-ground classroom practice. The emergence of this factor, in Chapter 4, during semi-structured interviews in this study was interesting. In the interviews, new teachers were implicitly asked to reveal the factor(s) that influence their teaching in the science classroom. I discuss their responses in Chapter 4 and will now turn attention to the theoretical framework that underpins my study.

2.7 Conclusion

My literature review revealed that there are very few studies of new teachers in South Africa. The situation is no better when it comes to the literature on their elicitation of learners' ideas in the science classroom social space. I presented both the theoretical framework as well as the analytical tools. I demonstrated that learning and teaching are social activities involving teachers as mediators and their learners as co-constructors engaged in meaning making. I provided arguments to illustrate the role of new teachers in the teaching sequences in relation to learners' ideas. Six descriptors that emerged from literature provided a glimpse into the new teachers' classes as practitioners of constructivist view of learning. To close the argument, I presented views on factors affecting constructivist practices in the science classroom. The next chapter looks at the steps followed in undertaking this study including information about the paradigm that influenced the manner in which I conducted the investigation.

Chapter 3: Methodology

3.1 Introduction

This chapter provides information as to how the study was conducted to seek an understanding of how new teachers work with learners' prior knowledge, from their perspectives. In this study, only teacher talk meant to facilitate learners' scientific understanding through elicitation of learners' ideas within the 'official classroom air time' (Cazden, 2001, p. 54) was relevant. From transcripts of classroom observation, excerpts of teacher talk which showed teaching approaches and patterns of interactions in the communicative approach (Table 2) were identified for analysis. I also conducted semistructured interviews and analysed data to determine factors teachers said influence their practice. In more detail, I describe the methodology employed in this study.

According to Creswell (2003), methodology refers to a plan of action that links procedures and techniques of data collection and analysis to results. As a consequent, I chose to follow a qualitative investigation employing a case study methodology to obtain in-depth contextualised data (Lincoln & Guba, 1985) about new teachers' classroom practice. Building on the thoughts of Stake (1995), Yin (2003), Opie (2004), and McMillan and Schumacher (2010), I define a case study as an in-depth investigation into a phenomenon within specified boundaries.

Defining boundaries means binding the case to time, context, settings and showing 'what will and will not be studied' (Baxter & Jack, 2008, p. 547). According to Flyvbjerg (2007) a case study is well suited to produce concrete, context-dependent knowledge. In addition, case studies have the largest number of potential audiences including academics who may be interested in its findings or previous theory position (Yin, 2003). As a consequence, I conducted a case study because I wanted to study teacher talk in relation to elicitation of learners' ideas in its normal context. That is, the audio recordings were done under conventional classroom situation as the teachers involved were working with their own learners as allocated by the teaching time table in their respective schools. This was in line with the requirement of the Gauteng Department of Education (GDE) that the investigation could proceed without adversely affecting the schedule of the school activities. Thus, the teacher participants were working under the natural settings to which they have become accustomed. Hence, I found case study to be a suitable research methodology because I wanted to study new teachers' practice in elicitation of learners' ideas in their natural context (Runeson & Host, 2009).

However, like all other models of research, case-study investigations have their own limitations. Flyvbjerg (2007) points out that there is criticism that case-study results are not scientific and therefore ungeneralisable. I agree with Opie's (2004) argument that for a case study, relatability rather than generalisation is important. The relatability of a study allows it to contribute to cumulative development of knowledge (Bassey, 1999). Relatability here refers to a description of how the outcome of a study relates to what is happening in another classroom (Opie, 2004). After all, knowledge is more than statistics (Flyvbjerg, 2007). However, this need not be construed as a criticism of quantitative methods. The point I am making here is that the circumstances in the study are suitable for a qualitative case-study methodology.

The purpose of this study was to understand how new teachers elicit learners' prior knowledge as promoted in CAPS. I selected two cases of new teachers and investigated whether these cases make the connections between the constructivist view of learning and the curricular aim. The assumption that new teachers take into account learners' ideas as emphasized in the university lectures (see, e.g., Rodriguez, 1998; Moore, 2003; Thomas & Pedersen, 2003; Wits School of Education, 2012) was investigated.

3.2 Researcher positionality

The case studies reported in this investigation are a product of a set of assumptions based on a constructivist worldview. A worldview is what Kuhn (1970) refers to as a "paradigm". A paradigm is informed by the assumptions about the nature of reality under study, assumptions about what constitutes knowledge of this reality, assumptions about the appropriate ways (methods) of building knowledge of that reality. In essence, a paradigm is a constellation of ideas that 'undergird our thinking' (Hatch, 2002, p. 12).

For this study, this reality was constituted by all the actions, results and findings of the research on teacher talk. Since the reality was nurtured by the participants and I, the knowledge generated here should be subjective – it is socially constructed by participants who come onto the study with their own interpretations of the world. To view knowledge as socially constructed means attaching substantial theoretical weight to the role of social interaction – viewing the role of societal interactions, in the Vygotskyan (1978) terms, to be central and necessary to learning and not merely an ancillary.

There are, however, teachers who use knowledge transmission practices from a paradigm that seeks to give science the role of being the sole source of knowledge. The assumption is that science is about facts. Such a worldview is referred to as positivist paradigm. They believe that science teaching and learning need to be approached from this assumption. The problem with this practice is that it projects a false objectivist view of the nature of scientific knowledge (Taylor, Fraser, & Fisher, 1997). This is a positivist perspective which claims that scientific knowledge exists independent of our minds, is unchanging over time and conveys universal truths.

Taylor et al., (1997) make the point that it is such perspectives that falsely entitle teachers the role of experts who transmit to their learners "accurate versions of the universal body of truths". Kuhn (1970) dispelled these claims as myths and I duly concur. Thus, this study was conducted from a constructivist paradigm and fully acknowledges the responsibility of the teacher to tell the scientific story – making available to learners an alternative way of viewing the natural world. The basic philosophical assumption that underpins this study is that because science knowledge is socially constructed by people, it is subjective and therefore, tentative.

3.3 Participants and sampling

3.3.1 Participants

The study took place in 2013 and the data collection lasted for three weeks. The participants in this study were teachers and learners from three different Grades, 8, 9, and 10 in two public schools. The number of learners was, approximately, 38 learners in Ms M's class, and 41 learners in Mr H's class. The numbers fluctuated as a result of learner absenteeism. However, I consistently followed particular classes of the teachers as per their time tables sticking with the same class. For example, if Mr H's class that I began to observe in the first day was Grade 8B, I recorded lessons of particular class, Grade 8B. That is, I observed the same classes throughout the investigation for each teacher.

The participants completed their B Ed degree at WITS and Ms M and Mr H were 28 and 25 years old, respectively. Ms M's school was located in a previously disadvantaged township community in the Johannesburg East district and most learners received free meals during lunch breaks. She joined the school three years before after finishing her B Ed studies. Mr H's school was located in the more affluent suburbs of Johannesburg South district and was a fee-paying school thus learners received no free meals. Both schools had poorly resourced laboratories. Hence, whenever practical work was undertaken it took the form of a demonstration. These schools were classified as poorly performing because they achieved 50% overall aggregate in the 2012 Grade 12 Senior Certificate examinations (Department of Basic Education (DBE), 2013). Mr H was a soft-spoken teacher and in the second year of his teaching career. He was passionate about using technology and would prepare most of his lessons on PowerPoint slides.

3.3.2 Sampling procedure

Convenience sampling of teacher participants who were former University of the Witwatersrand (WITS) students was done. They were deliberately chosen because they were relatively new in the teaching fraternity. I initially approached five new teachers and two volunteered to participate. I found them suitable because they were teaching Natural and Physical Sciences at secondary schools whose learners came from a wide range of sociocultural backgrounds. I interacted with them for more than seven years as a student at WITS. Thus, their talk in eliciting learners' views in the science classroom was of interest to this study.

At a briefing session I handed both teacher and learner participants letters of invitation and they both agreed to participate in the study. In the process I managed to build a strong rapport with the teachers and familiarised myself with the sites' settings. In the invitation to the teachers (See Appendix I) I mentioned that I will share the findings of the report with them for the purposes of reflecting, broadening and deepening the understanding of their own practice. All learners and teachers participated throughout with no withdrawals at any stage of the project.

3.4 Data collection instruments

Classroom observation was the primary data collection technique. I incorporated interviews into the design in order to seek collaborative data. The advantage of observations is that they may provide a deeper understanding of the phenomenon studied (Runeson & Host, 2009). Then, five lessons for each of the two new teachers were audio-recorded, transcribed and analysed. To understand factors affecting teachers' science teaching practice, it was necessary to conduct interviews to allow them to talk about these factors in depth. Thus, post classroom-observation semistructured interviews involving new teachers were conducted. Semistructured interviewing meant that both respondents were asked identical questions which were in some instances followed by probing. This 'flexibility ensured that important and salient topics were not excluded from the interview, and also provided enough structure to ensure comparability of responses' (Ballantyne, 2007, p. 4). The interviews were audiorecorded, transcribed and analysed to establish teachers' views of their own practice.

I noted contextual information such as school culture in relation to how each school day began and ended, and interesting nonverbal communication such as how the learners related to their teachers. In addition, the notes played an important role in enabling the capturing of information on the chalk board, overheard projector transparencies and PowerPoint slides. All these helped me in forming an opinion about contextual factors and they supplemented verbatim transcriptions.

3.5 Limitations of the design

I need to acknowledge that my mere presence can affect the classroom environment because 'human behaviour is never static. Classroom interaction is not the same, day after day for example, nor are people's understanding of the world around them' (Merriam, 1995, p. 55). My presence in the classroom observation process may have affected the behaviour of the participants thus impact on the results. Interview responses could be biased in that the respondent may describe things the way they think I want them. To take this into account, I attempted to remind them whenever possible that they needed to remain as sincere as possible since this study could provide results that assist in improving their own classroom practice. I only considered a small sample of teachers in the Johannesburg area due to time constraints and scope of a master's programme. However, I took any threats to validity and researcher bias into account through: triangulation of data in analysis process; use of audio recorder; verbatim transcription of data; member checking; and participant review.

3.6 Data collection and analysis

Data analysis happened iteratively with the first classroom observation. Merriam (2002) and Saldaña (2012) argue that data collection and analysis need to take place simultaneously in qualitative research studies. Simultaneous data collection and analysis, she argues, enables adjustments to be made along the way and avoid disaster of looking at volumes of data without a clue where to begin.

3.6.1 Analysis of classroom observation data

In the lesson transcripts, I identified interactions of teacher talk in which learners' ideas on school science were collected and explored. These were then categorized in terms of Mortimer and Scott's (2003) communicative approach model. For the first research question, *how do new teachers elicit learners' ideas about science concepts in the classrooms*?, I searched for the interactive/dialogic extracts which focus on how the new teacher encourages learners to put forward their ideas including those that are quite different from the school science view. For the second research question, excerpts of teacher talk which indicate *what the new teacher does with these ideas once they have collected them* were identified in the transcript. I audio recorded the lessons for verbatim transcriptions to minimise researcher bias.

3.6.2 Analysis of semistructured interview data

I used deductive thematic analysis to make meaning of the transcribed data and thus determine the answers to the third research question, w*hat do teachers say influences the nature of their classroom talk?* I determined the themes in the data through using a pre-determined coding scheme drawn from Anne Raymond (1997). Theme in this study was used to mean a sentence which is the result of coding, and identification of relationships between codes was carried out to describe what the data means. A code here refers to the word(s) resulting from reduction of a phrase in the text from participants' perspectives (McMillan & Schumacher, 2010) just as the book title represents and captures a book's primary content and essence (Saldaña, 2012). In the analysis I used "process codes" which is described as those words or phrases which capture action (McMillan & Schumacher, 2010; Saldaña, 2012). Several of the same codes were used repeatedly throughout the coding process. This is due primarily the repetitive patterns of action and consistencies in human affairs, and also because my aim was to find these repetitive patterns of action and consistencies in human affairs as documented in literature (Saldaña, 2012). Raymond (1997) identified ten factors that influence new teachers of science: science teaching practice; science beliefs; immediate classroom situation; social teaching norms; teacher's life; learners' lives; teacher education programme; past school experiences; early family experiences; personality traits. The interview transcripts were analysed for evidence of these themes in the interview data by recursive readings of the transcripts.

In sum, data reduction and management were necessary steps that led to coding data relevant to themes as suggested in literature. Thus, I coded the whole data set but analysis was limited to the pre-conceived, theory-based themes. First, to answer the first two research questions using classroom observations the themes were interactive/dialogic, interactive/authoritative, non-interactive/dialogic, and non-interactive/authoritative. Second, to answer the third and last research question using semistructured interviews themes were science beliefs, immediate classroom situation, social teaching norms, and teacher education programme. That said, in the analysis of both data sets, I needed to minimise subjectivity through taking into account issues of bias.

3.7 Validity, reliability, and relatability of the study

Validity denotes the trustworthiness of the findings such they are not biased by the researcher's subjective point of view (Runeson & Host, 2009). Put another way, validity is determined by the degree to which the findings accurately portray teacher talk in elicitation of learners' ideas in the science classrooms. Reliability refers to the case in which a second observer using the same theoretical framework interpreting the observations the same way I did. I share Lincoln and Guba's (1985) argument that 'since there can be no validity without reliability, a demonstration of the former is sufficient to establish the latter' (p. 316).

I set out to investigate teacher talk with respect to elicitation of learners' ideas in order to understand new teachers' practice in this regard, rather than to develop generalizable "truths". To do this, I attempted to stay as close as possible to literature. I read and reread the semi-structured interview transcripts in order to be familiar with the data and thus be able to identify key words and ideas that facilitate coding (McMillan & Schumacher, 2010). I included member checking as a way of improving the credibility of this study. I requested teacher participants to give feedback on the overarching themes that I used to interpret the results taking into account the third research question. The following section focuses on justification that the cases studied here reflect, as accurate as possible, the practice of new teachers in their elicitation of learners' ideas.

Constant reflection on existing literature was valuable because I was able to find out what other researchers have done about the problem under investigation in this study and that increased my knowledge of the research area. I gave each teacher participant copies of transcripts of their interactions with the learners and interviews. First, the purpose was for them to validate whether I represented them accurately. Second, the purpose was for them to consider the accuracy of the factors highlighted as influencing their teaching of science.

Thus, both the reading and rereading of transcripts provided the basis for ensuring that the findings were corroborated by collected data. The Supervisor, who also played the role of a 'critical friend', face-validated the semistructured interview instrument. Costa and Kallick (1993) and Opie (2004) reserve critical friend for a trusted person who asks provocative questions, provides constructive and non-judgemental feedback, and requires unambiguous statements supported by evidence. She critiqued such that I ensured that I paid attention to appropriate design methods of the study.

3.8 Ethical considerations

In order to ensure producing knowledge in an ethical manner (Merriam, 1998), I sought permission from the University of the Witwatersrand's Human Research Ethics Committee (HREC) as well as the GDE during the proposal stage of the study. Both institutions (see, Appendices I and J) granted permission. Then participation of the teachers, schools, learners and learners' parents was secured through consent letters and forms (see, Appendices K – Q). The new teachers' names as well as those of their learners were changed in this study to preserve anonymity. Participation by both new teachers and learners in this study was voluntary without any foreseeable risks.

Participation did not have any bearing on learners' marks in science and the participants were assured that withdrawal bore no consequences and could take place at any stage of the research without giving a reason. Furthermore, there was no financial gain for participation in this research study. The audio record was copied and together with the transcripts stored in a password-protected computer. Once both the transcript and the audio record are no longer needed they will be destroyed.

3.9 Conclusion

A qualitative case-study design of two new teachers was adopted for this study. The design was principally influenced by the constructivist paradigm which I described. I used classroom observation and interviews as data collection methods. Other than me, the participants in this study were the two new teachers and the schools in which they taught, their learners, as well as Supervisor. I explained that data collection took the form of audio-recording which was followed by verbatim transcription to increase the credibility of the study. I described how I accounted for possible bias arising from data collection techniques. The transcripts were analysed using Mortimer and Scott's (2003) tool as well as the thematic process. To account for ethical conduct, consent to participate in the study was sought and granted by teachers, learners and their parents/guardians after receiving permission from WITS and GDE to conduct the study. In the next chapter, I analyse, present and describe the results. Additionally, the chapter ends with a discussion of the results in relation to the sociocultural theory of learning.

Chapter 4: Data Analysis and Interpretation

4.1 Introduction

The purpose of this chapter is to present the outcomes of the analysis of data collected on teacher communication patterns in classrooms and subsequent interviews held with the two new teachers. Data from classroom observation, narratives of my personal observation of the classroom setting as well as semistructured interviews are presented, here. I have used pseudonyms "Mr H" and "Ms M" to refer to the two teachers. The research questions that guided this study were:

- *How do new teachers elicit learners' ideas about science concepts in the classrooms*?
- *What do the teachers do with these ideas once they have been suggested in the classroom*?
- *What do teachers say influences the nature of their classroom talk?*

I present selected excerpts of the teachers' lessons to show how I characterised different interactions that occurred during classroom observation. Although a detailed description of this tool was given in Chapter 2, I will refresh the reader's memory about its important aspects. I will then present the results. I will proceed with an interpretation of the result in a discussion.

4.2 Data analysis and presentation of results

4.2.1 Brief description of classroom talk analytical tool

This section presents an analysis of classroom teacher talk using the communicative approach model according to Mortimer and Scott (Table 1). I also present an interpretation of results about the communication patterns that new teachers tend to employ in their science classrooms. The approach is useful to determine whether the teacher engages with learners and whether in that interaction, learners' ideas are taken into account. Thus, I identified and characterised teacher-learner communication in terms of the tool. Table 4, below, is a description of components of the communicative approach and the code assigned to each.

An important point to raise here is that within the interactive/dialogic (I/D) communicative approach, there are two different levels of interanimation (exploration) of ideas according to Scott, Mortimer, and Aguiar (2006). They point out that elicitation of learners' ideas takes place at low interanimation or high interanimation. Low interanimation of learners' ideas refers to situations where a teacher elicits learners' ideas about the topics under discussion, but neither the teacher nor the learners probe the idea or make connections between the various ideas.

Table 4. Definition of communication approach components

I/D – Interactive/dialogic: teacher encourages learners to put forward their ideas including those that are quite different from the school science view.

NI/D – Non-interactive/dialogic: teacher considers learners' possible misconceptions without inviting any input from learners.

I/A – Interactive/authoritative: teacher uses a question-and-answer session to convey and consolidate the school science view though more than one view may be heard – alternative views are discounted. The teacher's sole aim is to focus on the single view, the school science view.

NI/A – Non-interactive/authoritative: as in delivering of a lecture, the teacher presents the school science view only in a monologue. A "closed" teaching situation in that new voices are not entertained by the teacher.

High interanimation of learners' ideas refers to the collection and probing, comparing and contrasting of ideas with a view to making connections between what is known and new concepts. The tool was useful in determining how new teachers worked with learners' ideas once they were available in the classroom learning and teaching environment. In the next section, I identified and characterised teacher-learner communication to support my argument that the analytical tool was useful. I present the ten topics from Natural and Physical Sciences lessons of the two teachers. The ten lessons were on varied topics, as illustrated in Table 5.

Table 5. Lessons recorded, transcribed and analysed

Teacher	Transcript	Topic	Grade	Length of period
Mr H	A	Particulate model of matter	8	40 minutes each
	B	Periodic Table of the elements	8	
	C	Human reproduction	9	
	D	Balancing Chemical Reactions	9	
	E	Electric circuit	8	

Ms M	F	Electric circuit	8	30 minutes each
	G	Measuring voltage	8	
	H	Particulate model of matter	8	
	I	Electricity	10	
	J	Electricity	10	

4.2.1.1 Results of classroom talk

Using excerpts, I counted the number of instances in which the *communicative approaches* occurred in six (see, Appendices A – F) of the ten lessons observed. The purpose of this exercise was to tally, then compare and contrast the *communicative approaches* in order to establish findings for the investigation. Table 6 below is presented to illustrate the prevalence of each approach in the excerpts.

Table 6. Number of instances of communicative approaches

New teacher	**Communicative approach**				
	I/D				
	Low level of interanimation of ideas	High level of interanimation of ideas	**NI/D**	**I/A**	**NI/A**
Mr H	6	0	1	4	6
Ms M	6	0	1	4	6

The teachers facilitated learner participation by asking questions to which learners responded most of the time. Thus, in this case, classroom talk was interactive and dialogic. But, when they fulfilled their responsibility to introduce the scientific perspectives and achieve shared understanding, they did so authoritatively. This illustrates the degree to which learners participated in the classroom's spoken discourse. They were required, instead, to make contributions to check their understanding of the taught school science view.

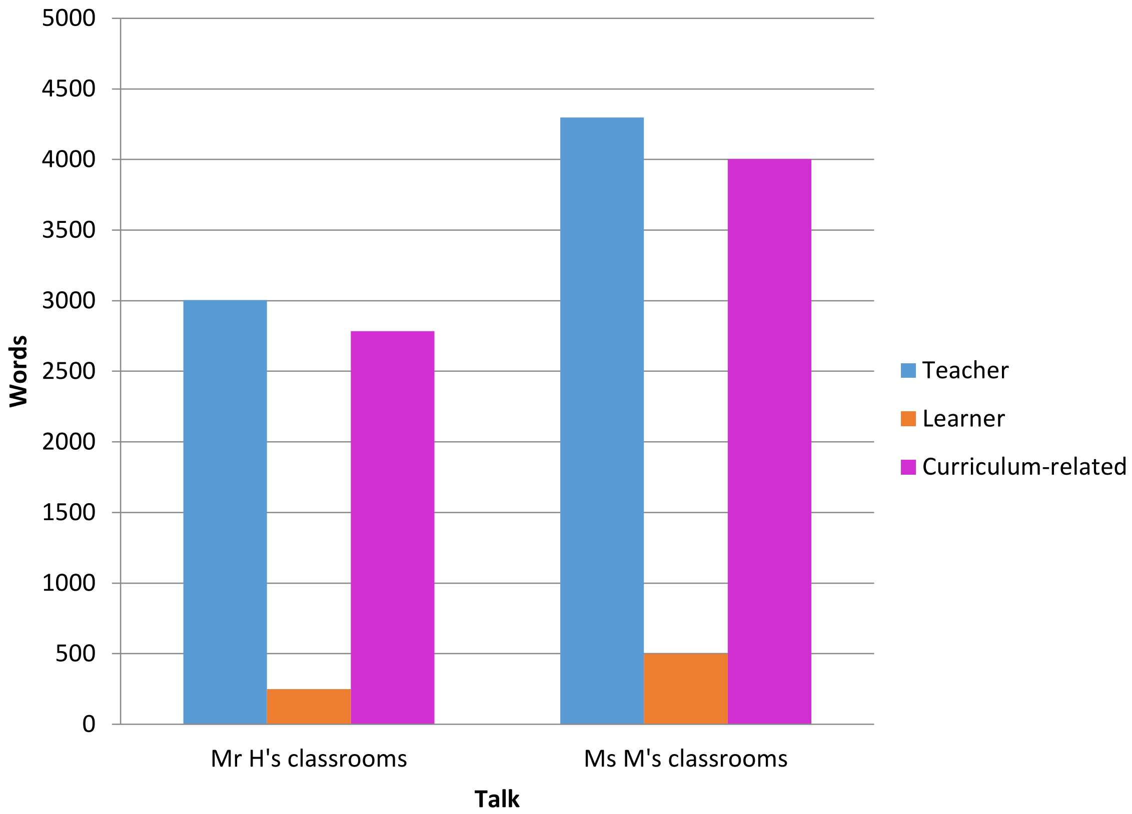

Figure 2: Number of words spoken in the new teachers' classrooms

Teacher talk dominates oral discourse in the classroom (Figure 2). On average, only about 10% of classroom talk was devoted to learner utterances. From a sociocultural perspective, I argue that there is inherently nothing wrong with this situation if scaffolding of learners' understanding takes place during teacher talk. Additionally, from the transcripts, Figure 2 shows that out of analysed turns of teacher talk, about 92% were curriculum-related. Curriculum-related talk refers to any teacher talk about the actual content or skills to be taught (Kogut & Silver, 2009). Another interesting point worth mentioning here is that in Table 6 above there are no interactive/dialogic approach instances that are at high interanimation of ideas. In the final analysis, in any teaching episode aimed at enhancing effective learning, there will be moments of both dialogic and authoritative dimensions played out in both interactive and non-interactive ways.

As examples of the communication patterns identified I present nine excerpts which I analysed using the communicative approach tool. The first excerpt was taken from Mr H's lesson. I begin the presentation with narratives of my personal observation to give a background to the setting in and around the classroom. The significance of this narrative is that though its content describes one school, I had the same experience at Mr H's school. For example, in most cases actual teaching started minutes into the period, intercom announcements and noises from outside the classroom disrupted lessons were common features of both schools.

> *This is the first day of classroom observation at school X and the sky is blue and clear. By the time the siren rings, Mr H and I are already in class waiting for learners to enter. We exchange a few formalities as learners begin trickling in about five minutes into the period. Even then, only a quarter is in class. The rest are gingerly making their way into the classroom. The actual teaching and learning begins approximately 12 minutes into the period. … Two intercom announcements are made in the middle of the lesson – this takes about a minute. Teacher thereafter struggles to get learners back into the focus. Finally after about 2 minutes they settle down.* [Extract from personal narratives – Monday, 9 September 2013].

4.2.1.2 Analysis of classroom talk

From the observation above, it can be deduced that the classroom interactions were affected and interrupted by factors such as late coming of learners and announcements from the administration office. Thus, communication patterns were limited by the circumstances over which the teachers had little control. However, despite the disturbances mentioned, I could identify and characterise teacher communication patterns which were sometimes dialogic and at other times authoritative as demonstrated in the extracts that follow. The excerpts were chosen on the basis of their importance in capturing the character of interactions (see, Table 7, below).

Table 7. Justification of why these particular excerpts were used

Teacher	Excerpt source	Justification
Mr H	Transcript A	To demonstrate an interactive discourse
	Transcript C	To demonstrate a dialogic discourse
	Transcript D	To demonstrate non-interactive/authoritative approach
	Transcript C	To demonstrate dominance of non-interactive/authoritative approach
Ms M	Transcript F	To show movement from interactive to non-interactive approach
	Transcript F	To demonstrate non-interactive/authoritative approach
	Transcript F	To show probing took place
	Transcript G	To show that probes and prompts were used, but to compare and contrast ideas
	Transcript E	To describe the brisk shifts in approaches and show teacher dominated talk

In these excerpts, my main point was to look for teacher communication patterns that elicit learners' ideas, and the level at which they took place. Put another way, I was interested to determine the presence of interactive/dialogic communication patterns at high interanimation of ideas.

Excerpt in transcript A: Interactive discourse in Mr H's lesson on particulate model of matter

The purpose of this excerpt is to present evidence that Mr H's lessons were predominately interactive in nature and moved along the dialogic-authoritative continuum of the communicative approach. In this excerpt, Mr H sets the scene for the new topic by reminding his learners about the previous topic they have been working on before I came to observe his lessons. Mr H presents a lesson on the kinetic particle model of matter by revising the concept of "matter".

(1) ***Mr H:*** *Ok, yesterday we looked at the … ehh … of the solar system … and we also looked at the structure of the earth. I did tell you that you should start looking at matter and material because we are going to look into it, today. So our topic for this afternoon is matter and material. I am going to project to you some stuff… and later on in the lesson, around the end of the period I will play a revision video of what we have learnt. Yeah, look forward to that. Now, when we speak of matter and materials what comes to your mind? What is matter?*

(2) ***L1:*** *Matter is anything that occupies space.*

(3) ***Mr H:*** *You wanted to say that …? [Pointing to another learner].*

(4) ***L2:*** *Matter is anything that occupies space.*

(5) ***Mr H:*** *So that is the definition of matter. Now, can you define, in terms of the atoms and molecules? If someone had to come and say please define for me matter in terms of molecules and atoms, what will you say? Yes!*

(6) ***Ll:*** *Liquid, gas [In chorus]*

(7) ***Mr H:*** *Liquid, gas. You are giving me examples of what matter is. Right!*

(8) ***L3:*** *Occupies space*

(9) ***Mr H:*** *Yeah, occupies space. Yes,* ***we*** *have already said that it occupies space and looking at the matter itself what is the relation now between [Hey … - screaming learning from outside class]. The state of matter, right, and in case of matter there are characteristics that define the state of matter. We said matter is something that occupies space and has mass. So we said there are three types matter, which is liquid, solid and gas. There are three phases of matter. So, these phases of matter we are going to do them in* ***order.*** *We have the solid, the liquid and the gas. What can you tell me about these phases?*

(10)	***L1:***	*They are close to each other*
(11)	***L2:***	*There are spaces between the particles*
(12)	***L3:***	*There are no spaces between them*
(13)	***Mr H:***	*So if there are no spaces between the particles, what then holds these substances together?*
(14)	***L4:***	*Is it glue?*
(15)	***Mr H:***	*No. what is it?*
(16)	***L5:***	*Oxygen.*
(17)	***Mr H:***	*Can oxygen hold things together?*
(18)	***L1:***	*The repelling and the attraction*
(19)	***Mr H:***	*No, we will come to that!*
(20)	***L4:***	*The temperature at which they are made.*
(21)	***Mr H:***	*We have a term, intermolecular forces. So, these forces they hold the particles together. So, this is the definition. To say that matter is made up of tiny particles which are atoms and what is an atom? What is an atom?*

After recapping the previous concepts and informing learners of current focus topic, in turn 1, the teacher poses a question to the whole class, “What is matter?”, opening up for an <u>*interactive/dialogic*</u> approach. In turns 1 to 4, learners appear to have internalised the general definition of matter and in turn 5, Mr H ends the episode, “So that is the definition of matter”. Mr H is still interacting with his learners but authoritatively. The communicative approach shifts to <u>*interactive/authoritative*</u>. Given that a response consistent with the school science view is provided, in turn 5 Mr H asks learners to explain taking into account the particulate model of matter. Then the interaction in turn 7 to 8 involves learners independently offering their ideas which represents a dialogic pattern of communication until the teacher clarifies what he needed to be understood by explaining matter in terms of atoms and molecule, in turn 9. Again, the teaching episode moves from <u>*interactive/dialogic*</u> to <u>*interactive/authoritative*</u> in turn 6 to 9. Then, immediately after ending the episode he opens another <u>*interactive/dialogic*</u> one at the end of turn 9, “There are three phases of matter. So, these phases of matter we are going to do them in order. We have the solid, the liquid and the gas. What can you tell me about these phases?” interaction goes on dialogic where learners take turns to contribute their ideas until turn 21 when the he says “This is the definition”. He makes available the scientific perspective that intermolecular forces hold molecules together. Thus, again, the episode represents a shift to <u>*interactive/authoritative*</u> communicative approach.

Excerpt in transcript C: Dialogic discourse in Mr H’s lesson on human reproduction

I present another excerpt in a bid to illustrate that an interactive discourse is a culture in Mr H’s lessons. Also, the excerpt shows the existence of the shifts in the communicative approach (from interactive/dialogic to interactive/authoritative) highlighted in excerpt, above. This excerpt comes from the teaching sequence at the end of the observation period of my study – it was the last lesson in which I observed Mr H's lessons. The excerpt follows from the teacher's background information on the formation of the ovum as a result of the sperm entering the egg cell. The communication pattern in this excerpt is overall dialogic played out within the school science context in which Mr H scaffolds his learners.

(11)	***Mr H:***	*We were not focusing on that … on fertilization. What happens is that we got what is this the egg and the we got the sperm, right, and we got the sperm and they are all fighting to fertilize, fertilize the ovum. This piece here [Pointing at sketch diagram on Overhead Projector (OHP) requesting that it must a learner moves it]. And when it has now entered the ovum there is a layer. What happens is that this nucleus … it then enters the ovum and at that point that it enters the fertilization takes place.*
(12)	***L1:***	*What is fertilization, Sir?*
(13)	***Mr H:***	*We will get to that at the later stage.*
(14)	***L1:***	*Ok.*
(15)	***Mr H:***	*Hmm … it [Returning to the question] relates to genes and twins and stuff like that. But basically you [learners] have an idea what is going on here, ok.*
(16)	***LI:***	*Yes*
(17)	***Mr H:***	*Great stuff. I want someone to read for us loudly.*
(18)	***L2:***	*[A learner volunteers to read from the textbook]*
(19)	***Mr H:***	*Sibusile is reading please keep quiet. [The learner reads from the textbook] … Ok, I want you to highlight for me. This is the stage of fertilization also known as conception. So if somebody next time, somebody asks you when were you born [Pointing at a learner], what will you say?*
(20)	***L3:***	*3^{rd}*
(21)	***Mr H:***	*Third of which month?*
(22)	***L3:***	*December*
(23)	***Mr H:***	*The 3^{rd} of what?*
(24)	***L3:***	*December*
(25)	***Mr H:***	*Ok, he was born on the third of December when someone asks you when you were conceived … the 3^{rd} of December minus 9 months. So, please like educated high school students. The moment of fertilization is known as conception. So take your birth date minus nine months.*
(26)	***L4:***	*What if you were born premature?*
(27)	***Mr H:***	*If you are premature it means you were born before nine months?*
(28)	***LI:***	*Yes*
(29)	***Mr H:***	*Ok. Wabona uthlowa. If you are premature it means you will fall! [Joking with his learners].*
(30)	***L5:***	*How do I count my conception date?*

(31) Mr H: *But, you count backward, right. Wena you wanna go out you're irritating me, now. [The learner to whom the comment is directed has thrown paper at his friends in the back of the classroom]. So, I also want you to highlight for me zygote. At conception cell, not the cell, the fertilized ovum called the zygote, write for me zygote that's what it is called. [Learners were asked to come to the board]. Write the fertilized ovum next to the diagram. The zygote forms a special membrane around it to prevent any other sperm to enter it. It is now fertilized. Where is the egg, the fertilized egg, where is it? Is in the fallopian tube, into the uterus so that it can attach itself to the … [Inaudible].*

In turns 11 – 17, Mr H introduces the concept of fertilization to his class through providing background information about the sperm cell fertilising the ovum, nucleus. Thus, turns 11-16 represent a dialogic pattern of communication. This time in his class the question comes from a learner. In turn 12, as soon as the teacher pauses, the learner spontaneously asks a question following the former's introduction "What is fertilization, Sir?" Thus this represents the new of an *interactive/dialogic* approach as the teacher responds indirectly to the question instead of offering the explanation, "Hmm … it relates to genes and twins and stuff like that. But basically you have an idea what is going on here, ok". In turn 19 and 25, Mr H gives general statements which use the term, "This is the stage of fertilization also known as conception" and "The moment of fertilization is known as conception", respectively, without taking into account the learner's question. The teacher does not return to the learner's question in the lesson. In turn 17, the teacher authoritatively interacts with his learners as he instructs a learner to read from the textbook. That is, there is movement from the interactive/dialogic approach to the *interactive/authoritative* approach. This represents a shift towards the authoritative end of the dialogic/authoritative dimension.

Turns 19-31 exemplify how a shift from interactive/dialogic to interactive/authoritative communicative approach occurs. The teacher engages L3 in turn 9 by posing a question for the purpose of explaining conception, "So if somebody next time, somebody asks you when were you born, what will you say?" This prompts a response from the learner, "3rd". Thus, the engagement is *interactive/dialogic*. In this excerpt, both teacher and learners pose questions. In turns 26 and 30, learners volunteer to ask questions. In turn 31, while still engaging his learners, he shifts focus and adopts an authoritative stance, "Write the fertilized ovum next to the diagram. The zygote forms a special membrane around it to prevent any other sperm to enter it. It is now fertilized". He asks a learner to read from the textbook to find the scientific perspective. This represents a shift to an *interactive/authoritative* approach.

Excerpt in transcript D: Non-interactive/authoritative approach in Mr H's lesson on chemical reactions

In this excerpt, I want to show an example of a non-interactive/authoritative approach in Mr H's lesson. Mr H here takes charge of what gets written on balancing equations in chemical reactions on the chalkboard. He makes explicit the school science point of view and thus brings his authority to bear in his rejection of input inconsistent with the scientific perspective.

(30)	***Mr H:***	*Now, let's go to chemical reactions. Eh, for chemical reaction we have equations for example ehh if we have N_2, H_2 to form NH_3. What is NH_3? Man 4, what is the name of NH_3?*
(31)	***Ll:***	*[Silence]*
(32)	***L6:***	*[Inaudible]*
(33)	***Mr H:***	*Aksiyiyo (It's not it)! Aniyazi (You don't know it)! Aksiyiyo (It's not it)!*

There is interactive classroom talk in turns 30 to 32 where some learners provide responses to the teacher's questions and he rejects them. He ends the invitations to an interactive talk, "Aksiyiyo (It's not it)! Aniyazi (You don't know)! Aksiyiyo (It's not it)!" and at this moment the flow of the oral discourse shifts from an *interactive/dialogic* to *non-interactive/authoritative* argument. The teacher gives indication that he intends moving to the final acceptable scientific view and thus makes it clear that there is only one acceptable answer to the name of NH_3.

Excerpt in transcript C: Non-interactive/authoritative approach on fertilization, again

I shall present further evidence of non-interactive/authoritative sessions in Mr H's class. He summarizes the progress thus far by intervening in the middle of his lesson.

(9)	***Mr H:***	*In don't want to show you this poster because we are done with the male thing but I gonna show you anyway. Ok can I put it here will it fall. Should I put it here, is it gonna fall.*
(10)	***Ll:***	*No.*
(11)	***Mr H:***	*We were not focusing on that … on fertilization. What happens is that we got what is this the egg and the … we got the sperm, right, and we got the sperm and they are all fighting to fertilize fertilize the ovum. This piece here [pointing at drawing on OHP signalling that it must be coved by a learner]. And when it has now entered the ovum there is a layer. What happens is that this nucleus he then enters the ovum and at that point that it enters the fertilization takes place.*
(12)	***L:***	*What is fertilization, Sir?*
(13)	***Mr H:***	*We will get to that is the later stage.*

The teacher reminds his learners of the progress made in attempting to convey the school science point of view. He repeatedly uses "we" to indicate to the class how far they have come, “What happens is that this nucleus he then enters the ovum and at that point that it enters the fertilization takes place”, what the lesson is not about, “We were not focusing on that … on fertilization”, and where they are going to and defines fertilization as the learner in line 12 asks, “What is fertilization, Sir?” The significance of the “we” in his talk seems to be giving the impression that there has been shared understanding of the school science perspectives.

Excerpt in transcript A: Non-interactive/dialogic approach in the particulate model of matter

The purpose of this excerpt is to illustrate a non-interactive/dialogic communicative approach. I illustrate how Mr H excludes the participation of his learners in the discussion while paying attention to views expressed previously.

(9)	***Mr H:***	*… There are three phases of matter. So, these phases of matter we are going to do them in order. We have the solid, the liquid and the gas. What can you tell me about these phases? [Pointing to three diagrams showing the arrangement of particles in solids, liquids, and gases, on the board]*
(10)	***L1:***	*They are close to each other*
(11)	***L2:***	*There are spaces between the particles*
(12)	***L3:***	*There are no spaces between them*
(13)	***Mr H:***	*So if there are no spaces between the particles, what then holds these substances together?*
(14)	***L4:***	*Is it glue?*
(15)	***Mr H:***	*No. what is it?*
(16)	***L5:***	*Oxygen.*
(17)	***Mr H:***	*Can oxygen hold things together?*
(18)	***L1:***	*The repelling and the attraction*
(19)	***Mr H:***	*No, we will come to that!*
(20)	***L4:***	*The temperature at which they are made.*
(21)	***Mr H:***	*We have a term, intermolecular forces. So, these forces they hold the particles together. So, this is the definition. To say that matter is made up of tiny particles which are atoms and what is an atom? What is an atom?*
(22)	***LI:***	*[Inaudible]*
(23)	***Mr H:***	*We have what is called the kinetic model of matter and it is in the textbook. There are four most important fact of what matter is made of and its function. We looked at the first one … that things are made of matter. There are spaces between the particles. There are spaces in between the particles. There are spaces between particles even though we think they are not there. Now there are forces involved in the kinetic. The second one is … they are in continuous motion … that causes*

them to vibrate immediately they experience heat and energy that is when they vibrate. And, that is what I have said that the things that hold them together are the intermolecular forces.

This excerpt is taken from the middle of the teacher's lesson. Line 9-21 shows the usual pattern of interactions – from an *interactive/dialogic* approach in which the teacher collects ideas from L1, L2, L4 and L4, to the *non-interactive/authoritative* in which Mr H ends the interaction by providing the "official version", in line 21, "So, these forces they hold the particles together. So, this is the definition". Soon after that, in the same line 21, he asks a question, "What is an atom?". Thus, this initiates a shift to another *interactive/dialogic* approach as he attempts to collect ideas. But, learners there is silence (line 22). Then, in line 23, Mr H revisits and summarises the concept of spaces between particles. To do this, he presents two contrasting views which were expressed by learners: "There are spaces between the particles" and "There are no spaces between them". These are views that were not resolved in previous lessons. He pays attention to more than one point of view and thus the approach becomes dialogic. However, this reviewing of ideas takes place without asking learners to take turns in expressing them. That is, he pays attention to more than one point of view without involvement of learners in the classroom talk. Hence, the talk shifts to a non-interactive/dialogic approach. In this excerpt, classroom talk moved from *interactive/dialogic* to *non-interactive/authoritative*, then from *interactive/dialogic* to *non-interactive/dialogic*. I shall now turn attention to Ms M's lessons.

Excerpt in transcript H: Movement from non-interactive/authoritative to interactive/dialogic in the particulate model of matter

I begin by showing how the oral discourse moves from the non-interactive/authoritative to interactive/dialogic approach. She authoritatively reminds her learners about where they are in the lesson. She then attempts to invite learners to put forward their ideas about the scientific concepts and phenomena which case the approaches tends to be interactive/dialogic as well as interactive/authoritative in nature.

(7) **Ms M:** *Now, we are moving to the particle, the particle model of matter. Although the particles in gases and liquids cannot be observed, the following deductions can be made based on the investigations. The first one says that all matter consists of small particles. The second one says that there are spaces between the particles. Let's say you have two beakers or 2 cups, the one or two 2-litre bottle now you … them up, you fill the other one with marble and you fill the other one with sand. When you combine two 50cm^3 volume you expect to have a 100 cm, right? Let's say una 50 grams of marble and you have a 50 grams of sand. When you combine the 50 gram* *of marble with and 50 gram of sand you expect to have 100, right? 50 plus 50 is 100, right? However, in matter it does not work like that. Because there are spaces between particles, when you take those marbles you place them in a beaker, then they will … Patrick!*

***(8)* L:** *Be on top of each other.*

***(9)* Ms M:** *They will lie on top of each other, right? Then you pour the sand. Because the marbles have spaces between them the sand will run through those spaces. So the combined mass won't be 100 grams because there are spaces between the particles. But if ever there were no spaces between the particles. But, because there are spaces between the marbles the mass won't combine to 100g. Any question? Any question?*

***(10)* Ll:** *[Silence]*

***(11)* Ms M:** *Ok, the particles are in constant motion… What it means is that, let's say you have, excuse me! [Trying to call to order a learner who is talking to her neighbour]. What it means is that you have a water droplet let's say you have a water droplet, you let it drip, drip, drip. Those water they are going to collect, like let's say you have a jar then you have a … with water then you put them drop by drop. They are going to drip one after the other because the particles are in constant motion. Any question? Blessing, any question?*

***(12)* L:** *[The learner shakes his head to indicate he has no question?].*

In the first cycle of this excerpt, Ms M excludes the participation of her learners in the talk on the particle model of matter. As in the case of Mr H, she reminds her learners about the phenomenon they need to focus on by using "we", "Now, we are moving to the particle, the particle model of matter". She informs them of what is going to happen next while attempting to explain the model to her learners. The teacher's explanation is necessary because it is "unlikely that they would stumble across the big ideas encapsulated" (Mortimer & Scott, 2003, p. 71) in the kinetic model of matter. The model is abstract.

In the process, she gives the scientific view on the particulate nature of matter. I deduce that this represents a <u>*non-interactive/authoritative*</u> *approach*. However, in her closing story, she starts a second cycle which is interactive in character. She invites her learner to make known his idea on the positioning of particles in matter, "Because there are spaces between particles, when you take those marbles you place them in a beaker, then they will … Patrick!". Now, she interacts with her learners and the classroom talk shifts to the dialogic end of the authoritative/dialogic spectrum as she evaluates the response, "They will lie on top of each other, right?". Thus, the communicative approach has become <u>*interactive/dialogic*</u>.

Excerpt in transcript F: From interactive to non-interactive approach

I present this excerpt to show that Ms M interacted authoritatively with her learners as she explains the school science terms of invisible static electricity charges that cause attraction forces between particles in molecules and compounds.

(19)	***Ms M:***	*Ok, let's say you have a comb, ikama, and you have a piece of papers, then you rub the comb in your hair. Then, when you take the comb and attract them or a ruler, the papers will attract to the ruler because there is a force of attraction. When you have two magnets, when the south pole with the, you take the south pole and a north pole they are going to attract because there is a force of attraction. But, when you have … [Learner interjects].*
(20)	***L:***	*Like boy and girl! [Laughter from teacher following learner's comment].*
(21)	***Ms M:***	*But when you have a south pole facing the south pole they are going to repel each other. Any question? Patrick?*
(22)	***L:***	*[Inaudible].*
(23)	***Ms M:***	*Everything! Remember that when I first introduced the lesson I said everything in the universe is made of matter. So matter includes the particles, the atoms, the molecules. Everything. Any question?*

In the opening line (L19), the teacher uses analogies of a comb attracting pieces of paper after being rubbed on hair as well as bar magnet's South and North Pole to explain static electricity. She introduces a new scientific view as to the existence of electric charges in matter and a learner voluntarily elects to provide his own, "Like boy and girl!". As a consequence, the classroom talk is *interactive/dialogic* in character. However, in line 23, she reviews the definition of matter with her learners without requiring their input and provides more clarity on what constitutes matter, "Remember that when I first introduced the lesson I said everything in the universe is made of matter. So matter includes the particles, the atoms, the molecules. Everything." This is an example of a *non-interactive/authoritative* approach. Thus, this excerpt is evidence of a transition between dialogic and authoritative approaches that takes place in Ms M's lessons.

Excerpt in transcript F: Ms M talks school science

In this excerpt, I shall show that teacher's communication patterns can be characterised as non-interactive/authoritative as I found in Mr H's classroom.

(26)	***L:***	*No. Mam.*
(27)	***Ms M:***	*Why don't you take down notes because we are going to do an activity after this and I am taking this books [Pointing at learner's book] with me when I go. Since we have learnt about circuit diagram we can look at the two types of electric*

circuits. Can you name them? These are circuit diagrams, right. We all know how to represent certain apparatus using a diagram. So now because you know we are going to learn about electric circuit. Remember that our topic is electric circuit in circuit diagrams. So, now we are going back to the main topic. We are going to look at electric circuit. The … [Interruption].

(28) L: *Sorry Mam I just want to take …*

Ms M rebukes a learner who seems to be watching her instead of taking notes as she teaches. In the process, she takes a look back and forth about the concepts involved in the lesson without involving her learners. They do not interact with her as she continues to summarise progress thus far. She informs to class of where they are going by reminding them that "Since we have learnt about circuit diagram we can look at the two types of electric circuits". Here, the focus is on pausing to look at previous concepts. She assumes that they have a common understanding of the features of a circuit diagram and how it is represented diagrammatically. She further reminds the learners "we are going back to the main topic. We are going to look at electric circuit." Ms M, as it the case in Mr H's lessons above, uses "we" to seemingly illustrate that a shared meaning has been established on the concept of circuit diagram and its representation. I have counted six of them ('we') in her talk in line 27 alone. Though the intention to share a common understanding of the school science view is noble, there can be no guarantee that it has been achieved since individual learners construct their own understanding of concepts because scientific concepts do not carry unique meanings (Mortimer & Scott, 2003). Thus, the classroom talk in this excerpt is *non-interactive/authoritative* in character.

Excerpt in transcript F: Ms M probes in electric current lesson

I present this excerpt from a demonstration by Ms M to show that, probing took place also in Ms M's classroom. Ms M's aim of the lesson was to make learners construct understanding of a series circuit, a common grade eight Natural Sciences topic that is useful to master before high school Physical Sciences – Physics in particular. Among other things she traced the path of the electrons in in the drawings and pointed out what would happen in the series circuit if one of the bulbs were to burn out. Ms M gave her learners a circuit that she had assembled using a circuit board. On the board three cells, two bulbs, a switch and an ammeter were connected in series and, a voltmeter is connected in parallel. The teacher asked the learners to determine whether one of the bulbs would glow when she turned its switch off.

(1) Ms M: *Ok, this is a series circuit, you can see they are working they are all glowing, right? Then, I remove one, then I remove one bulb and it is working you saw that, right. It's*

		working you can see, right? The switch is still here. Then, I put this one which is not working. ***Can you guess what's going to happen?***
(2)	***L1:***	*Yes. It's going to light*
(3)	***Ms M:***	*Going to light! Anyone who wants to predict what's going to happen?*
(4)	***L2:***	*No, angeke ilaite (No, it will not light)*
(5)	***Ms M:***	*Angithi bengifake lela beyilaita uyibonile angithi. Now I have removed this light it's working I have replaced with this one which is working. This is a series circuit I'm done with parallel**. Can you predict what is going to happen?** Izoglowa (Will it glow) or not?*
(6)	***L3:***	*No, angeke ilaite (No, it will not light)*
(7)	***Ms M:***	*No. It's not. It's not going to work. Can you tell me why? No it's not that. In a series circuit, are you listening?*
(8)	***L4:***	*The batteries are not working.*
(9)	***Ms M:***	*No. The batteries are working. You see. No, you see it's still glowing so the batteries are working. But when I include this one which is not working it is not glowing. When I put it here, it's going to glow. Remember that I am not including this one. So, I have to include this and predict what's going to happen. I have in series a bulb that is working and one bulb that is not working. <u>In a series circuit when one light bulb ceases or when one bulb is not working, all the light bulbs are not going to work</u>. Can you tell me why?*
(10)	***L3:***	*Because the electricity circuit is cut, so the circuit is not complete.[Discounts learner's idea with no reason- does not revisit it, later]*
(11)	***Ms M:***	*Atlhegang?*
(12)	***L5:***	*Mam, electricity …*
(13)	***Ms M:***	*Very good! Because the circuit is incomplete even though I close the switch. Because this path is not working the electricity is not flowing from this path to that path so the circuit is incomplete. But, in a parallel circuit it doesn't matter. When one, you can notice in your home. Let's say the kitchen bulb ceases is not working the kitchen light will also glow.*

From turn 1 to 9, the classroom talk is <u>*interactive/dialogic*</u> as Ms M collects learners' ideas and probes for their understanding. She starts the interaction by posing a question, "Can you guess what's going to happen?". Two possible hypotheses are presented (Turns 2 – 6). These are, "Yes. It's going to light" (L2), "No, angeke ilaite [No, it will not light]" (L3). Up to turn 8 learners were not providing her with the scientific responses. Thus, turn 1 to part of turn 9, represents communicative approach shifts from <u>*interactive/dialogic*</u> to <u>*non-interactive/authoritative.*</u> That is, she uses dialogic interactive talk to elicit learners' ideas on electric current and later on a non-interactive authoritative stance to give the "official" version of what happens when one bulb goes out in a series circuit, "In a series circuit when one light bulb ceases or when one bulb is not working, all the light bulbs are not going to work". From part of turn 9, the talk again shifts to an interactive/dialogic approach as Ms M invites justification, "Can you tell me why?" Here, the teacher seeks elaboration on learner's' idea. In line 12, the learner responds, "Mam, electricity*".* Ms M immediately judges the response as correct from the school science view. The classroom talk ends on an *interactive/authoritative* note. Thus, turn 9 to 13 represent a shift again from an *interactive/dialogic* approach to an *interactive/authoritative* approach. Next, I focus on the analysis and interpretation of semistructured interview data.

Excerpt in transcript G: Missed opportunities for high interanimation of ideas

In this excerpt, Ms M attempts to present the school science perspective on electric current. This excerpt is intended to show how Ms M probed her learners' ideas except for the purposes of contrasting and comparing learners' ideas. In this way, I hoped to show that prompts used in new teachers' classrooms seemed not to create opportunities for high interanimation of ideas. That is, teacher communication patterns seemingly did not lead to comparing and contrasting of learners' ideas.

(1) Ms M: *Ok, as I have just said, that today we are going to learn about measuring voltage. That is your heading. I've asked you, what is a voltage? What is a voltage?*

(2) L1: *Something that … something that powers. Is a power of energy that is found in an electric box*

(3) Ms M: *Something that is found in electric box!*

(4) L1: *Yeah!*

(5) Ms M: *Thabo.*

(6) L2: *Is the power of energy that is found in an electrical box*

(7) Ms M: *Is a power of energy that is found in an electrical box? [Bounces back the answer to sustain the scientific story]*

(8) L2: *An electric box!*

(9) Ms M: *An electric box. So, what you are saying is that voltage is only found in an electric box?*

(10) L3: *No. Mam i-battery. It is the voltage found in bulb.*

(11) Ms M: *No, a bulb does not have a voltage – it has a watt.*

(12) L3: *I think, Mam, some other thing like maybe 16 V.*

(13) Ms M: *No, 16 volts it simply says is energy that is required by the bulb to light. Ok, a voltage is the ability of a cell to produce current.*

(14) L4: *What? Please, repeat, Mam!*

(15) Ms M: *Voltage is the ability of a cell to produce current.*

Ms M poses a question to learners who take turns to respond (turns 1 – 8). In this way an *interactive/dialogic* communicative approach is maintained by the teacher and her learners, particularly L2 and L4. These learners volunteer their answers and the teacher does not evaluate them as right or wrong but simply accepts them. In turn 9, Ms M seems to probe the learners' ideas by reformulating L2's response, "So, what you are saying is that voltage is only found in an electric box?" However, these ideas are not extended, further, using, for example, prompts such as "L2 says that …, L3 thinks that … So, what do you say, L4?". In turn 15, Ms M intervenes to end the talk on the meaning making process, authoritatively. The school science perspective on voltage is the focus of the lesson and is made available to end the interactions, "Voltage is the ability of a cell to produce current". Thus, a shift to a *non-interactive/authoritative* teaching approach takes place. The exchanges from learners were brief. The following excerpt is further evidence that brisk dialogic to authoritative phases seem to be a common feature in the classrooms.

Excerpt in transcript E: Brisk dialogic/authoritative shifts in classroom talk

The aim of using this excerpt is to exemplify prevalence of brisk question-and-answer sessions which moved from interactive/dialogic to non-interactive/authoritative in new teachers' classrooms. This excerpt further demonstrates that teacher talk dominated interactions in the classrooms.

(1) **Ms M:** *Ok, class, today we are going to learn about electric circuit. What do you understand by the term, electric circuit? What do you understand about the term, electric circuit? What is an electric circuit, Lindokuhle!*

(2) **L1:** *It is a flow whereby …*

(3) **Ms M:** *Is a flow … of what? [learners noisy]*

(4) **L1:** *Of charges.*

(5) **Ms M:** *Not exactly. I'm not asking about the electric current. Electric current is a flow of charges, right. I am asking about the electric circuit. Do you know what is an electric circuit? Have you come across one?*

(6) **Ll:** *Yes.*

(7) **Ms M:** *Ok, define for me what is an electric circuit … Elina? [Pointing at the learner].*

(8) **L2:** *Something like wires, batteries and globe.*

(9) **Ms M:** *Very good. When we talk about electric circuit we are talking about an arrangement of components. For instance, you may have a battery, a switch, a light bulb, and other components connected in such a manner that electricity may flow. So, electric circuit in other words is an electric device that provides path for electric current to flow. Before we learn about electric current we need to know the international symbols that are used. Just like as builder. A builder needs a plan in order to build a house. Electricians and scientists … electricians and scientists also need a plan in* *order to know how to install electricity to various rooms of a house or classes in your school. So, that plan is known as a circuit diagram. [Teacher draws circuit diagram on the board].*

From turn 1 to 8, the dialogue begins with an *interactive/dialogic* approach, as usual, with Ms M posing a question, "What do you understand about the term, electric circuit? What is an electric circuit, Lindokuhle!" Then, learners make their ideas available. Learners L1 and L2 give their responses, "It is a flow whereby … ", "Something like wires, batteries and globe", respectively. Ms M ends the exchanges by judging the responses in terms of the school science view, "Very good. When we talk about electric circuit we are talking about an arrangement of components. For instance, you may have a battery, a switch, a light bulb, and other components connected in such a manner that electricity may flow." The talk shifts from a dialogic phase in which Ms M elicited learners' ideas to a much more authoritative stance in which the school science view is confirmed. Thus turns 1 – 9 represent a shift of classroom talk from an *interactive/dialogic* communicative approach to an *interactive/authoritative* approach.

4.2.2 Brief description of interview analytical tool

Semistructured interviewing took place early September 2013 after school in one of the offices of the teachers' Heads of Department (HOD) to minimise noise disruptions and disturbances from other teachers and learners. The HODs were welcoming as they were made aware of the research study in a briefing they received from their respective principals. In each case, I arrived at the schools after confirming the presence and readiness of the teachers to honour the appointment. The purpose of the visit was to collect interview data for analysis and interpretation.

The purpose of this section was to determine the answer to third research question, w*hat do teachers say influences the nature of their classroom talk?* In other words, I wanted to understand the factors that teachers say made them work with learners' ideas the way they did. I wanted to understand their approach to learners' ideas in the science classroom in order to reconcile their actual classroom practice with their ideal interactive classroom. To do this, I transcribed, verbatim, semistructured interviews data and thematically analysed data.

In this section I present results and an analysis of semistructured interview data. I used theoretical thematic analysis in the analysis of semistructured interview data. According to Hayes (1997), one possible way of precluding my influence in the analysis of data is to allow previous theory to give direction. This adds to the reliability of the results. Hence, the themes within data were identified in a theoretical or deductive way (e.g., see Boyatzis, 1998; Hayes,

1997) using Raymond's (1997) model (see, Figure 1). Coding involved reading through interview data marking phrases or words that appear to refer to the same thing with particular codes as described in Table8, below I described this model in Chapter 2. However, Table 8, below, may refresh the memory of the reader. Interview data was coded consistent with procedures outlined by Braun and Clarke (2006). Coding of the teachers' responses was based on the interview questions pertaining to factors influencing their expressed intention to elicit learners' ideas.

Table 8. Coding system

Theme	Process coding
Science beliefs	About the nature of science and science pedagogy (teaching & learning of science)
Immediate classroom situation	The learners (abilities, attitudes, and behaviour), time constraints, the science topic at hand
Social teaching norms	The school philosophy, administrators, standardised tests, curriculum, textbook, other teachers, resources
Teacher education programme	Science content course, methods courses, field experiences, student teaching

The frequency counts of codes in this study bear no significance to the results because 'In many cases, rare experiences are no less meaningful, useful, or important than common ones. In some cases, 'the rare experience may be the most enlightening one' (Krane, Andersen, & Strean, 1997, p. 215). Further to that, Braun and Clarke (2006) remarked that 'a theme might be given considerable space in some data items, and little or none in others, or it might appear in relatively little of the data set' (p. 82). In doing so, they effectively summarized the importance of capturing a theme to value its substance. But, Braun and Clarke were not done there – they continued by explaining the statement made:

> it is not the case that if the theme was present in 50% of one's data items, it would be a theme, but if it was present only in 47%, then it would not be. Nor is it the case that a theme is only something that many data items give considerable attention to, rather than a sentence or two. (p. 82)

For these reasons, a code was created though only one of the two teachers uttered the words and frequency counts are included solely so that readers and I can note how often words were mentioned by the teachers. Put another way, frequency count of codes, in Figure 3, are not necessarily associated with any degree of importance.

4.2.2.1 Results of semistructured interviews

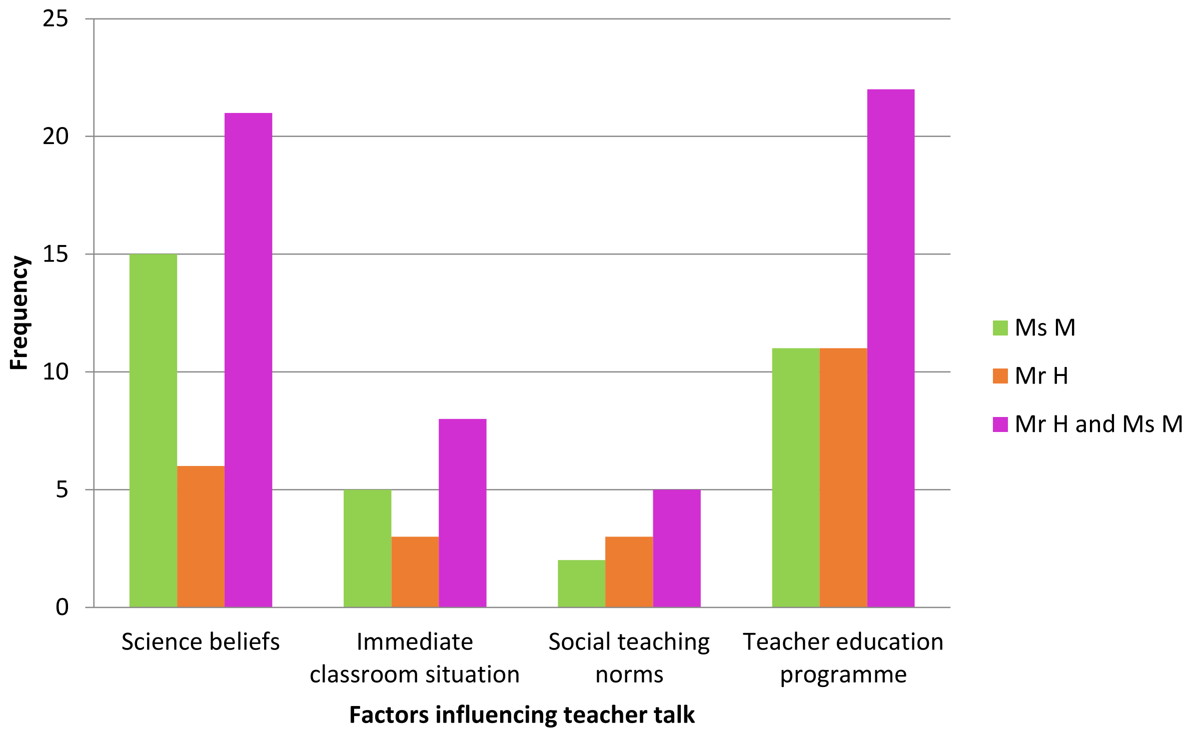

Figure 3: Semistructured interview results on factors influencing new teachers' talk

4.2.2.2 Analysis of semistructured interview data

In this section an account of the interviews is presented which outlines the insights into the new teachers' perspectives of their individual practices. The interviews with Mr H and Ms M offer insights to the kinds of ideas which each holds about what influence their classroom practice. The first step taken in analysing the data was therefore to transcribe all of the audio records of interviews. The coding scheme belongs to the some pre-determined system of themes. The excerpts, below, are meant to illustrate and exemplify the findings which I described in the section, above. Excerpts from the interviews of Mr H and Ms M are presented below to provide an overview of the four themes which appeared to influence the graduates' communication patterns.

4.2.2.2.1 Teacher education programme

Methodology courses

The two teachers completed the same methodology courses taught by the same lecturers. They both expressed their appreciation of the importance of learners' ideas showing this by describing them in terms of the constructivist view of learning. When asked to explain prior knowledge and its importance, they said:

Ms M

> [15]*Very. It's the basis of each and every lesson that I teach in class. When I present new content the prior knowledge comes up and it's always and it is what I begin with in my teaching … [9]Prior knowledge is constituted by everything from the little things they do in their everyday life the little theories, the little facts or myths cultural background. That constitutes their prior knowledge*

Mr H

> [2]*Hmm, prior knowledge is the information, and, hmm, basically the knowledge that learners bring into class before you actually teach the topic of the day … [3]Is to see is if they have sort of an idea of what I am going to teach about because they come there with already they have ideas in their minds if I can make an example, an element, resources. So to draw on that prior knowledge it actually tells you what they see, resources, elements are [Inaudible].*

Field experience and student teaching

The teachers also talked about how they were able to make the learning of science interesting by creating and using activities that work. To describe what they considered to be teaching strategies that worked well for them, they appealed to their experiences. For example, Ms M described engaging her leaners in practical work as "[22]It's always fun". Similarly, Mr H expressed his view from his field experience:

> [23]*You can teach outside the classroom and learners will be happy to learn outside the school ground and about science then you teach outside the classroom then they have fun outside.*

4.2.2.2.2 Science beliefs

Learning of science

New teachers had their own perceptions about their learners and how they learn science. They constructed knowledge about science, learners, and the science classroom relative to their own experiences. Ms M used group work strategy to make her learners interact with the content through talk – giving time to learners to turn and talk to their neighbours, for example. She acknowledged that she could not reach all of them:

> [10]*I usually know learners are actively participating when I see them engaging in the content that I am presenting if they asking questions … When you want to do a demonstration some of them are busy there at the back with their own thing.*

In the case of Mr H, learning of science depended on him:

> *I would rather have those questions directed to me then I will direct the questions to learners which then can be answered*

Teaching of science

New teachers talked about how they control classroom interactions. Ms M commented that she had her own way of teaching science:

> *I usually like peer teaching. I like to get them working among themselves and I move around so that I can get ideas from them. I don't like to be the one who always do the talking in class I always doing the talking in class I always like to pick up on them like to pick on them.*

The new teachers in this study influenced and controlled construction of knowledge by their learners. When asked about whether he allows learner-learner interactions, Mr H stated that "Not really because it is not a chance *[Inaudible]* that hmm lies on me to give them".

4.2.2.2.3 Social teaching norms

<u>*Curriculum*</u>

Both teachers were concerned about pacing, covering the curriculum.

Mr H:

> [18]*Things that I find difficult is trying to keep a balance between try to cover all the slides sometimes when you and try to focus on the power point forget that I need to interact with them interact with them.* [19]*Sometimes when you interact with them you end up not finishing so that's basically it.*

Ms M:

> *Ahh, sometimes you find that hmm learners aren't moving at the same pace as you wish. Say, for instance, you arrange them in groups, you find that there is one person dominating in the group they're still not clear what they need to do.*

<u>*Resources*</u>

The availability of resources and sometimes Mr H became self-sufficient. He purchased equipment from his own pocket for conducting learning activities in the classroom:

> [20]*I use, most of the time I use power point tangible resources which I buy some I create* [21]*to make things easier and the subject interesting*

In the case of Ms M, she conducted demonstrations on electric current at her Table and learners had to gather around her while she attempted to teach this topic. She made a comment that:

> [22]When you want to do a demonstration some of them are busy there at the back with their own thing.

4.2.2.2.4 Immediate classroom situation

<u>*Time constraints*</u>

There was seemingly a concern about limited time available to promote interactions. In the classrooms new teachers attempted to interact with their learners to elicit ideas principally through talk. However, they said that their intention to interact was constrained by time. Mr H, for instance, mentioned that "[19]Sometimes when you interact with them you end up not finishing so that's basically it."

Further to that, Ms M seemed to express views relating timing her engagement of learners:

> [23]*So, what I like to do is to always engage them in what I do… so that I can keep* [24]*checking if they are moving at the same pace with me*

<u>*Managing learner behaviour*</u>

Mr H went as far as to say that he restricted learner-learner interactions on the basis that they tend to be disruptive:

> *So, to avoid disruptions in class I would rather have those questions directed to me then I will direct the questions to learners which then can be answered.*

Similarly, Ms M commented about her learners:

> [23]I use it sometimes as a positive reinforcement. They know if they behave well then there is pract.

4.3 Discussion

These data provided some insights into the new teachers' communication patterns and the factors that influence them. Classroom talk argued against interview data indicated a gap between what new teachers say and their actual teaching practices. The results from ten classroom observations and two semistructured interviews are presented separately in three sections according to the research questions.

4.3.1 How do new teachers elicit learners' ideas about science concepts in the classrooms?

The first research question asked how new teachers elicit learners' ideas in the science classroom in an interactive/dialogic sense. The evidence suggests that new teachers posed questions and expected learners to respond in accordance with the school science perspectives – they discounted responses that they deemed to be scientifically incorrect. For example, Ms M evaluated learners' answers by saying, "No, a bulb does not have a voltage – it has a watt", "No, 16 volts it simply says is energy that is required by the bulb to light", and Mr H said, "No. what is it?", "No, we will come to that!". In both teachers' lessons, there was evidence of dialogic interactions as well as authoritative interactions. That is, the lessons were largely interactive with few moments in which teachers' approach was non-interactive as a result of their ultimate responsibility to present the school science view to learners.

However, the results suggest that these dialogic interactions took place at the low level of interanimation of learners' ideas. Teachers paid little attention to probing learners' ideas thus limiting their opportunities to make meaning of the school science view. The fact that learners responded accordingly to the teachers' question, does not necessarily imply that the rest of them in that particular lesson internalized the concepts. One possible reason for the low interanimation level is that the nature of science as an authoritarian subject which automatically minimizes opportunities for dialogic discourse at high interanimation (Osborne, Erduran, & Simon, 2004). They make the point that 'the authoritarian, dogmatic nature of the discipline means that opportunities for dialogic discourse are minimized (p. 997). However, in contrast, Morge (2005) argues that scientific knowledge is constructed and teachers have the option of viewing it precisely as a social construction. Thus, I concur with Morge's (2005) argument because scientists themselves discuss their ideas, theories among themselves as well, which demonstrates that school science concepts require exploration in the classroom, too. However, this takes place best when learners initiate the discussions.

The results presented above illustrate that teacher questions dominated the interactions and this situation is regarded as a constraint to meaningful learning (Chin & Osborne, 2008). Learners' questions are important but they were few in the lessons of both Mr H and Ms M. The questions may reveal underlying misconceptions and errors (Driver, Asoko, Leach, Mortimer, & Scott, 1994). Thus, opportunities for the exploration of concepts were limited and in the process underlying misconception may be perpetuated. The lack of learner question also impacts on dialogic exchanges in the science classroom. The topic on human reproduction, fertility, created a space for the emergence of interactive/dialogic communicative approach of a high interanimation. That is, there were opportunities for a considerable scope to explore socio-scientific issues since this topic was interesting and had the potential to spur dialogic interactions at a high level – issues such as the good and the bad of the contraceptive pill. Nothing like that happened, though.

The new teachers could not support talk in their classrooms – learner questions were not probed such that whole-class discussion could take place. I did not intend to observe talk for its sake only because, as Walshaw and Anthony (2008) point out, more talk in classrooms does not necessarily enhance learner understanding. I am cognisant of the fact that these were new teachers who were attempting to define their role in the science classroom in the absence of induction programmes. Clearly, it follows that new teachers need to be skilled in the area of elicitation of learners' of learners' ideas at a high interanimation.

4.3.2 What do teachers do with these ideas once they have been suggested in the classroom?

The second research question was asked to determine what the teachers do with these ideas once they were available on the social classroom environment. From the analysis of results above, there were no instances which could be classified as interactive/dialogic at a high interanimation of learners' ideas. Put another way, there were limited interactions involving teachers probing learners' ideas to the extent that contrasting and comparing took place. Thus, evidence suggests that new teacher does little to compare and contrast learners' ideas. In fact, the few glimpses came from two of Ms M's request to learners to formulate *hypotheses* about whether or not a series circuit would work if the bulb were blown out, "Can you predict what is going to happen?" She then invited them to explain why they got that particular result after hypothesizing. Learners did not respond and finally she told them her hypothesis, "Can you tell me why?"

However, learners' ideas provided opportunities for exploration of concepts. In Mr H's class, on human reproduction, they enquired, "Why can't women swim? [when they are pregnant]", "How do I count my conception date?" and "Why can't some ladies get pregnant?" These questions were important and valid, in my view and thus they warranted a response either in the same lesson or in subsequent lessons to enhance their curiosity to make sense of the natural world. In support of this notion, Scott et al. (2006), suggest that the practice in which learners' ideas are contrasted and compared with the school science perspective supports effective learning. In addition, on this matter, Mercer, Dawes, and Staarman (2009) maintain that:

> Talk is considered to be more dialogic the more it represents the students' points of view and the discussion includes their and teacher's ideas. So a sequence in which several students explained their ideas about a phenomenon and discussed with the teacher and the rest of the class how those ideas related to scientific knowledge would be judged interactively/dialogically. (p. 354)

Teacher questions and probes in classroom interactions are significant forms of scaffolding in that they help learners conceptualise school science ideas which would be beyond their unassisted efforts (Kawalkar & Vijapurkar, 2011).

These questions engendered interest and excitement in learners and I want to think that they may have looked forward to a sustained interrogation of these questions as they independently volunteered to ask them. Such learner contributions is consistent with the suggestion that 'content which is directly linked to students' interests or is highly exposed in the media tends to support the emergence of students' questions' (Aguiar, Mortimer, & Scott, 2010, p. 179). In one of classroom observations I did, Mr H was honest and open that he did not know some of the answers to the learners' questions. He, however, ended the talk authoritatively, "But, now you are asking silly questions. Do my activity". Mr H's response is consistent with the claim that sometimes the learners' questions are difficult for both the teacher and learners to respond to (Chin & Osborne, 2008). In my experience as a science teacher this is the sort of response that would follow if difficult questions were not answered by the teacher.

Dori and Herscovitz (1999) remarked that, in a study by Watts, Alsop, Gould, and Walsh (1997), learners' questions made a teacher aware of her inadequate subject matter knowledge. This point that new teachers learn the content while teaching is exemplified in Mr

H's response to a learner's question on the topic of human reproduction, about reduction in sperm count resulting from bathing in hot water, "I don't know if there is a connection". Hence, he seems to keep classroom discussion to a minimum thus constraining dialogic interactions and like many new teachers, points out Brickhouse (1992), relied on the textbook, which did not have the answer to the learner's question.

The suggestion that once the [new] teacher has been exposed to learner questions they will be in a stronger position to work with them if and when they arise in future (Aguiar et al., 2010) is welcome. This suggestion makes it possible for the new teacher to benefit from exposure to learners' questions and, thus build for themselves a stronger knowledge base. Exposing new teachers to learners' questions may enable them to form better strategies of handling them. Borko and Livingston (1989), however, found that new teachers seem to lack the techniques to facilitate sharing of ideas at a high level interanimation level although they may have the intentions to do so. Thus, though the suggestion by Aguiar et al. (2010) provides thoughtful insight on coping with learners' difficult questions, I think that we need more than just advice. I argue in the next chapter that new teachers' development programmes informed by research studies, need to be undertaken in this regard.

The results illustrate that the new teachers do not always probe learners' responses. Further to that, if they do, the prompt seldom invoked further elaboration of learners' point of view and thereby sustain the interaction. Most of teacher questions were of information recall type, "What is matter?, "What is a … an electric circuit?", "Define for me an atom in terms of …", and so on. In appreciation of the value of exploring learners' ideas, Scott et al. (2005) argue that the practice in which learners' ideas are contrasted and compared with the school science perspective supports effective learning. Nonetheless, the fact that both teachers and learners posed questions is indicative of a dialogic pattern of communication. The results demonstarate that there are two poles in communication patterns in the science classroom – movement from dialogic to authoritative communicative approach (Mortimer & Scott, 2003).

The results reveal a high occurrence of interactive/authoritative communicative approach. I attribute this to the fact that most of science concepts are abstract. Accessing the natural world and its properties is problematic and almost impossible for learners to do in a science lesson since it requires sophisticated laboratory instrumentation (Johnson, Hodges, & Monk, 2000). Matthews (2002) point out that it took scientists years of patient study to bring scientific knowledge to its current state. Hence, Saglam and Millar (2006) suggest that learners are unlikely to have encountered some scientific concepts like electromagnetic induction prior to instruction. Thus, new teachers seemed to have no choice but to authoritatively introduce the school science perspective. Additionally, non-interactive/authoritative approach has worked and continues to work for other learners whose learning style ultimately adjusted to this teaching approach (A. Msimanga, personal communication, November 15, 2013). Mortimer and Scott (2003) concur and make this point clear:

> A class of science students could sit and discuss among themselves from now until doomsday, for example, the ways in which kinematics trolleys run down slopes and it is highly unlikely that they would ever stumble across the big ideas encapsulated in Newton's laws of motion. It is the job of the science teacher to intervene to introduce new ideas and terms, and to move the scientific story along. (p. 71)

4.3.2.1 Teacher talk dominates

A corollary finding was that teacher talk dominates classroom spoken discourse (see, Table 2). This is a finding that is consistent with other research studies on classroom interaction (Morton, 2012; Hayes & Matusov, 2005; Antón, 1999). The teacher is responsible for, and in charge of, what happens in their classroom. Additionally, they determine who contributes questions and responses during classroom interactions. The teacher uses authority – a fundamental component of roles that come with the position. As a consequence, the teacher tends to talk much more than the students. According to Anderson (1989), teachers who spent more time interacting with learners about content create better opportunities for learning. Further to that, I found that a large percentage of the talk was curriculum related. I want to suggest that the fact that curriculum-related matters occupied much of classroom talk is reasonable in light of the ultimate responsibility of the teacher – the underlying concern to cover the content material. This focus on curriculum content was reflected as a factor that influence about curriculum coverage expressed in interviews. However, I concur with Kogut and Silver (2009) when they suggest that while the bulk of teacher talk is curriculum-related is a positive feature of the instruction, the heavy use of teacher-led activities led to a traditional pedagogy with limited opportunity for exploration of learners' responses.

4.3.3 What do new teachers say influences their teaching?

As stated earlier, one of the concerns of this study was the issue of factors influencing new teachers' communication patterns in the science classroom. On the basis of the results and within the limitations of the small sample, some tentative findings were made. I present a discussion of results of the analysis of interview data. The findings reported here are only focused on the factors influencing new science teachers' practice – in relation to the third research questions that partly guided the study. To answer this question, I found Raymond's (1997) analytical tool very useful because it suggests a range of comprehensive factors influencing new teachers' practice in the science classroom. Further to that, it builds toward an understanding of factors that contribute to the inconsistency between what new teachers say they do and what they actually do in the science classroom (Raymond, 1997). I found that new teachers seemed to indicate that, in descending order, their education programmes at university, science beliefs that they hold, social teaching norms, and immediate classroom issues impacted on their classroom practice. A discussion of these factors follows.

4.3.3.1 Teacher education programme

The results suggest that teacher education programme had the strongest influence on new teachers (see, Figure 3). In their teacher education programme they acquired subject-matter knowledge, study the learning and teaching theories, and acquired a new repertoire of approaches to planning, instruction, and assessment (Feiman-Nemser, 2003). Further to that, in this study, the new teachers, it seems, applied their methodology content knowledge in the actual classroom teaching. They viewed learners' ideas as important by making efforts to collect them. They described the constructivist theory well showing their familiarity with the concept including an understanding that learners' knowledge consists of misconceptions. The new teachers' repertoire of "activities that work" developed from their own schooling in science, their preservice teacher education including the TE component, their own teaching experience, and from trusted colleagues (Appleton, 2003).

According to Appleton (2003), the choice of strategies that are believed to work involves making the subject interesting and fun and hands-on activities such as experiments and demonstrations. He points out that these choices shed some light onto new teachers' development of their personal science pedagogical content knowledge (PCK) and reinforce teachers' beliefs about science. To understand the knowledge that is needed for science teaching, Shulman (1986) coined the concept of PCK as a unique form of knowledge that makes subject content understandable to learners. New teachers' knowledge of likely misconceptions within science is important to address misconceptions. Therefore, since teachers said they elicited learners' prior knowledge to monitor learning and address misconceptions, I hoped they had planned to account for the latter in their teaching of electric circuits, in particular. However, this represented another missed opportunity to engage learners at high interanimation level.

4.3.3.2 Science beliefs

The two new teachers held different pedagogical beliefs. Ms M expressed views about the teaching and learning of science that were less traditional than Mr H. She said that she preferred group work and indeed her classroom arrangement of desks allowed for such interactions. She practiced this view in the classroom. Similarly Mr H practiced his view that learner-learner interactions tend to disrupt classroom talk. The desks in his class were arranged in rows facing the chalkboard leaving little room for face to face learner-learner interactions. Speaking from a constructivist perspective, desks arrangement and interactions in Mr H's classroom communicated to learners the idea that he was in control and the sole source of information. Raymond (1997) characterized such approach as traditional. All teachers of science have implicit and explicit beliefs about science, teaching, and learning (Fletcher & Luft, 2011; National Research Council (US), 2001). Preservice teachers also bring their belief systems to their practice during TE (Eick & Reed, 2002). Thus, I find it reasonable to think that these two new teachers held beliefs about science and learning and teaching of science when they entered their education programmes. It is important, in my view, for new teachers to also examine their own beliefs against the aim of CAPS. Tsai's (2002) suggests that new teachers' beliefs may be amenable to change as a result of instruction during their preparation programmes. However, this suggestion was not the focus of my investigation and, thus, it is beyond the scope of this study to address this issue further.

4.3.3.3 Immediate classroom situation

First, managing learner behaviour was mentioned as a factor influencing teacher talk. I personally observed this during classroom observation. As mentioned earlier, Ms M had to attend to some learners at the back of her class as they were doing their own thing while some learners were attempting to construct understanding of school science. Mr M mentioned that learner-learner interactions tended to be disruptive. That said, I also noted that an inordinate amount of the allocated instructional time is taken up by activities unrelated to the lesson topic.

I witnessed these disruptions in most of the lessons I observed. Some learners in both teachers' classrooms moved in and out of their classrooms in the middle of lessons.Some learners came late into the classroom. Some learners were daydreaming, occasionally distracting or even pestering other learners during lessons. Some talked to each other in the middle of lessons and intermittent announcements on the intercom such that teachers had to suspend talk to avoid teaching over background noises. As a consequence, new teachers spent some time recruiting learners' attention. Thus, the actual time period allocated to teaching and learning was compromised. This militates against the teachers' suggestion that there was insufficient time to enact their envisaged classroom teaching practices.

4.3.3.4 Social teaching norms

Legislation governing schooling places the management of classrooms and learning on the teacher (Brickhouse, 1994; McCroskey & Richmond, 1983). Teachers ask the learners to write tests and examinations, make presentations, behave, and so on. They praise, reward and punish learners if they cross the line. This authority influences teacher-learner classroom interactions (McCroskey & Richmond, 1983). Both teachers mentioned that pacing was important in their classroom talk. They expressed notions that they needed to ensure that while attempting to interact, coverage of curriculum was not compromised. Mr H particularly expressed this idea more than Ms M. This seems to indicate that curriculum coverage took a central role in their practice. In terms of the South African schools legislation, school governing body is responsible for the allocation of funds for resources from the school budget. However, the supplies needed to do the experiments in the textbook were not available in the classroom and the money to purchase them had to come from Mr H's pocket.

In summary, the teachers commented that collecting learners' ideas at the start of the lesson was important because learners used them to build up new knowledge. Indeed, in classroom observations, I saw them attempt to elicit learners' ideas. In the classrooms, they enacted their individual beliefs about learning and teaching of science.Thus, triangulation of both classroom talk and interview data led to the conclusion that new teachers' beliefs about teaching and learning of science were apparently consistent with their actual practice.

4.3.3.5 The concept of current electricity in the science classroom

From the lessons of Ms M and Mr H, I decided to present a brief discussion on the topic electricity. In my many years of experience as a Grade 12 Physical Science Paper 1 (Physics) final examinations marker, analysis of learner performance per question pointed to the poor marks achieved on "electricity" questions. The diagnostic report confirms this situation (see, for example, Department of Basic Education (DBE), 2013). However, to say that the others, for instance, the molecular model of matter, are not difficult would be a misrepresentation of facts. They are also abstract concepts that put heavy learning demand on the learner. In other words, they are equally difficult.

Electricity is an everyday phenomenon which most learners experience at school, home, church, synagogue, mosque, and so on. In spite of this, it has always been a difficult topic for learners to understand because of its underlying alternative conception. That is, electricity is a fundamental driving force of our modern society (Jaakkola & Nurmi, 2004). Unfortunately, most learners have this deeply engraved conception that there exists something from the battery which moves around the circuit meeting wires and other components of the circuit and it is precisely this idea that limits their ability to understand how electrical circuits work (Driver, Squires, Rushworth, & Wood-Robinson, 1985). According to Mackay and Hobden (2012), assessment of learners' work on electricity reveals that they hold conflicting ideas about circuits. These are learners' errors which teachers need to plan to account for in their teaching (Bishop & Denley, 2007). However, during lesson observations, data indicating that teachers probed any of these misconceptions in their talk was absent.

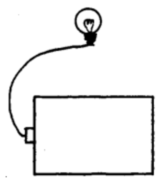

Figure 4.1 The unipolar/model

Explanation: Learners' idea is that only one wire is active.

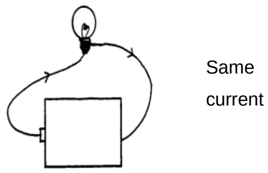

Figure 4.2 The scientists model

Explanation: This is the scientific perspective showing that current is the same throughout the wires entering and leaving the battery.

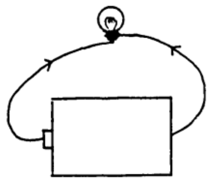

Figure 4.3 The clashing currents model

Explanation: Learners think of current flowing from both terminals of the battery. They sometimes explain the light in terms of the clash of the currents

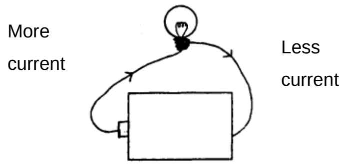

Figure 4.4 The current consumed model

Explanation: Learners here think of current as 'used up' by the bulb hence there is less in the wire going back to the battery.

Figure 4: Learners' mental models of a simple DC circuit (Driver, Squires, Rushworth, & Wood-Robinson, 1985)

I observed Ms M using an analogy of a hose pipe to explain the flow of electric current and thus help her learners to understand electricity. Driver et al. (1985) maintain that research studies support the use of analogies to explain critical concepts surrounding electricity for as long as their limitations are made explicit and they caution science teachers that 'many strategies designed to help pupils to understand electricity actually introduce and reinforce problems' (p. 117). These problems are the misconceptions which may last a lifetime, even when alternative scientific explanations are understood and accepted (Dawes, 2004).

Mulford and Robinson (2002) develop this point further and argue that learners believe that their ideas are correct because they help them make sense of the world around them and thus the new "wrong" school science information may be memorised in order to earn marks, but it is likely to be quickly forgotten because it does not make sense. I end this discussion here and comment on language of instruction since interpreting the quality of the lessons was beyond the scope of this study. Although language is not the focus of this study, it would be artificial not to refer to it since teaching of science through talk involves speech.

4.3.3.6 Ability to communicate in the language of instruction

Though this study was not construed to yield information on the effect of language of instruction in science classrooms where it is not learners' Mother Tongue, I noted its influence in the teaching-learning process. The language of science instruction in those schools was English though this was the Second or Third or sometimes the Fourth Language for most of the learner participants and teachers. For the learner and teacher participants, textbooks are in English. Howie (2001) points out that learners studying science through a second language have trouble in articulating their ideas in open-ended questions and in understanding some question in class, tests and examinations. Indeed, I saw this problem reflected in the difficulty experienced by the learners in articulating their ideas in class. The transcripts are testimony to this – sometimes IsiZulu would be used in verbal interactions, in both schools. However, I am aware that other learners do not thrive in verbal classroom interactions in relation to the science content (Walshaw & Anthony, 2008). But, judging by their enthusiasm during the lesson on fertilization, I am inclined to argue that most learners had the willingness to talk science. Some of them language (code) switched.

Dlodlo (1999) argues that it is during code-switching that the science that is in the concepts is lost or distorted because code-switching requires expert knowledge of science vocabulary in the different African languages. The teacher invariably does not possess this quality and the necessary registers are non-existent. However, in my view, the learning of science in African languages remains a difficult goal to achieve in the absence of scientific registers in those languages as some concepts are may not be easy translate. Developing this point for IsiZulu speaking learners, the terms force, energy and power may all be referred to as 'amandla' in IsiZulu. Therefore, there is an inherent risk of using terms that seem to be equivalent but in fact refer to different phenomena. As alluded to earlier, this language issue is a subject of debate and is beyond the scope of this study. I now turn attention to questioning and probing in the classrooms.

4.3.3.7 Missing curricular saliency

There is evidence here that teacher talk is concerned with curriculum coverage and, thus, limiting opportunities to support learning through making connections between learners' existing ideas and new school science concepts. I argue that new science teachers face the tension between interacting with learners at high level of interanimation of ideas and covering the curriculum. I also argue, in support of Geddis, Onslow, Beynon, and Oesch's

(1993) notion that these new teachers have not adequately developed the curricular saliency skill. The authors describe curricular saliency as the teacher's knowledge of the depth to which a topic should be covered and hence the amount of time to spend on it. They indicate that factors such as classroom size, teacher beliefs, and time, inhibit the practices learnt. Bishop and Denley (2007) point out that deciding when to intervene and when to stand back is a skill accomplished by most experienced teachers. In view of their limited teaching experience, new teachers are more likely to stick to their preplanned feedback irrespective of what was happening in the class (Borko & Livingston, 1989).

In the interviews, new teachers seem to indicate that were it not the lack of sufficient time, they would explore and interrogate learners' ideas in the science classroom. However, teachers who foster effective learning in their classes use the formal time allocated to teaching and learning to allow interactions, provoke debates, and spend a lot of time probing learners' ideas (Trigwell, Prosser, & Waterhouse, 1999). They further point out that it takes a change in the way teachers conceive of teaching and learning. This seems to suggest that inadequate skill on curricular saliency as well as belief about teaching and learning influence new teachers' classroom practice.

4.4 Conclusion

First, I used part of the analytical framework developed in Mortimer and Scott (2003) – communicative approach – to characterise and understand classroom talk in the science classroom. I illustrated through excerpts to show that teaching and learning of school science concepts consisted of shifts in the teacher communication patterns. The results illustrate that the new teachers use questioning to elicit learners' ideas in the science classroom. Although most of the teachers' lessons were interactive and dialogic, the evidence suggests very little probing of learners' ideas took place. In terms of the sociocultural theoretical framework on which this study stands, teacher questioning or probing in the science classroom needs to support and challenge learners' ideas slightly above their current thinking. The point I am making here is that new teachers need to strike an appropriate balance between questioning and instructing learners on the correct school science view of the natural world and engaging them in genuine dialogic interactions which require elaborations. Research findings show that the former tends to dominate and the latter is rare.

Given the analysis in the preceding Chapter, there is no basis to suggest that any communicative approach in Mortimer and Scott's (2003) scheme is superior. This statement implies that authoritative interactions are as important as dialogic interactions in the science classrooms. While dialogic interactions are important, for example, in the topic on current electricity, concepts such as potential difference and emf need authoritative introduction since, as Aguiar, Mortimer and Scott (2010) point out, science offers a structured view of the world such that it is not possible to appropriate the tools of scientific reasoning without guidance and assistance by a teacher. In the Department of Basic Education's (2013) report, it is recommended that teacher training on current electricity was needed so that the topic could be taught effectively.

Second, the findings in the study and others suggested factors influencing new teachers' communication patterns. I drew upon Raymond's (1997) framework to understand factors influencing new teachers' communication patterns. From the interviews, it emerged that teacher education programmes, beliefs, social teaching norms, and classroom situation influence new teachers' talk. Thus, this result implies that though teachers embrace eliciting learners' ideas at high level of interanimation, there are constraints which impede their efforts. Hence, they resort to collecting learners' ideas and evaluating them rather than probing these ideas further. Finally, in light of this being a case study, the findings needed to be interpreted in relation to other possible science classrooms in similar context. In this country, I want to think that the findings resonate with most of the classrooms, particularly in situations where science was learnt in English second language.

The next section, Chapter 5, concludes the report. The focus is on the overview of the research process. This will be done through addressing whether the research questions were answered by the data. I will provide a critical evaluation of the limitations of the study and show how I accounted for them. Next I will make recommendations for future research.

Chapter 5: Reflections and Conclusions

5.1 Introduction

The purpose of this study was to understand how new teachers elicited and worked with learners' ideas in the science classroom so as to determine whether their classroom practice is consistent with the aim in CAPS. In this chapter, I will provide interpretations of the findings in relation to previous studies. Next, I will point out limitations of the study in relation to methodology and findings, and reflect on the research process. On the basis of the results of this research study, I will make recommendations with respect to the gaps emanating from the study to illustrate the importance of the findings. Finally, I will identify an area of research for future studies.

5.2 Summary of findings

5.2.1 A reflection on teacher communication patterns

This study sought to make a contribution to the characterization of teacher communication patterns particularly during elicitation of learners' ideas which involves questioning and probing between teachers and learners. The study revealed that the two new teachers attempted to teach science from constructivist principles as required in CAPS. They, in classroom practice, seemed eager collect and probe learners' ideas and introduce the scientific story to their learners. Thus, it is reasonable to conclude that the finding of this study is that new science teachers' classrooms were interactive though largely authoritative. This finding is consistent with Msimanga's (2013) who found that teachers took an authoritative communicative approach most of the time in their lessons. She investigated talk as a meaning making tool in three experienced science teachers' classrooms in Soweto schools for five years. On new teachers, Brooks and Brooks' (1999) intensively conducted classroom-based research on changes in factors that affect constructivist practices. That study's finding was that new teachers attempted to collect learners' ideas. A three-year study by Lederman (1999) found, similarly, that new teachers graduated with a range of knowledge about how they should interact with the science content and what they and their learners should be doing in the classroom. In a research study designed to teach learners how to negotiate their ideas about science concepts through dialogic interactions, Dawes (2004) found that talk is the medium for preparing learners for and generating new understandings.

Encouraging also is that new science teachers still attempt to elicit learners' ideas in dialogic interactions, a practice consistent with the sociocultural conception of learning as discussed in Chapters 2 and 4. The evidence suggested that new teachers elicit learners' ideas through posing questions to check previously established school science knowledge. However, according to Morge (2005) checking knowledge in this way comes from a conception of learning that corresponds to memorizing – it encourages learners to memorise school science knowledge because it is the "truth". He argues that simply checking learners' knowledge can result in exclusion of some learners and thus limiting their participation. This provides evidence for Mortimer and Scott's (2003) suggestion that elicitation of learners' ideas need to take place at a high interanimation level.

However, the evidence in this study suggested that new teachers do little to compare and contrast learners' ideas. They do not probe learners' responses – they merely collect and evaluate them. When Mortimer and Scott (2003) and Scott, Mortimer and Aguiar (2006) argue that dialogic interactions are rare in the science classroom, they particularly refer to the scarcity of high interanimation of learners' ideas interactions. Indeed, 'the dialogic function of teacher talk is realised as the teacher encourages students to put forward their ideas, to explore and to debate points of view' (Scott, 1998, p. 62). Thus, the findings of this study seem to be consistent with the previous findings in Mortimer and Scott (2003) – that dialogic talk at high level of interanimation of ideas is rare.

Drawing on the Mortimer and Scott's ideas, there are two fundamental reasons for this contention. First, if learners' ideas are probed they learn to elaborate upon their ideas and thus become aware of how the scientific community builds its knowledge. Second, it is precisely at these moments of probing that there is the greatest chance of effective learning taking place. I concur with these assertions because contrasting and comparing learners' ideas in the science classroom creates opportunities for learners to use their existing frameworks to understand subsequent science content. Thus, it is important for teachers to encourage high level of interanimation of learners' ideas because, as Taber (2009) suggests, they have consequences for the learning of science in the classroom. Next, I reflect on semistructured interview data.

5.2.2 A reflection on factors influencing teacher communication patterns

Based on the interviews, I found that teacher preparation programmes and science beliefs had strongest influence on new teachers' communication patterns while immediate classroom situation as well as social teaching norms seemed to be less significant. In contrast to Raymond's (1997) finding, lack of resources in the new teachers' schools had the slightest influence on teaching. Smeaton and Waters (2013), in his study of six new teachers in three American secondary schools found that factors affecting new teachers' classroom practice were: lack of time; emphasis on teaching to tests; lack of resources; and, frequent need for behavioural interventions. A study of new science teachers in primary schools by Appleton and Kindt (1999) found that collegial support, self-confidence, resources and less priority for science influenced classroom practice. There are many other variables that affect practice, including learner's aptitude, for example. I will restrict the discussion to only those that were identified in this study – in the order of their significance.

First, teacher preparation programme had the strongest significance in influencing new teachers' communication patterns. They expressed this view during interviews and actually enacted it – they used the skill learnt in the university curriculum. This finding is consistent with that of Steaton and Waters (2013). They, as it is in this study, wanted to determine whether six new teachers were consistently using the research-based instructional strategies learnt in their teacher preparation programmes and the elements that affected their practice. However, other studies found that new teachers do not apply constructivist views they learnt in their methodology courses at university (see, for example, Boulton-Lewis, Smith, McCrindle, Burnett, & Campbell, 2001). In a study of 28 new teachers in Swaziland, Mazibuko (1999) found that teachers say that university courses did not adequately prepare them for some of the things they were expected to do in schools. Further to that, Raymond (1997) found that past school experiences, science beliefs, and immediate classroom situation had the strongest influence on new teachers.

Teacher preparation programmes were found to play a key role in helping teachers develop a realistic understanding of the realities of teaching life (Kelchtermans & Ballet, 2002). Ballantyne (2007) suggests that if teacher preparation programmes had not been effective in preparing teachers, 'teachers may reject the knowledge and skills that they learned at university and unthinkingly adopt the teaching culture at their school' (p. 2). However, cases of new teachers reverting back to ways in which they were taught are associated with praxis and poor teacher preparation programmes (Ballantyne, 2007). In many cases, immediate classroom situation becomes more powerful than teacher preparation programmes in determining teacher practice (Stuart & Thurlow, 2000). On the whole, this finding seems to be an indication that teacher education programmes that encourage constructivist teaching and learning principles are having an impact in classroom practice.

Second, science beliefs about learning and teaching of science influenced new teachers' classroom talk. The teachers' views and classroom practice were consistent in relation to their belief in the importance of eliciting learners' ideas. Lederman (1999) made a similar finding. However, this finding seems to contradict Simmons et al. (1999) who found that new science teachers' classroom practices contrasted sharply with their beliefs. Benson (1989) also found that new teachers profess beliefs which they may not enact in practice. Third, immediate classroom situations, such as learner behaviour and time constraints, were found to affect teacher talk. In contrast, Smeaton and Waters (2013) and Abell and Roth (1992) found that new teachers experienced little disruptions in their classrooms. They assert that the teachers appealed to their personalities to gain and hold learners' attention during teaching. Appleton (2003) found that new teachers experience tough times in the science classroom as they attempted to engage their learners. Consequently, the level of effort and skill required by new teachers to teach science from constructivist perspectives may not be achievable for many (Appleton, 2003). Appleton and Kindt's (1999) suggested science takes more time and effort to prepare and teach than many other subjects. They argue that teaching science from constructivist principles requires, among other things, thorough planning anticipating learners' questions and misconceptions. In classroom observations, I did not see new teachers addressing misconceptions. However, both teachers pointed out that discipline was an issue in their interactions.

Third, during interviews, time constraint was sighted as an immediate classroom factor influencing classroom talk. A similar finding was made by Smeaton and Waters (2013) who found that teachers restricted learner-learner interactions as they considered it as a time-consuming exercise. My classroom observation of new teachers suggests that the actual time available for teaching and learning is not used efficiently by the new teachers' schools. Thus, I subscribe to the general argument that more instructional time is not the panacea to this perceived constraint. Other options, such as implementing what we already know about effective instruction and classroom management, seem to have a much greater potential payoff than simply increasing the time (Karweit, 1985). However, Brooks and Brooks (1999) disagree. They point out that teachers end up answering questions for the students to keep the pace of the lesson brisk and this practice often interferes with their ability to help learners understand complex concepts. This point was raised by the new teacher in the interviews. They were both concerned with pacing. Brooks and Brooks further argue assert that given that most curriculums simply pack too much information into too little time, though at a significant cost to the learner, new teachers are concerned with finishing the science content. However, power relations is another factor influencing talk in the science classroom.

Fourth, Mercer and Howe (2012) point out that talk is rare in classrooms because of social teaching norms that require teachers and learners to follow ground rules in which the: teacher is the dominant person deciding who talks; learner should quickly try to provide answers to teachers' questions which are as relevant and brief as possible; learners who call out an answer without being asked are breaking a rule. While I could not agree more with Mercer and Howe (2012) in their criticism of rigid classrooms, I tend to challenge the view that this norm is responsible for the scarcity of dialogic talk. In the context of the large classroom sizes in South African schools, particularly those that participated in this study, enacting constructivist perspectives of learning could be daunting. From my own personal experience, there is very little possibility of conducting science lessons with a view to engage learners at high interanimation of ideas. Faced with an average class size of forty learners in a forty-minute lesson leaves no more than about a minute for new teacher to compare and contrast ideas. Taking into account that this minute is split into procedural time, instructional time, and task time (Karweit &Slavin, 1982), each learner has few seconds to compare and contrast ideas in the science classroom. However, social teaching norms such as resources were less significant in influencing practice. This is consistent with Appleton and Kindt's (1999) finding that fewer new teachers cited lack of resources as a factor influencing their practice. However, Smeaton and Waters (2013) found that 'Limited school supplies forced the teachers to buy their own materials, straining their personal budgets' (p. 79). Thus, the difficulty in securing resources as experienced by Mr H is common for new teachers (Brickhouse & Bodner, 1992).

5.3 Limitations of study

Limitations are worth mentioning in consideration of the study's results. Some of the limitations relate to methodology, sample and sampling. Firstly, the sample was very small. The study was an investigation of two new teachers in their natural classroom setting over a short period. Secondly, the convenience sampling procedure decreased the generalizability of the findings. I am cognisant of the fact that McMillan and Schumacher (2010) state that findings from case studies are not generalizable – they provide summaries for understanding education and for future research.

The purpose of the interviews was to gain insightful background into new teachers' views so as to interpret their actual classroom practice against the aim in CAPS. I wanted them to reflect broadly upon their practice with respect to elicitation of learners' ideas. With the benefit of hindsight I think further probing and prompting could have followed depending on the responses given by the participants. I think this was affected by inexperience on my part. For example, I did not ask, "But, I did not see you show that in the classroom", "Can you tell me why?". I merely followed the script as it read on the Interview Schedule (see, Appendices G and H). However, the fact that I really needed to understand their practice from their account spurred me on.

Other researchers also argue that replication of a qualitative investigation will not yield the the same results (as it might in quantitative research) (Creswell, 2003; Merriam, 1995). Rather, both sets of results stand as two interpretations of the phenomenon. Lincoln and Guba (1985) argue that the key aspect of a qualitative research is the consistency of the findings with the data collected. Further to that, the goal of qualitative research is to investigate a particular phenomenon in depth rather than determining what is generally true of many. I believe that the study throws light into classroom practice of new teachers in relation to their elicitation of learners' ideas. In addition, the study provides some insight into teachers' practice in determining whether they were teaching science in line with the aim in CAPS.

Finally, I used case studies of new teachers to understand the communication patterns of these particular teachers in depth. Drawing on the argument of Chin and Brown (2002), the general can be found in the particular. Thus, findings from particular case studies situation may be transferable to other science classroom contexts (Merriam, 1988). Further to that, data in this case study were collected from a small sample. Thus, the confidence of making firm conclusions was eroded and considered to be inappropriate. That notwithstanding, themes were evident in both data from classroom talk and interviews and tentative conclusions were proposed. It is on this basis that I propose that the findings of the study be considered as ground for further research on new teachers in respect of elicitation of learners' ideas.

5.4 Recommendations

Although new teachers elicit learners' ideas, they need to do so at high level of interanimation. Firstly, the curriculum implementation directorate in the education department may need to monitor the alignment of actual classroom practice with the curricular aims in CAPS. Secondly, they may need to provide induction programmes to help new teachers sustain their ability to promote constructivist view of learning in the science classroom. Teacher education programmes may need to guide student teachers as to how to orchestrate dialogic interactions and how to use curricular saliency to manage the balance between finishing the curriculum and encouraging genuine dialogic talk in the science classroom.

5.5 Suggestions for future research

The problem seemed to be that experienced teachers did not elicit learners' ideas since they predominately transmitted information to learners while CAPS encourages teaching of science from constructivist perspectives of learning. Additionally, this study found that new teachers elicit learners' ideas but only at a low level of interanimation. First, a larger longitudinal that follows teacher participants from their first year of university training to their induction years of teaching is needed to capture their science classroom communication patterns in relation to elicitation of learners' ideas at high interanimation. Second, research needs to be undertaken to understand fully how beliefs guide new teachers' practice because, according to Fletcher and Luft (2011), there is a greater disconnect between what curricular aims and actual practice in the early years of teaching. These studies would contribute to a better understanding of new teachers' classroom practice, particularly in relation to elicitation of learners' ideas. Further to that, I subscribe to the suggestion that every teacher needs to become able to see the talk and social interaction in their classroom from a sociocultural perspective (Mercer & Howe, 2012).

5.6 Conclusion

This research on communication patterns in the science classroom of new teachers was inspired and informed by a sociocultural perspective on learning. I began this report with the rationale that although the aim in CAPS is that South African science teachers need take into account learners' ideas, research studies found that experienced science teachers' beliefs about the teaching and learning of science seem to be resistant to teaching perspectives that take into account learners' ideas. I envisaged that new teachers' practice may be different because they are trained in and are encouraged to use constructivist practices. As a consequence, I drew upon a social constructivist perspective on learning to gain insights about communication patterns of teacher talk and factors affecting them.

I collected and analysed data drawing upon the models of Mortimer and Scott, and Raymond for analysing classroom interactions and semistructured interviews, respectively. My classroom observation finding indicated that new teachers interacted with their learners to collect ideas through talk although at low level of interanimation. Additionally, evidence from interview data seems to suggest that teacher preparation programmes and beliefs about science, teaching and learning strongly influence teacher talk. I suggested that longitudinal studies that track teachers from preservice to induction years may need to be undertaken to better understand how their beliefs influence actual practice, and how they may be encouraged to engage in dialogic interactions at high interanimation level.

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Appendices

7.1 *Appendix A –Mr H: Lesson 1*

(1)	***Mr H:***	*Morning. We continue with reproduction. We are on fallopian tubes. If an ovum has been released right it is upright why is it upright is. What am I saying, sexual intercourse is when the man is now aroused – and the man has now been aroused means his penis is now aroused it is now full of blood and all the blood as rushed to the penis and now it is ready. The vagina is so you know what I am talking about. The 10m cm portion of the female reproductive organ it enters that and once it is in there it ejaculates and shoots up semen. Semen is what it is both the fluid and the sperm itself. Where did the sperm get it energy from? Which part of the male organ?*
(2)	***Ll:***	*The prostate gland s and seminal vesicles*
(3)	***Mr H:***	*This is information you need to know you need to know this terms and conceptualize It enters the body and then semen shoots out and then the sperm move s up into the fallopian tube What is it doing in the fallopian tube it wants to fertilize the ovum that are not matured*
(4)	***Ll:***	*[A number of learners laugh aloud]*
(5)	***Mr H:***	*What's so funny?*
(6)	***Ll:***	*[Silence]*
(7)	***Mr H:***	*If an ovum has been fertilized and released and it fertilization will take place Alright I don't know if I can take down the slide. I don't need noise, ok, shh*
(8)	***Ll:***	*Yes.*
(9)	***Mr H:***	*In don't want to show you this poster because we are done with the male thing but I gonna show you anyway. Ok can I put it here will it fall. Should I put it here, is it gonna fall.*
(10)	***Ll:***	*No.*
(11)	***Mr H:***	*We were not focusing on that on fertilization. What happens is that we got what is this the egg and the we got the sperm, right, and we got the sperm and they are all fighting to fertilize fertilise the ovum. This piece here [pointing at drawing on OHP signalling that it must be coved by a learner]. And when it has now entered the ovum there is a layer. What happens is that this nucleus he then enters the ovum and at that point that it enters the fertilization takes place.*
(12)	***L:***	*What is fertilization, Sir?*
(13)	***Mr H:***	*We will get to that is the later stage.*
(14)	***L:***	*Ok*
(15)	***Mr H:***	*Hmm … it is relates to gins and twins and stuff like that. But basically you have an idea what is going on here ok*
(16)	***Ll:***	*Yes*
(17)	***Mr H:***	*Great stuff. I want someone to read for us loudly*
(18)	***Ll:***	*[A learner volunteers to read from the textbook*

(19)	***Mr H:***	*Sibusile is reading please keep quiet. [The learner reads from the textbook] … Ok I want you to highlight for me. This is the stage of fertilization also known as conception. So if somebody next time somebody asks you when were you born [Pointing at a learner]*
(20)	***Ll:***	*3rd*
(21)	***Mr H:***	*Third of which month*
(22)	***Ll:***	*December*
(23)	***Mr H:***	*The 3rd of what?*
(24)	***Ll:***	*December*
(25)	***Mr H:***	*Ok he was born on the third of December when someone asks you when you were conceived … the 3rd of December minus 9 months so please like educated high school students. The moment of fertilization is known as conception. So take your birth date minus nine months*
(26)	***L:***	*What if you were born premature?*
(27)	***Mr H:***	*If you are premature it means you were born before nine months*
(28)	***Ll:***	*Yes*
(29)	***Mr H:***	*Ok. Wabona uthlowa. If you are premature it means you will fall!*
(30)	***Ll:***	*How do I count my conception date?*
(31)	***Mr H:***	*But you count backward, right. Wena you wanna go out you're irritating me now*
(32)	***L:***	*[The learner was throwing paper at their friends in the back of the room*
(33)	***Mr H:***	*So I also want you to highlight for me zygote. At conception cell not the cell the fertilized ovum called the zygote, write for me zygote that's what it is called. [Learners asked to come to the board]. Write the fertilized ovum next to the diagram. The zygote forms a special membrane around it to prevent any other sperm to enter it. It is now fertilized. Where is the egg the fertilized egg where is it is in the fallopian tube into the uterus so that it can attach itself to the … [Inaudible].*
(34)	***L:***	*womb*
(35)	***Mr H:***	*What ehh I cannot hear you. Shh then it says you guys are restless there what's going on* *[Teacher reads from textbook]* *Alright it's fine let's continue*
(36)	***L:***	*Akadlanga amagwinya [Did not eat fat cakes]*
(37)	***Mr H:***	*So as soon as it … it starts to grow. Now it is no longer one cell that is fertilized and now it looking like this [Pointing at a slide picture on the OHP] ... because it's got more cells. Sorry. That is now called an embryo. Once it starts to divide itself into different cells and cells that are gonna make the brain, the bone, etc. Now it's called an embryo it stays the massive piece. This is called as implantation. Something very important that happens at this point. [Teacher reads from textbook] So now the egg … ok, so now the egg has now being fertilized it moves down the fallopian tube it now divides it implants itself into the wall of the uterus. At that point then the body says ok ovaries you don't need to make eggs*

(38)	***L:***	*Can we see the egg, Sir?*
(39)	***Mr H:***	*Yes you can't see it. It is very small the same way ok did I hit you [Trying to determine if he hit someone when he turned to the board]. Ok, the fertilization. And girls you can have your egg … because once you are pregnant no other sperm can fertilize … [Reading from textbook, learner misbehaves is sent outside by teacher]. Ok, then it says after plantation the ovary …[Continues reading from textbook]*
(40)	***L:***	*Sir, how does a fly fertilise?*
(41)	***Mr H:***	*Ok the same way the fertilized … I have no idea! … [Continues reading from textbook]. Don't waste my time out! [Pointing to a disruptive learner. But, he does not move out and the teacher ignores that – does not take any further action]*
(42)	***L:***	*Yes, Sir, what is the oestrogens?*
(43)	***Mr H:***	*I have no idea. I think you will learn about this hormones in matric I think finish, what grade is this? 9. You will learn about it t when you get to grade 10, hey. [Reads from textbook] After this stage it's called an embryo and it starts looking like a human being. And I think when it now called a foetus and I think it is at that point that you cannot abort because it looks like a human being*
(44)	***L:***	*How does it look?*
(45)	***Mr H:***	*Ok there is an image on the board [Pointing to the image of a foetus on the screen] Sperm cell nucleus female nucleus of the egg jelly like. On your right side is that dark what is that block thing. I want you to highlight fertilization implantation and zygote. Not the whole column just the word I said the word he is now highlighting the whole line. [Reading] Ok, eh mm they are very good swimmers but certain things boys when you get to the higher grade and when you do biology you will learn sometimes the woman's ovum it does not move down the fallopian does not and you have a situation.*
(46)	***L:***	*Why can't some ladies get pregnant?*
(47)	***Mr H:***	*Or something happens boys sometimes your sperm count is low which means a … the lady cannot fall pregnant which means that for example a lot of married woman go through this. Sometimes your woman, ladies, sometimes your pH level is in your vagina is too acidic [Announcement from intercom] Start doing activity 3, now. No talking, just do activity 3 no talking- [while announcement continues]. There's someone outside I still have to mark that activity 3, everyone.*
(48)	***L:***	*What if I don't' finish?*
(49)	***Mr H:***	*If you don't finish it now you will do it as a homework. No, do it now while you do this I will do this quickly as I was saying there's always complications. Sometimes the male reproductive organ also has issues sometimes the vagina is too acidic and ends up killing the sperm before they enter sometimes it is both problem when you are married sometimes it is you boys when you have a low sperm count. Bottom line is that both people need to be healthy and both reproductive organs need to be healthy*

(50)	***L:***	*Ok. Sir, if you bath with hot water it reduces your sperm.*
(51)	***Mr H:***	*If you do anything that damages your body. Ok. I don't know if there is a connection between temperature and sperm count. But, research point s in that direction.*
(52)	***L:***	*Is it true that bananas and peanuts increase sperm?*
(53)	***Mr H:***	*There has not been scientific confirmation*
(54)	***L:***	*Why can't women swim?*
(55)	***Mr H:***	*It depends on what they are using to protect their bodies when they have their periods. It is not that that they can't swim. Hi shut up you have been talking. [A very talkative and excited boy]*
(56)	***L:***	*Is it healthy to have sex when you are pregnant*
(57)	***Mr H:***	*I don't know. But, now you are asking silly questions. Do my activity.*

7.2 Appendix B – Mr H: Lesson 2

(1) **Mr H:** *Ok, yesterday we looked at the … ehh … of the solar system … and we also looked at the structure of the earth. I did tell you that you should start looking at matter and material because we are going to look into it, today. So our topic for this afternoon is matter and material. I am going to project to you some stuff… and later on in the lesson, around the end of the period I will play a revision video of what we have learnt. Yeah, look forward to that. Now, when we speak of matter and materials what comes to your mind? What is matter?*

(2) ***L1:*** *Matter is anything that occupies space.*

(3) ***Mr H:*** *You wanted to say that …?[pointing to another learner]*

(4) ***L2:*** *Matter is anything that occupies space.*

(5) ***Mr H:*** *So that is the definition of matter. Now, can you define, in terms of the atoms and molecules? If someone had to come and say please define for me matter in terms of molecules and atoms, what will you say? Yes!*

(6) ***Ll:*** *Liquid, gas [In chorus]*

(7) ***Mr H:*** *Liquid, gas. You are giving me examples of what matter is. Right!*

(8) ***L3:*** *Occupies space*

(9) ***Mr H:*** *Yeah, occupies space. Yes,* **we** *have already said that it occupies space and looking at the matter itself what is the relation now between [Hey … - screaming learning from outside class]. The state of matter, right, and in case of matter there are characteristics that define the state of matter. We said matter is something that occupies space and has mass. So we said there are three types matter, which is liquid, solid and gas. There are three phases of matter. So, these phases of matter we are going to do them in* ***order.*** *We have the solid, the liquid and the gas. What can you tell me about these phases?*

(10) ***L1:*** *They are close to each other*

(11) ***L2:*** *There are spaces between the particles*

(12) ***L3:*** *There are no spaces between them*

(13) ***Mr H:*** *So if there are no spaces between the particles, what then holds these substances together?*

(14) ***L4:*** *Is it glue?*

(15) ***Mr H:*** *No. what is it?*

(16) ***L5:*** *Oxygen.*

(17) ***Mr H:*** *Can oxygen hold things together?*

(18) ***L1:*** *The repelling and the attraction*

(19) ***Mr H:*** *No, we will come to that!*

(20) ***L4:*** *The temperature at which they are made.*

(21) ***Mr H:*** *We have a term, intermolecular forces. So, these forces they hold the particles together. So, this is the definition. To say that matter is made up of tiny particles which are atoms and what is an atom? What is an atom?*

(22) ***Ll:*** *[Silence]*

(23)	***Mr H:***	*We have what is called the kinetic model of matter and it is in the textbook. There are four most important facts of what matter is made of and its function. We look at the first one … that things are made of matter. There are spaces between the particles. There are spaces in between the particles. There are spaces between particles even though we think they are not there. Now there are forces involved in the kinetic. The second one is … they are in continuous motion … that causes them to vibrate immediately they experience heat and energy that is when they vibrate. And, that is what I have said that the things that hold them together are the intermolecular forces.*
(24)	***L5:***	*Where?*
(25)	***Mr H:***	*Look at the textbook! Now in the definition, the first definition that I gave you we said that matter is made of tiny particles … and we said atoms are smallest parts of elements and what are molecules … molecules, what are molecules?*
(26)	***L6:***	*They are made of compounds*
(27)	***Mr H:***	*So from an atom we get the smallest building block of matter so oxygen is actually made of atoms. So elements, atoms make elements and, elements make compounds. Because atoms are building blocks of elements, elements are the building blocks of molecules. And, if you want to build molecules you need atoms. So in all that we have discussed the phases of matter, in the solid one the particles are close together, in the liquid far apart and the gas very far apart and we also discussed that atoms are the building blocks of elements. So in the textbook, the first exercise in the top you go through that. Before we go, I want us to answer this one from 1 until 3 before. Can you write that one right now and based on the discussion I will put the video on.[Teacher turned the video on for learners to watch so as to see the different states of matter]*

7.3 Appendix C – Mr H: Lesson 3

(1)	***Mr H:***	*Eh, good morning!*
(2)	***Ll:***	*Morning, Sir!*
(3)	***Mr H:***	*Eh, last time we did atoms and molecules. We got elements and compounds. Then, we are going to do chemical reactions. Nje …Njengoba sihlalasenza [As we always do], ah mmm, what is an element? Yes!*
(4)	***L1:***	*One type of …*
(5)	***L2***	*Atom–[Another learner finishes the sentence].*
(6)	***Mr H:***	*One type of atom!*
(7)	***Ll:***	*Yes!*
(8)	***Mr H:***	*Yes, an element is a substance that is made of one type of atom. Now, let's look at compounds. What are compounds? Yes! [Pointing a learner]*
(9)	***L3:***	*Compounds are atoms that are connected together …*
(10)	***Mr H:***	*I am not quite sure … Not quite right! Eh, Man 4, let's listen to her!*
(11)	***L4:***	*A compound has two or more atoms bonded together.*
(12)	***Mr H:***	*All your answers are correct! A compound is a substance that is formed from two or more elements. Elements and compounds. Man 4, so elements and compounds, when they bond they form what we call, an equation. Now, you are required to know … the first twenty elements … by heart. And the other elements such as chromium, manganese, iron, copper nickel cobalt zinc bromine iodine. Eh, ok. Let's start from 1. What is element 1?*
(13)	***L5:***	*Ini? (What?)*
(14)	***Mr H:***	*Element number 1!*
(15)	***L5:***	*Hydrogen.*
(16)	***Mr H:***	*Two!*
(17)	***Ll:***	*Helium.*
(18)	***Mr H:***	*Three!*
(19)	***Ll:***	*Lithium.*
(20)	***Mr H:***	*Element no 4 , no 5,6,7,8,9,10,11,12,13,1,4,15,16,17,18,19,20 [Learners mention the names of elements in chorus]. Now what does Cr stands for? What element is represented by Cr?*
(21)	***Ll:***	*Chromium.*
(22)	***Mr H:***	*Which elements is by Mn? Mn?*
(23)	***Ll:***	*Magnese! Manganese!*
(24)	***Mr H:***	*Sure! Fe?*
(25)	***Ll:***	*Iron.*
(26)	***Mr H:***	*Co?*
(27)	***Ll:***	*It's a copper.*
(28)	***Mr H:***	*Cobalt! Ni is nickel, Cu is copper, Zn is zinc, Kr is krypton, I is iodine. Pb?*
(29)	***L4:***	*Pb is lead [Learner expresses her joy at knowing that lead is the name for Pb].*
(30)	***Mr H:***	*Now, let's go to chemical reactions. Eh, for chemical reaction we have equations for*

example ehh if we have N_2, H_2 to form NH_3. What is NH_3? Man 4, what is the name of NH_3?

(31) **Ll:** *[Silence]*

(32) **L6:** *[Inaudible]*

(33) **Mr H:** *Aksiyiyo (It's not it)! Aniyazi (You don't know)! Aksiyiyo (It's not it)!*

(34) **L7:** *Nitrogen hydrogen*

(35) **Mr H:** *Nitrogen hydrogen! [Probing]. Ok, masimmameleni! {Ok, let's listen).*

(36) **L8:** *Nitrogen oxide!*

(37) **Mr H:** *No!*

(38) **L9:** *Aminomia! I don't know. [Laughter by some learners.]*

(39) **Ll** *Ammonia! Ammonia, sir!*

(40) **Mr H:** *And we can't … [Inaudible] … we have to balance it. So, to balance this, eh, to make things easier we have something called CHO. We have to balance the carbon first then the hydrogen and then oxygen. Then, the remaining elements. On the left hand side we have 2 hydrogens. Here we have three. So what do we do? Senzani lapha? (What do we do, here?). Neo, re eetsang {Neo, What do we do??*

(41) **Ll:** *[Learners make suggestions]*

(42) **Mr H:** *Ok, guys. Sure? Alright. Nitrogen must be five. Ayaphi? Eyi 1 uyazi why? Amahydrogen ayi 3 plus amahydrogen ayi … [Inaudible].*

(43) **L11:** *I am confused! Yo!*

(44) **Mr H:** *Ok, nayi ama oxygen ayi 2 hydrogen/nitrogen ayi 5. Ok. Ok. I believe that ok what do we do when we add or subtract fraction we find the … the what …what the LCD yes so for 3 and 2 what is the LCD therefore for hydrogen we must have to have 6 to have six we must multiply by 3 and 2*

We have 2 nitrogen on our lhs and 2 hydrogen. We have six h on our left hand side. Yangipalela, Ganyane (I's difficult, Ganyane)!

(45) **Ll:** *[Learners make various attempts until the teacher comments on one response from a learner]*

(46) **Mr H:** *Eh, ok. Siyambona ukuthi une idea uyazama ukuthi ibalanse ileft hand side yakhe ne right hand side (We see that he tried to balance his right hand side with the leaft hand side). What's this, Man-4? Sodium and this chlorine. What's NaCl?*

(47) **Ll:** *[Silence].*

(48) **Mr H:** *Table salt. Sodium chloride. Sodium chloride. Then, here on our left hand side we have one sodium here we have one sodium but when it comes to chlorine we have we 2 … have to put our 2. 2 chlorine 2 chlorine. Then our equation is balanced!*

(49) **L11:** *Ok what if there is 2 Na this side the re 2 sodium and 1 chlorine I am confused at that point.*

(50) **Mr H:** *Ok on our left side we have I sodium 2 chlorine. Therefore, we have to put our two here. If you have to put our 2 here we can't put it here 2 here we now have two sodium and 2 chlorine awe have to balance our left hand. We have to put our 2 here.*

(51) **L9:** *So sir … [Inaudible].*

(52)	***Mr H:***	*The 2 is for sodium and chlorine (2NaCl).*
(53)	***L9:***	*Oh!!!*
(54)	***L12:***	*Ok, ufake ini? (Ok, what did you insert?)*
(55)	***Mr H:***	*Two chlorine to balance the 2 chlorines. Then, if you have this 2 here it applies to both sodium and chlorine. Eh, Man 4 … Man 4, that one is for you! [Long pause]. Ufuna ukuzoshaya dai deng (You want to do that thing?).*
(56)	***L6:***	*No.*
(57)	***Mr H:***	*Ok class. What's the name for this compound? What's the name for this compound? [Long pause]. What's the name of then what's the name of this compound? Ok. What is the name of this?*
(58)	***L8:***	*Chlorine!*
(59)	***Mr H:***	*And this?*
(60)	***L12:***	*Potassium*
(61)	***Mr H:***	*What do we do at the end?*
(62)	***Ll:***	*Kumele zilingane. Ja. Kumele zilingane (They must balance) [Discussions among learners].*
(63)	***L2:***	*Is it right, Sir?*
(64)	***Mr H:***	*Into ayishoyo ukuthi (What she is saying is that) this two umela wonke lama (represents all these) element. This two here is for potassium and chlorine so this thing is balanced. Let's count how many oxygens we have on our left hand side … and on our right hand side we have 6 – 3 times 2, so oxygen is balanced. Ok, page 5 this is potassium chlorine. Let's come to potassium it is 2 for potassium and chlorine is 2 so 2 chlorine so the equation is balanced. Questions?*
(65)	***Ll:***	*[Discussion among learners] Ok. Uyayibona lento le inkinga yethu yini? (Do you see this, what is our problem?) I oxygen so yini lento ekhona ukuzilinganisa siyazimaltiplaya (Oxygen, so what is it that can balance we multiply them)*
(66)	***L2:***	*Asidlali umshayna (We are not playing the Chinese game of Phaphi).*
(67)	***Mr H:***	*Eyi, eyi! Attention learners!*
(68)	***L2:***	*[Learner continues to assist others in understanding balancing equations].*
(69)	***Mr H:***	*Questions?*
(70)	***Ll:***	*[Learners applaud the learner who was explaining the balancing on the board]*
(71)	***Mr H:***	*Questions?*
(72)	***L2:***	*[Learner continues to finalize his explanations to other learners as they continue seeking more clarity].*
(73)	***Mr H:***	*Man 4, here is this one for you. I hope you understand! Now, H_2 plus O_2 react to for H_2O. Now, hydrogen plus oxygen … [Teacher writes equation on the board]. On our left hand side, how many hydrogens do we have?*
(74)	***Ll:***	*2*
(75)	***Mr H:***	*Right hand side?*
(76)	***Ll:***	*2*
(77)	***Mr H:***	*On left hand side, 2, right hand side 1 then ayikho (not) balanced. We have to balance*

		the oxygen. To make o equal 2 what must we do?
(78)	***Ll:***	*2. 2*
(79)	***Mr H:***	*Then immediately on our right hand side hydrogen. Hydrogen is 4, oxygen is equal to 2. Right hand side is 2, ne? But, ayikho (not) balanced. We need to balance our hydrogen.*
(80)	***Ll:***	*2 on hydrogen.*
(81)	***Mr H:***	*Then, the equation is balanced. $2H_2$ plus O_2 equals $2H_2O$! Imibuzo (Questions)? Diputso (Questions)?*
(82)	***Mr H:***	*Eyi, eyi, eyi, eyi, naw' umsebenzi (Eyi, eyi, eyi, eyi, here's work). [Teacher writes class activity on the board]. Eh, Man 4? [Calling on the learner and others in the classroom to focus on their work at hand. In the process, t\he siren sounds signalling end of period].*

7.4 Appendix D – Ms M: Lesson 1

(1)	***Ms M:***	*Good afternoon, class!*
(2)	***Ll:***	*Good afternoon, Mam!*
(3)	***Ms M:***	*Ok, today we are going to learn about matter. Everything in the universe consists of matter. Matter exists as either a solid, a liquid or a gas (learners are still streaming in to the class). Ok, the particles in matter are so small that they cannot be seen with the naked eyes and we call them atoms or molecules. Let's say you have a piece of paper, right. This is your piece of paper. You can cut this piece. Kenneth! You can divide this piece of paper into small pieces until you are unable to divide the paper. Let's uthatha lephepha ayuyalidabula, uyalidabula into small pieces, right. Uma ulidabula kanjalo you will reach a point where awusakwazi ukulidabula lelophepha. So that's how matter is.*
(4)	***L:***	*Ah, ubhorekile. Mxoshe [Shifting attention away from himself]*
(5)	***Ms M:***	*Ok, molecules consists of atoms that have forces that attract them to each other. The principle of … the principle theory of matter says that matter cannot be created nor destroyed. It can be changed from one form or phase to another. Let's say you have an ice cube. When you have the ice cube you cannot destroy or create it. All you have to do is to change its mass. It's either you melt it to liquid, it's either you melt it to liquid or you boil it so that it evaporates then you have a gas, right? Any question?*
(6)	***Ll:***	*[Silence]*
(7)	***Ms M:***	*However, in matter it does not work like that. Because there are spaces between particles when you take those marbles you place them in a beaker, then they will … Patrick!*
(8)	***Ll:***	*[Inaudible]]*
(9)	***Ms M:***	*Now, we are moving to the particle, the particle model of matter. Although the particles in gases and liquids cannot be observed, the following deductions can be made based on the investigations. The first one says that all matter consists of small particles. The second one says that there are spaces between the particles. Let's say you have two beakers or 2 cups, the one or two 2-litre bottle now you … them up, you fill the other one with marble and you fill the other one with sand. When you combine two 50cm^3 volume you expect to have a 100 cm, right? Let's say una 50 grams of marble and you have a 50 grams of sand. When you combine the 50 gram of marble with and 50 gram of sand you expect to have 100, right? 50 plus 50 is 100, right?*
(10)	***L:***	*They will lie on top of each other.*
(11)	***Ms M:***	*They will lie on top of each other, right? Then you pour the sand.* *Because the marbles have spaces between them the sand will run through those spaces. So the combined mass won't be 100 grams because there are spaces between the particles. But if ever there were no spaces between the particles. But, because there are spaces between the marbles the mass won't combine to 100g. Any question? Any question?*

(12) Ll: *[Silence]*

(13) Ms M: *Ok, the particles are in constant motion… What it means is that, let's say you have, excuse me!*

What it means is that you have a water droplet let's say you have a water droplet, you let it drip, drip, drip. Those water they are going to collect, like let's say you have a jar then you have a … with water then you put them drop by drop. They are going to drip one after the other because the particles are in constant motion. Any question? Blessing, any question?

Another example is that, let's say I have a, a body spray. I have a perfume, right, ngizanayo la eklasini ngiya spreya where I am. After some while le ekhoneni bazoyizwa i-perfume inuka. Because those particles … because those particles are in constant motion they are going to travel in the air until they reach that corner of the class. Any question?

(14) Ll: *[Silence]*

(15) Ms M: *Ok, let's say kini babheykha isinkwa or bakheykha amakhekhe. The aroma will be in the house first because there is air ngaphandle khani sizozwakala i-smell because the particles are in constant motion. Any question?*

(16) Ll: *[Silence]*

(17) Ms M: *Ntokozo, hlala phansi. Hlala phansi. Hlala phansi! Hlala phansi!*

Ok, there are forces of attraction and repulsion between the particles. The further apart the particle the weaker the forces between them. Let's say you have … excuse me. You are making noise!

Musa, go and sit down, boy. Musa, Kenneth!

Ok, let's say you have a comb, ikama, and you have a piece of papers, then you rub the comb in your hair. Then when you take the comb and attract them or a ruler, the papers will attract to the ruler because there is a force of attraction.

When you have two magnets, when the south pole with the, you take the south pole and a north pole they are going to attract because there is a force of attraction. But, when you have … [Boy learner interjects]

(18) L: *Like boy and girl!*

(19) Ms M: *(Laughter from teacher following learner's comment) But when you have a south pole facing the south pole they are going to repel each other. Any question? Patrick?*

(20) Ll: *[Silence]*

(21) Ms M: *Everything! Remember that when I first introduced the lesson I said everything in the universe is made of matter. So matter includes the particles, the atoms, the molecules. Everything. Any question?*

(22) Ll: *[Silence]*

(23) Ms M: *Ok, on average particles move faster at higher temperature than at a lower temperature. What it, what it means is that let's say you have a cup of hot water and a cup of cold water. Then in the, ok, at the same time you put sugar inside those cups. Which sugar is going to melt first?*

(24)	***Ll:***	*[Silence]*
(25)	***Ms M:***	*For example, let's say you have a cup of sugar. Ok, the sugar in the hot water is going to melt first than the one in cold water because the particles have a higher … they move faster at a higher temperature. Any question?*
(26)	***Ll:***	*No!*
(27)	***Ms M:***	*Any question, Sifiso, Athlegang, Lindokuhle! Any question? So, why are you making noise? Any question, Athlegang? … Any question, Lindokuhle?*
(28)	***L:***	*Ngimtshele mam?*
(29)	***Ms M:***	*Mthsele! Angikzwanga mina! (Tell her, I did not hear you!)*
(30)	***L:***	*[Learner attempts to explain what matter is to their neighbour]*
(31)	***Ms M:***	*Very good! Sowuyazi ukuthi what is matter! Any question? Ok, tomorrow I am going to explain that schedule, ne!*

7.5 Appendix E – Ms M: Lesson 2

(1)	***Ms M:***	*Ok, class, today we are going to learn about electric circuit. What do you understand by the term, electric circuit? What do you understand about the term, electric circuit? What is an electric circuit, Lindokuhle!*
(2)	***L:***	*It is a flow whereby …*
(3)	***Ms M:***	*Is a flow … of what?*
(4)	***L:***	*Of charges.*
(5)	***Ms M:***	*Not exactly. I'm not asking about the electric current. Electric current is a flow of charges, right. I am asking about the electric circuit. Do you know what is an electric circuit? Have you come across one?*
(6)	***Ll:***	*Yes.*
(7)	***Ms M:***	*Ok, define for me what is an electric circuit … Elina? [Pointing at the learner].*
(8)	***L:***	*Something like wires, batteries and globe.*
(9)	***Ms M:***	*Very good. When we talk about electric circuit we are talking about an arrangement of components. For instance, you may have a battery, a switch, a light bulb, and other components connected in such a manner that electricity may flow. So, electric circuit in other words is an electric device that provides path for electric current to flow. Before we learn about electric current we need to know the international symbols that are used. Just like as builder. A builder needs a plan in order to build a house.* *Electricians and scientists … electricians and scientists also need a plan in order to know how to install electricity to various rooms of a house or classes in your school. So, that plan is known as a circuit diagram. [Teacher draws circuit diagram on the board]*
(10)	***Ms M:***	*Ok, I have written two columns here, as I go through the circuit diagrams you are going to write the name here then you draw the symbol next to the name.*
(11)	***L:***	*Mam, siyabhala, manje? (Mam, are writing, now?) [Drawing the teacher's attention to her desire to carry on copying the notes on the board]*
(12)	***Ms M:***	*The first electric circ… the circuit diagram is a conductor. When we draw a conductor we use an unbroken line. Can you tell me why do we use an unbroken line? [Long silence]* *When we represent a conductor we use an unbroken line, can you tell me why …, Blessing? Why do we use an unbroken line when we draw a conductor?*
(13)	***L:***	*[Learner does not respond]*
(14)	***Ms M:***	*We use an unbroken line because the current must flow, remember that. So, when the line is broken the current cannot flow continuously. So, we use an unbroken line to represent the current flowing continuously. So, the next component that we are going to look at is the light bulb. When you draw the light bulb, excuse me [Teacher corrects error in diagram] … when we draw a*

		light bulb there are different versions of drawing it. In some other textbooks they, they write like this … it's also a light bulb. These unbroken lines they represent a conductor. A conductor may be a metal, wires, etc., so this line represents a conductor. Then this circle represents a light bulb. Then this line inside the circle represents the filament. A filament is the thing inside the bulb that give light off when the switch is closed.
(15)	***Ms M:***	*Now I am going to look at the open switch. Are you drawing? Now, we going to look at the open switch. When the switch is open the current is not flowing. So, we say the circuit is? … Incomplete.* *When the switch is closed, we say that the circuit is complete and the current is flowing. Do you know what is a voltmeter?*
(16)	***Ll:***	*No!*
(17)	***Ms M:***	*What is a voltmeter? Clement, what is a voltmeter?*
(18)	***L:***	*Battery.*
(19)	***Ms M:***	*No. A voltmeter is not a battery. Athlegang?*
(20)	***L:***	*Used to calculate voltage*
(21)	***Ms M:***	*Very good, a voltmeter measures the voltage of an electric circuit. So a voltmeter is an instrument used to measure the voltage and is always connected in parallel. Then, we have the ammeter. Do you know what is an ammeter?*
(22)	***L:***	*No.*
(23)	***Ms M:***	*Ok, an ammeter is an instrument we use to measure the current, remember the electric current flowing in a circuit. So, if ever we want to know the electric current that is flowing in a circuit diagram, in an electric circuit we use an ammeter. An ammeter is always connected in a series. Then, we have the resistor. A resistor opposes the movement of charges and causes the current to be stiff. [Long pause]. Then, we have a cell. Do you see that I've written or a battery? So, a battery is a … excuse me. [Interruption from intercom- Attention learners …] So, a battery is a col, a collection of cells. When you have one cell we call it a cell, one. Then if you have more than one cell we call it a battery. If you look at the circuit diagram that … the electric circuit, we can all see, right. I have 1,2,3. I don't call them cells. I say this is a battery. When it is one we say it is a cell. So, if I have to, if I want to draw a battery using this style, representing this 1, 2 3, I was going to say 1, 2, 3. This is a battery. You can't draw one cell and then say it's a battery.*
(24)	***L:***	*No. [Interruption from intercom- Attention teachers …]*
(25)	***Ms M:***	*Then, we have a rheostat. A rheostat is an electrical instrument used to control a current by varying the resistance in an electric circuit but does not change the current of an electric circuit -it does not interfere. Patrick, are you writing?*

(26)	***L:***	*No. mam.*
(27)	***Ms M:***	*Why don't you take down notes because we are going to do an activity after this and I am taking this books [Pointing at learner's book] with me when I go. Since we have learnt about circuit diagram we can look at the two types of electric circuits. Can you name them? These are circuit diagrams, right. We all know how to represent certain apparatus using a diagram. So now because you know we are going to learn about electric circuit. Remember that our topic is electric circuit in circuit diagrams. So, now we are going back to the main topic. We are going to look at electric circuit. The … [Interruption].*
(28)	***L:***	*Sorry Mam I just want to take …*
(29)	***Ms M:***	*Slindokuhle, sit down. You are making noise. Ok, we are done with the circuit diagrams now I am moving on to the electric circuit. We have two types of electric circuits. Can you name them? Banele.*
(30)	***L:***	*Currents is power*
(31)	***Ms M:***	*No. Anyone who wants to try! We have two types of electric circuits. We did this, we did this in primary, right?*
(32)	***Ll:***	*Yes.*
(33)	***Ms M:***	*Ok, some of you did this in primary. We have two types of electric circuits. Can you remember them? Should I tell you?*
(34)	***L:***	*Yes.*
(35)	***Ms M:***	*Ok, we have … circuit, here we have a parallel. A parallel circuit. Clement, thank you. Ok, so, today … we are going to look at the parallel circuit … then later on go and look at the series. Can I ask you something? Which way is effective for connecting bulbs at home or at school? Is it series or parallel?*
(36)	***Ll:***	*Parallel … Series [Guessing]*
(37)	***Ms M:***	*Parallel! Which way is …is, you are making noise. We have two types that we a series or way parallel- which way is appropriate or effective for connecting lights at school, at home, at school. Is it series or parallel?*
(38)	***Ll:***	*Series!*
(39)	***Ms M:***	*Series! No.*
(40)	***Ll:***	*Parallel! Ngishilo [One learner loudly claims to have known the correct answer]*
(41)	***Ms M:***	*But, then you doubt yourself! Ahh, Sanele uyangiphoxa! Ok, the appropriate or effective way is to connect bulbs in a parallel way, at home. Can you tell me why, Athlegang?*
(42)	***L:***	*I think it hmmm … we can switch one and have one off*
(43)	***Ms M:***	*Very good. Did you hear what she said? Excuse me for that. Did you hear what she said, excuse me. Very good. Athlegang. So, in a parallel circuit the current passes through the different components by different paths at the same time. When you look at this circuit diagram … this is a circuit diagram, right, and this is the parallel one. Ok, as Athlegang said, when you have a*

		switch in a parallel circuit you can switch one light at a time but in a series circuit when you switch one light all the lights go on. So, this is a parallel, you can … ok, the current passes the, the different components by different paths. When you look at this circuit diagram you can see that there is this path this path is alright and this one is not. Then, you have another path. This light bulb is not on. Can you tell me why?
(44)	***L:***	*Because there is no connection!*
(45)	***Ms M:***	*There is a connection. There is a connection.*
(46)	***L:***	*The switch is open.*
(47)	***Ms M:***	*Very good. Because the switch is open. So, because the switch is open here the current can't flow! Can you see at the back? [Learners appreciate the learning by clapping hands showing amusement]. Can you see at the back? Please, Elina, can you see?*
(48)	***L:***	*I don't believe that!*
(49)		*Ok, now the switch is closed do you see what happens?*
(50)	***Ms M:***	*All the lights are on. Now, we say that the circuit is complete.*
(51)	***Ll:***	*Yes.*
(52)	***Ms M:***	*Can you see, now*
(53)	***Ll:***	*[Laughter and commenting to each other about unrelated matters]*
(54)	***Ms M:***	*Ok, the light bulb are all, they are all glowing, right, because the current is complete - the circuit is complete.*
(55)	***L:***	*Ufuna ukuyofaka kubayskili*
(56)	***Ms M:***	*Ok, when the light bulbs are connected in the parallel the circuit branches as you can see when you look at this circuit it branches it does not have one straight line going all the way and backward and forth. This one it branches. It goes this way then it goes this way. You can see that. The current divides so we have the current flowing this side then we also have the current flowing this side. If, each light bulb receives the portion of the main current so that they will glow with the same brightness. When I press here, they all glow, right, with the same brightness. But, in some …, they glow in the same brightness, you can see. So, the current is divided equally, even though it branches. But when we have 2 light bulbs, whereby … you know light bulbs you see there are watts 60 watts, 100 watts. If their watts is different they are not going to light with the same brightness. If their watts is different if it's not the same. Let's say I have globe with 60 watts and a globe with 100 watts. Their brightness is not the same. The one with 60 watts is dimmer, the one with 100 watts is brighter. The more lights are connected in a parallel the smaller the resistance in the current the bigger the current that flows. Can you tell me the advantages of using the parallel?*
(57)	***L:***	*[Laughs out loud instead of answering]*
(58)	***Ms M:***	*Ok, in a parallel … circuit unlike the in the series, when you have, let's say*

		this the circuit diagram is not working, right. You can see that this light bulb is working you can see and this one is working.
		You will forgive me emuva (at the back), ne! And this one is also working … then I remove one of the light bulbs they are both working. Then, I put this one which is not working. You see that this one is still working? This one is not working. No. this thing is not working. So, in the parallel, you see, there is no bulb there so it is not but when the switch is closed the current is flowing you can see but there is no bulb here but it can still glow. In a circuit, in a series circuit, in a series circuit, this is a series circuit, right!
(59)		*Ok, this is a series circuit, you can see they are working they are all glowing, right? Then I remove one then I remove one bulb and it is working you saw that, right. It's working you can see, right. The switch is still here. Then I put this one which is not working.* ***Can you guess what's going to happen?***
(60)	***L:***	*Yes. It's going to light.*
(61)	***Ms M:***	*Going to light! Anyone who wants to predict what's going to happen?*
(62)	***L:***	*No, angeke ilaite [No, it will not light].*
(63)	***Ms M:***	*Angithi bengifake lela beyilaita uyibonile angithi. Now I have removed this light it's working I have replaced with this one which is working. This is a series circuit I'm done with parallel. Can you predict what is going to happen? Izoglowa [Will it glow] or not?*
(64)	***L:***	*Izoglowa [It will glow].*
(65)	***Ms M:***	*No. It's not. It's not going to work. Can you tell me why? No it's not that. In a series circuit, are you listening?*
(66)	***L:***	*The batteries are not working.*
(67)	***Ms M:***	*No. The batteries are working. You see. No, you see it's still glowing so the batteries are working. But when I include this one which is not working it is not glowing. When I put it here, it's going to glow. Remember that I am not including this one. So, I have to include this and predict what's going to happen. I have in series a bulb that is working and one bulb that is not working. In a series circuit when one light bulb ceases or when one bulb is not working, all the light bulbs are not going to work. Can you tell me why?*
(68)	***L:***	*Because the electricity circuit is cut, so the circuit is not complete.[Discounts learner's idea with no reason- does not even revisit it, later]*
(69)	***Ms M:***	*Atlhegang?*
(70)	***L:***	*Mam, electricity …it's not together*
(71)	***Ms M:***	*Very good! Because the circuit is incomplete even though I close the switch. Because this path is not working the electricity is not flowing from this path to that path so the circuit is incomplete.*
		But, in a parallel circuit it doesn't matter. When one, you can notice in your home. Let's say the kitchen bulb ceases is not working the kitchen light will also glow.

(72)	***L:***	*No, Mam!*
(73)	***Ms M:***	*I-layti lase khishini lizo laita angithi even though elase-bedroom lingasebenzi – because they are connected in parallel. One switch can, in series, one switch control all the light bulbs. However, in a parallel you may use different switches to control different light bulb. So it does not depend on that one switch or one form of … energy, right. Any question so far?*
(74)	***Ll:***	*[Silence]*
(75)	***Ms M:***	*There is metal here. Remember that … one person at a time, please!*

7.6 Appendix F – Ms M: Lesson 3

(1)	***Ms M:***	*Good afternoon, class!*
(2)	***Ll:***	*Good afternoon, Mam!*
(3)	***Ms M:***	*Ok, today we are going to learn about matter. Everything in the universe consists of matter. Matter exists as either a solid, a liquid or a gas (learners are still streaming in to the class).Ok, the particles in matter are so small that they cannot be seen with the naked eyes and we call them atoms or molecules. Let's say you have a piece of paper, right. This is your piece of paper. You can cut this piece. Kenneth! You can divide this piece of paper into small pieces until you are unable to divide the paper. Let's say uthatha lephepha ayuyalidabula (you tear this piece of paper), uyalidabula(you tear it) into small pieces, right. Uma ulidabula kanjalo (as you tear it) you will reach a point where awusakwazi ukulidabula lelophepha (you can no longer tear the paper). So that's how matter is.*
(4)	***L:***	*Ah, ubhorekile. Mxoshe [Oh, he's bored. Chase him away!]*
(5)	***Ms M:***	*Ok, molecules consists of atoms that have forces that attract them to each other. The principle of … the principle theory of matter says that matter cannot be created nor destroyed. It can be changed from one form or phase to another. Let's say you have an ice cube. When you have the ice cube you cannot destroy or create it. All you have to do is to change its mass. It's either you melt it to liquid, it's either you melt it to liquid or you boil it so that it evaporates then you have a gas, right? Any question?*
(6)	***L:***	*[Silence]*
(7)	***Ms M:***	*Now, we are moving to the particle, the particle model of matter. Although the particles in gases and liquids cannot be observed, the following deductions can be made based on the investigations. The first one says that all matter consists of small particles. The second one says that there are spaces between the particles. Let's say you have two beakers or 2 cups, the one or two 2-litre bottle now you … them up, you fill the other one with marble and you fill the other one with sand. When you combine two 50cm^3 volume you expect to have a 100 cm, right? Let's say una 50 grams of marble and you have a 50 grams of sand. When you combine the 50 gram of marble with and 50 gram of sand you expect to have 100, right? 50 plus 50 is 100, right? However, in matter it does not work like that. Because there are spaces between particles, when you take those marbles you place them in a beaker, then they will … Patrick!*
(8)	***L:***	*Be on top of each other.*
(9)	***Ms M:***	*They will lie on top of each other, right? Then you pour the sand. Because the marbles have spaces between them the sand will run through those spaces. So the combined mass won't be 100 grams because there are spaces between the particles. But if ever there were no spaces between the particles.*

		But, because there are spaces between the marbles the mass won't combine to 100g. Any question? Any question?
(10)	***Ll:***	*[Silence]*
(11)	***Ms M:***	*Ok, the particles are in constant motion… What it means is that, let's say you have, excuse me! [Trying to call to order a learner who is talking to her neighbour]. What it means is that you have a water droplet let's say you have a water droplet, you let it drip, drip, drip. Those water they are going to collect, like let's say you have a jar then you have a … with water then you put them drop by drop. They are going to drip one after the other because the particles are in constant motion. Any question? Blessing, any question?*
(12)	***L:***	*[The learner shakes his head to indicate he has no question?]].*
(13)	***Ms M:***	*Another example is that, let's say I have a, a body spray. I have a perfume, right, ngizanayo la eklasini ngiya spreya where I am. After some while le ekhoneni bazoyizwa i-perfume inuka. Because those particles … because those particles are in constant motion they are going to travel in the air until they reach that corner of the class. Any question?*
(14)	***Ll:***	*[Silence]*
(15)	***Ms M:***	*Ok, let's say kini babheykha isinkwa or bakheykha amakhekhe (at your home they bake bread or they bake cakes). The aroma will be in the house first because there is air ngaphandle khani sizozwakala (then the air will spread) i-smell because the particles are in constant motion. Any question?*
(16)	***L:***	*[Silence]*
(17)	***Ms M:***	*Ntokozo, hlala phansi [Ntokozo, sit down]. Hlala phansi [Sit down]. Hlala phansi [Sit down]! Hlala phansi! [Sit down!]. Ok, there are forces of attraction and repulsion between the particles. The further apart the particle the weaker the forces between them. Let's say you have … excuse me. You are making noise! Musa, go and sit down, boy. Musa, Kenneth!*
(18)	***Ll:***	*[Silence]*
(19)	***Ms M:***	*Ok, let's say you have a comb, ikama, and you have a piece of papers, then you rub the comb in your hair. Then when you take the comb and attract them or a ruler, the papers will attract to the ruler because there is a force of attraction. When you have two magnets, when the south pole with the, you take the south pole and a north pole they are going to attract because there is a force of attraction. But, when you have … [Learner interjects].*
(20)	***L:***	*Like boy and girl! [Laughter from teacher following learner's comment].*
(21)	***Ms M:***	*But when you have a south pole facing the south pole they are going to repel each other. Any question? Patrick?*
(22)	***L:***	*[Inaudible].*
(23)	***Ms M:***	*Everything! Remember that when I first introduced the lesson I said everything in the universe is made of matter. So matter includes the particles, the atoms, the molecules. Everything. Any question?*

(24)	***L:***	*[Silence].*
(25)	***Ms M:***	*Ok, on average particles move faster at higher temperature than at a lower temperature. What it, what it means is that let's say you have a cup of hot water and a cup of cold water. Then in the, ok, at the same time you put sugar inside those cups. Which sugar is going to melt first? For example, let's say you have a cup of sugar. Ok, the sugar in the hot water is going to melt first than the one in cold water because the particles have a higher … they move faster at a higher temperature. Any question?*
(26)	***Ll:***	*No [In chorus]*
(27)	***Ms M:***	*Any question, Sifiso, Athlegang, Lindokuhle! Any question? So, why are you making noise? Any question, Athlegang? … Any question, Lindokuhle?*
(28)	***Ll:***	*No [In chorus].*
(29)	*L1:*	*Ngimtshelile mam? (I told him, Mam!) [A learner indicating that he told a classmate about what matter is].*
(30)	***L2:***	*Mthsele! (Tell her)[Learner pushes another to let the teacher know what matter is].*
(31)	***Ms M:***	*Angikzwanga mina! {I did not hear you!)*
(32)	***L3:***	*[Learner repeats her statement].*
(33)	***Ms M:***	*Very good! Sowuyazi ukuthi (Now you know) what is matter! Any question?*
(34)	***Ll:***	*[Silence].*
(35)	***Ms M:***	*Ok, tomorrow I am going to explain that schedule, ne!*
(36)	***Ll:***	*Yes.*

7.8 *Appendix G – Interview Schedule: Mr H*

Hello, my name is Ben Shongwe. Thank you for agreeing to see me and participate in this interview. I've been … asked to talk with you to fulfil the requirements of my studies. During the talk, I would like to discuss about learners' prior knowledge/ideas or intuitive theories. I would like to remind you that this talk is tape-recorded so that I do not miss very important information you give and we save time. This interview should last about ten minutes. The interview is now beginning and the first question is:

R – Researcher **NT – New Teacher**

		MAIN QUESTIONS	ADVICE AND PROBES	PROCESS CODING	THEME
(1)	**R:**	**What subject do you teach?**			
(2)	**NT:**	I am doing Natural Science. Thank you			
(3)	**R:**		**Any other subject that you teach?**		
(4)	**NT:**		Physical Science		
(5)	**R:**	**How many years of teaching experience do you have?**			
(6)	**NT:**	I have two years			
(7)	**R:**	**Do you enquire about learners' prior knowledge in your teaching of science?** *(Allow for "wait time" as it is crucial to gain this information)*			
(8)	**NT:**	[1]Yes, I do.		[1]Confirms elicitation of learners' ideas	[1]Science beliefs
(9)	**R:**		**In your view, what is meant by prior knowledge?**		

(10)	**NT:**		[2]Hmm, prior knowledge is the information, and, hmm, basically the knowledge that learners bring into class before you actually teach the topic of the day	[2]Defines prior knowledge as learners' preconceived ideas	[2]Teacher education programme
(11)	**R:**		**Why do you enquire about learners' intuitive theories?**		
(12)	**NNTT:**		Why do I enquire about them? [3]Is to see is if they have sort of an idea of what I am going to teach about because they come there with already they have ideas in their minds if I can make an example, an element, resources. So to draw on that prior knowledge it actually tells you what they see, resources, elements are *[Inaudible].*	[3]Description of constructivist theory of learning	[3]Teacher education programme
(13)	**R:**		**Do you think new learning relates to experiences or questions about the world in and outside of school?**		
(14)	**NT:**		[4]Well, in this time and in this century I believe it does because most of the things we learn about in class are the things we and outside the classroom are the things we face. Think it does because most of the time to see what particles mean inside and outside the classroom so it basically it new learning things it incorporates everything the inside and the outside experience. We can see that when learners answer we see they have an idea what part *[Inaudible].*	[4]Acknowledges importance of linking classroom science to everyday experiences	[4]Teacher education programme
(15)	**R:**	**What for you constitutes learners' prior knowledge?**			
(16)	**NT:**	[5]Hmm. Their ability to raise their views of a subject that I introduce each and every time I get into class which I first *[Inaudible].* The ability to if I drop a topic and write on the board and they are able to say some		[5]Defines prior knowledge as learners' preconceived ideas	[5]Teacher education programme

		things about it let's say perhaps I write mining on the board and already they can think about digging of gold and how South Africa is reach in gold *[Inaudible].* The evidence I have that they have a prior know of a certain topic that I am teaching			
(17)	**R:**		**When would you know that learners are actively participating in your lesson?**		
(18)	**NT:**		[6]Well that one is a bit difficult because sometimes you, some learners are passive while they do understand and those who are active who are well participants in class, who answer questions and are well focussed. [7]So some of them you can only prove when you give them a task to write that when you get to know if they understand what you taught them or not	[6]Learners' passiveness may not imply they do not understand new content [7]Tasks determine whether new knowledge was constructed	[6]Science beliefs [7]Science beliefs
(19)	**R:**		**Do your learners ask other learners to explain their ideas to them?**		
(20)	**NT:**		[8]Not really because it is not a chance *[Inaudible]* that hmm lies on me to give them. [9]So, to avoid disruptions in class [10]I would rather have those questions directed to me then I will direct the questions to learners which then can be answered	[8]Learners' relate science content at teacher's discretion. [9]Managing behaviour. [10]Not in favour of learner-learner interactions	[8]Science beliefs [9]Immediate classroom situation [10]Science beliefs
(21)	**R:**	**Do you think learners' prior knowledge is important?**			
(22)	**NT:**	[11]Very much so.		[11]Acknowledges importance of learners' ideas	[11]Science beliefs

(23)	**R:**		**Why do you think so?**		
(24)	**NT:**		[12]Because you cannot build on just an empty slate. You need a foundation of concepts.	[12]Acknowledges connection between prior knowledge and new knowledge	[12]Teacher education programme
(25)	**R:**		**What do you do with leaners' prior knowledge?**		
(26)	**NT:**		[13]To build things in a logical order of what they already have	[13]Acknowledges connection between prior knowledge and new knowledge	[13]Teacher education programme
(27)	**R:**	**In your view, science is best taught by using which teaching strategies?**			
(28)	**NT:**	[14]One of the most working techniques that I have noticed are things that are tangible. [15]The use of chalk board has already went out, is outdated so things like power point and the children are not interested so things like power point you use and environment outside is more *[Inaudible]* other than things you write on the chalkboard.		[14]Field experiences, student teaching [15]Chalkboard use is outdated	[14]Teacher education programme [15]Social teaching norms
(29)	**R:**		**Usually, what do you find difficult as you employ your teaching strategies?**		
(30)	**NT:**		[16]Hmm, one thing that I find difficult … trying to balance a balance between the interaction. [17]To make NS interesting. [18]Things that I find difficult is trying to keep a balance between try to cover all the slides sometimes when you and try to focus on the	[16]Striking balance between engaging learners and curriculum pacing [17]Field experience, student teaching [18]Covering curriculum makes teacher forget to interact	[16]Social teaching norms [17]Teacher education programme [18]Social teaching norms

			power point forget that I need to interact with them interact with them. [19]Sometimes when you interact with them you end up not finishing so that's basically it.	[19]Classroom interactions consume time	[19]Immediate classroom situation
(31)	**R:**		**What strategies work well for your lessons?**		
(32)	**NT:**		[20]I use, most of the time I use power point tangible resources which I buy some I create [21]to make things easier and the subject interesting	[20]Buying resources [21]Field experience, student teaching	[20]Immediate classroom situation [21]Teacher education programme
(33)	**R:**		**What other teaching strategy might you use?**		
(34)	**NT:**		[22]Hmm, say a trip let's say they are preparing for a big exam you take them for a trip a science trip to *[Inaudible].*	[22]Acknowledges importance of linking classroom science to everyday experiences	[22]Teacher education programme
(35)	**R:**		**Why?**		
(36)	**NT:**		[23]You can teach outside the classroom and learners will be happy to learn outside the school ground and about science then you teach outside the classroom then they have fun outside	[23]Field experience, student teaching	[23]Teacher education programme
(37)	**R:**	**Thank you for your participation. Do you have anything you wish to say or ask about?**			
(38)	**NT:**	No.			
(39)	**R:**	**Thank you.**			

7.9 *Appendix H – Interview Schedule: Ms M*

Hello, my name is Ben Shongwe. Thank you for agreeing to see me and participate in this interview. I've been … asked to talk with you to fulfil the requirements of my studies. During the talk, I would like to discuss about learners' prior knowledge/ideas or intuitive theories. I would like to remind you that this talk is audio-recorded so that I do not miss very important information you give and we save time. This interview should last about ten minutes. The interview is now beginning and the first question is:

R – Researcher **NT – New Teacher**

		MAIN QUESTIONS	ADVICE AND PROBES	PROCESS CODING	THEME
(1)	**R:**	**What subject do you teach?**			
(2)	**NT:**	I teach Natural Sciences			
(3)	**R:**	**Thank you.**	**Any other subject that you teach?**		
(4)	**NT:**		Ahh, yes, I also teach Physical Sciences and Mathematics		
(5)	**R:**	**Ahh, thank you. How many years of teaching experience do you have?**			
(6)	**NT:**	Ahh, I've been teaching for 3 years, now.			
(7)	**R:**	**Thank you. Do you enquire about learners' prior knowledge in your teaching of science?** *(Allow for "wait time" as it is crucial to gain this information)*			

(8)	**NT:**	[1]Yes, I do all the time!		[1]Acknowledges importance of learners' ideas	[1]Science beliefs
(9)	**R:**	**Hmm, thank you.**	**Then, in your view, what is meant by prior knowledge?**		
(10)	**NT:**		[2]Ok, in my view prior knowledge is the learn … is the knowledge that learners bring to class before you even teach them. [3]It is the little ideas they have about the topic you are going to teach.	[2]Defines prior knowledge as learners 'ideas [3]Acknowledges connection between prior knowledge and new knowledge	[2]Teacher education programme [3]Teacher education programme
(11)	**R:**		**Do you think … do you enquire about learners' intuitive theories?**		
(12)	**NT:**		[4]Yes, I do. Ok …	[4]Confirms elicitation of learners' ideas	[4]Science beliefs
(13)	**R:**		**Do you think new learning relates to experiences or questions about the world in and outside of school?**		
(14)	**NT:**		[5]Yes, I do. I think it does.	[5]Acknowledges importance of linking classroom science to everyday experiences	[5]Teacher education programme
(15)	**R:**		**How?**		
(16)	**NT:**		[6]Ok. Most of the time we already read from theories that learners come to class with knowledge. So the knowledge that we present in class is usually … put emphasis or organizes the knowledge that they already had when they come to class… [7]So, it is always important for you to go back to the	[6]Description of constructivist theory of learning	[6]Teacher education programme

			ideas they have because they build up. [8]They help you as a teacher to arrange your lesson to see where you need to emphasize.	[7]Acknowledges importance of learners' ideas [8]Acknowledges importance of learners' ideas	[7]Science beliefs [8]Science beliefs
(17)	**R:**	**What for you constitutes learners' prior knowledge?**			
(18)	**NT:**	[9]Prior knowledge is constituted by everything from the little things they do in their everyday life the little theories, the little facts or myths cultural background. That constitutes their prior knowledge		[9]Defines prior knowledge as learners' ideas	[9]Teacher education programme
(19)	**R:**		**When would you know that learners are actively participating in your lesson?**		
(20)	**NT:**		[10]I usually know learners are actively participating when I see them engaging in the content that I am presenting if they asking questions if they are interested if they want to know more about what I am presenting if they want to understand better if they think or ask if there is anything more to what I have already said. If they are actively engaging with the *[Inaudible]* I am presenting. [12]If they participate I see they are moving with me and they are actively engaging with what I am presenting	[10]Active participation entails asking questions [12]Striking balance between engaging learners and curriculum pacing	[10]Science beliefs [12]Immediate classroom situation
(21)	**R:**		**Do your learners ask other learners to explain their ideas to them?**		
(22)	**NT:**		[13]Oh, yes they often do. And that's one strategy that I	[13]In favour of learner-learner	[13]Science beliefs

			like to use 'cause I present the knowledge and to see if they understand. [14]I ask one of the learners to explain to the others to see if they understood what I was saying so that I can always pick up misconception from what they are saying	interactions [14]Organises ideas to address misconceptions	[14]Science beliefs
(23)	**R:**	**Do you think learners' prior knowledge is important?**			
(24)	**NT:**	[15]Very. It's the basis of each and every lesson that I teach in class. When I present new content the prior knowledge comes up and it's always and it is what I begin with in my teaching.		[15]Acknowledges connection between prior knowledge and new knowledge	[15]Teacher education programme
(25)	**R:**		**What do you do with leaners' prior knowledge?**		
(26)	**NT:**		[16]I ask them what they already know about the topic. So from the little things that come I am able to organise my lesson how I'm gonna present it, what, resource to use. [17]How and when to bring examples that will help them based on what they already know	[16]Acknowledges connection between prior knowledge and new knowledge [17]Acknowledges connection between prior knowledge and new knowledge	[16]Teacher education programme [17]Teacher education programme
(27)	**R:**	**In your view, science is best taught by using which teaching strategies?**			
(28)	**NT:**	[18]Hmm, I cannot say there is one strategy that is best to use for teaching science. Different content hmm, require different strategy to use. What I would say is that		[18]Different strategies for different lesson purpose – strategy that works	[18]Science beliefs

		it's important for teachers to know which particular strategy to use, for which content that they're presenting		
(29)	**R:**	**Usually, what do you find difficult as you employ your teaching strategies?**		
(30)	**NT:**	Ahh, sometimes [19]you find that hmm learners aren't moving at the same pace as you wish. Say, for instance, [20]you arrange them in groups, you find that there is one person dominating in the group [21]they're still not clear what they need to do. [22]When you want to do a demonstration some of them are busy there at the back with their own thing. [23]So, what I like to do is to always engage them in what I do… so that I can keep [24]checking if they are moving at the same pace with me	[19]Curriculum pacing interferes with intentions [20]Group work preferred [21]Learners' lack of understanding activity instructions [22]Learner behaviour [23]In favour of learner-learner interactions [24]Curriculum pacing interferes with intentions	[19]Social teaching norms [20]Science beliefs [21]Immediate classroom situation [22]Immediate classroom situation [23]Science beliefs [24]Social teaching norms
(31)	**R:**	**What teaching strategies work well for you?**		
(32)	**NT:**	[25]I usually like peer teaching. [26]I like to get them working among themselves and I move around so that I can get ideas from them. [27]I don't like to be the one who always do the talking in class I always doing the talking in class I always like to pick up on them like to pick on them. [28]Because I believe teaching is learning. I learn from them so that I can better my teaching.	[25]Likes peer teaching [26]In favour of learner-learner interactions [27]Does not like knowledge transmission [28]Teaching involves learning from learners to improve teaching	[25]Science beliefs [26]Science beliefs [27]Science beliefs [28]Science beliefs
(33)	**R:**	**What other teaching strategy might you use?**		
(34)	**NT:**	[21]Well, I <u>like</u> practical to do a lot of practical work in science.	[21]Lot of practical work	[21]Science beliefs

			[22]It's always fun. [23]I use it sometimes as a positive reinforcement. [24]They know if they behave well then there is pract. And, they always enjoy them. [25]So, it's something, it's always fun. [26]Something fun yet helpful very and it helps them with their understanding	[22]Field exp, student learning [23]Managing behaviour [24]Managing behaviour [25]Activities that work [26]Activities that work	[22]Teacher education programme [23]Immediate classroom situation [24]Immediate classroom situation [25]Teacher education programme [26]Teacher education programme
(35)	**R:**	**Thank you for your participation. Do you have anything you wish to say or ask about?**			
(36)	**NT:**	No.			
(37)	**R:**	**Thank you.**			
		I'm glad to be part of this.			
(38)		**Thank you. Thank you very much.**			

7.10 Appendix I – Wits Ethics approval

Wits School of Education

27 St Andrews Road, Parktown, Johannesburg, 2193 Private Bag 3, Wits 2050, South Africa
Tel: +27 11 717-3064 Fax: +27 11 717-3100 E-mail: enquiries@educ.wits.ac.za Website: www.wits.ac.za

Student Number: 9310786A

Protocol Number: 2013ECE138M

Date: 20 August 2013

Dear Benjamin Shongwe

Application for Ethics Clearance: Master of Science Education

Thank you very much for your ethics application. The Ethics Committee in Education of the Faculty of Humanities, acting on behalf of the Senate has considered your application for ethics clearance for your proposal entitled:

Understanding teacher communication patterns in the science classroom:
The case of dialogic talk in pre-service teachers' lessons

The committee recently met and I am pleased to inform you that clearance was granted.

Please use the above protocol number in all correspondence to the relevant research parties (schools, parents, learners etc.) and include it in your research report or project on the title page.

The Protocol Number above should be submitted to the Graduate Studies in Education Committee upon submission of your final research report.

All the best with your research project.

Yours sincerely

MMabeta

Matsie Mabeta
Wits School of Education

011 717 3416

CC Supervisor: Dr. A Msimanga

7.11 Appendix J – GDE Research approval

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no. D2014/140

GDE RESEARCH APPROVAL LETTER

Date:	**8 July 2013**
Validity of Research Approval:	**8 July 2013 to 20 September 2013**
Name of Researcher:	**Shongwe B.**
Address of Researcher:	**8193 Ratale Street**
	Daveyton
	1520
Telephone Number:	**084 305 4968**
Fax Number:	**086 615 5731**
Email address:	**b.shongwe@yahoo.com**
Research Topic:	**Understanding teacher communication patterns in the Science classroom: the case of dialogic talk in pre-service teachers' lessons**
Number and type of schools:	**FIVE Secondary Schools**
District/s/HO	**Johannesburg Central; Johannesburg East; Johannesburg North and Johannesburg South**

<u>Re: Approval in Respect of Request to Conduct Research</u>

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

2013/07/09

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

1

Making education a societal priority

Office of the Director: Knowledge Management and Research
9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0508
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

7.12 *Appendix K – Consent letter, Principal*

8193 Ratale Street
Daveyton, 1520
Email: b.shongwe@yahoo.com
Contact cell number: 084 305 4968
7 August 2013

Dear ……… (name of the principal)

My name is Benjamin Shongwe. I am a Masters' student in the School of Education at the University of the Witwatersrand. I am doing research on communication patterns in the Natural Sciences classrooms entitled "**Understanding teacher communication patterns in the science classroom: Case studies of talk in new teachers' science classrooms**". My research involves observing new science teachers' teaching and analysing the interaction between the teacher and learners to determine their communication patterns. I am interested in how teachers elicit learners' ideas and how they work with them during the lesson. To do this I would like to audio record the lessons so as to be able to revisit them afterwards. I would also like to interview the teachers to get an understanding of their thinking about learners' ideas and why they work with them in the way they do. Both the audio recordings of the lessons and the interviews will be transcribed for further analysis.

The research participants (teachers and learners) will not be disadvantaged in any way. I will seek their consent and will assure them that they may withdraw from the study at any time without any penalty. I will also seek the learners' parents/guardians permission for their child/ward to participate in the study. There are no foreseeable risks in participating in this study. The participants will not be paid for this study.

The names of the research participants and identity of the school will be kept confidential at all times and in all academic writing about the study I will use pseudonyms. This includes any published and written work resulting from the study. All research data will be kept for a maximum period of 5 years following completion of the study after which it will be destroyed.

The study will be conducted such that it does not disrupt any school activity. To avoid disruptions, I will conduct the research during the scheduled teaching periods as allocated by the school timetable. I will explain my research at the beginning of the term and give learners the choice to participate. Please, note that no learners will be excluded from lessons if consent is not given.

I am happy to provide any further information.

Yours sincerely

BShongwe

Benjamin Shongwe
(Researcher)

7.13 *Appendix L – Consent letter, Learner*

8193 Ratale Street
1520, Daveyton
Email: b.shongwe@yahoo.com
Contact cell number: 084 305 4968

7 August 2013

Dear Learner

My name is Benjamin Shongwe and I am a Masters' student in the School of Education at the University of the Witwatersrand. I am doing research on communication patterns in the Natural Sciences classrooms.

My research involves audio recording lessons to allow me to revisit them, afterwards. The audio-recording is necessary to ensure accurate transcription of lessons.

I am inviting you to participate in the study and request your consent to observe and audio record some of your science lessons. Your participation is important and will help me with the study.

Remember, this is not a test, it is not for marks and it is voluntary, which means that you don't have to do it. Also, if you decide at any point that you prefer to withdraw from the study, this is completely your choice and will not affect you negatively in any way.

To ensure your anonymity, I will not use your real name but I will make one up so that no one can identify you. All information about you will be kept confidential in all my writing about the study. Also, all collected information will be stored safely and destroyed after 5 years following the completed of my study.

I will also seek the consent of your parents/guardians. A separate information sheet and consent form has been prepared for your parents/guardians.

I look forward to working with you!

Please feel free to contact me if you have any questions.

Thank you.

BShongwe

Benjamin Shongwe

7.14 *Appendix M – Consent letter, Parent*

8193 Ratale Street
Daveyton
1520
Email: b.shongwe@yahoo.com
Contact cell number: 084 305 4968
7 August 2013

Dear Parent/Guardian

My name is Benjamin Shongwe and I am a Masters' student in the School of Education at the University of the Witwatersrand. I am doing research on communication patterns in the Natural Sciences classrooms. My research involves audio recording lessons to allow me to revisit them, afterwards. The audio-recording is necessary to ensure accurate transcription of lessons.

I am requesting your consent for your child/ward to participate in the study. I wish to observe and audio record some of the science lessons. Your child/ward's participation is important and will help me with the study.

Your child/ward will not be disadvantaged in any way. S/he can withdraw from participating in my study at any time during this project without any penalty. Also, you may withdraw your permission at any time. There are no foreseeable risks in participating. Your child/ward will not be paid for this study.

Your child'/ward's name and identity will be kept confidential at all times and in all academic writing about the study. His/her individual privacy will be protected in all published and written data resulting from the study through the use of pseudonyms. All research data will be destroyed 5 years after completion of the study.

Please let me know if you require any further information.

Thank you very much for your support.

Yours sincerely.

Benjamin Shongwe

(Researcher)

7.15 *Appendix N – Consent letter, Teacher*

8193 Ratale Street
1520, Daveyton
Email: b.shongwe@yahoo.com
Contact cell number: 084 305 4968
7 August 2013

Dear …… (Teacher's name)

My name is Benjamin Shongwe. I am a Masters' student in the School of Education at the University of the Witwatersrand. I am doing research on communication patterns in the Natural Sciences classrooms entitled "**Understanding teacher communication patterns in the science classroom: Case studies of talk in new teachers' science classrooms**". My research involves observing new science teachers' teaching and analysing the interaction between the teacher and learners to determine their communication patterns. I am interested in how teachers elicit learners' ideas and how they work with them during the lesson. To do this I would like to audio record the lessons so as to be able to revisit them afterwards. I would also like to interview the teachers to get an understanding of their thinking about learners' ideas and why they work with them in the way they do. Both the audio recordings of the lessons and the interviews will be transcribed for further analysis. I am inviting you to participate in my study.

Why you have been chosen: The reason why I have chosen you is because you are a new science teacher (less than five years of teaching after completing your degree). I believe that the importance of eliciting learners' ideas was emphasized in your teacher training programmes and would like to see how you do this in your own lessons.

Your role if you decide to take part:
I am requesting to observe and audio record about five of your science lessons. I would also like to conduct a 10minute interview with you after your teaching just to get an understanding of how you elicit and use learners' ideas. Both the lesson and the interview will be audio recorded. I am requesting that you consider the consent form provided and kindly sign it if you agree to participate in the study. However, you are still free to withdraw at any time without giving a reason and without any penalty. There are no foreseeable risks in participating and you will not be disadvantaged in any way. You will not be paid for this study.

Confidentiality: Your name and identity will not be revealed and pseudonyms will be used in all academic writing about the study. Your individual privacy will be protected in all published and written work resulting from the study. All research data will be destroyed 5 years after completion of the study.

Thank you very much for your help and for reading this as well. Please, let me know if you require any information.

Yours sincerely,

Benjamin Shongwe
(Researcher)

7.16 Appendix O – Consent form, Learner

Learner Consent Form

Please fill in the reply slip below if you agree to participate in my study called: *Understanding teacher communication patterns in the science classroom: The case of dialogic talk in new teachers' lessons*

My name is: ____ **in Grade:** ______

Permission for observations

I agree to be observed in class. Yes/No

Permission to be audiotaped

I agree to be audiotaped during the observation lessons Yes/No

I know that the audiotapes will be used for this project only Yes/No

I know that Benjamin Shongwe will keep my information confidential and safe and that my name and the name of my school will not be revealed. Yes/No

I know that I do not have to answer every question and can withdraw from the study at any time. Yes/No

I know that I can ask not to be audiotaped, photographed and/or videotaped. Yes/No

I know that all the data collected during this study will be destroyed within 3-5 years after completion of my project. Yes/No

Sign_____________________________ Date___________________________

7.17 Appendix P – Consent form, Parent

Parent's Consent Form

Please fill in and return the reply slip below indicating your willingness to allow your child to participate in my voluntary research project called: "**Understanding teacher communication patterns in the science classroom: Case studies of talk in new teachers' science classrooms**".

I, ________________________________ the parent of ________________________________

Permission for observations

I agree that my child may be observed in class.
Yes/No

Permission to be audiotaped

I agree that my child may be audiotaped during the interview or observation lesson
Yes/No
I know that the audiotapes will be used for this project only
Yes/No

I know that Benjamin Shongwe will keep my information confidential and safe and that my child's name and the name of his/her school will not be revealed. Yes/No

I know that he/she does not have to answer every question and can withdraw from the study at any time. Yes/No

I know that he/she can ask not to be audiotaped, photographed and/or videotaped. Yes/No

I know that all the data collected during this study will be destroyed within 3-5 years after completion of my project.
Yes/No

Parent Signature: _________________________ Date: ____________________

7.18 Appendix Q – Consent form, Teacher

Teacher's Consent Form

Please fill in and return the reply slip below indicating your willingness to be a participant in my voluntary research project called: "**Understanding teacher communication patterns in the science classroom: Case studies of talk in new teachers' science classrooms**".
I, ____ give my consent for the following:

Permission for observations

I agree to be observed in class. Yes/No

Permission to be audiotaped

I agree to be audiotaped during the interview or observation lesson Yes/No
I know that the audiotapes will be used for this project only Yes/No

Permission for interview

I would like to be interviewed for this study. Yes/No
I know that I can stop the interview at any time and don't have to answer all the questions asked. Yes/No

I know that Benjamin Shongwe will keep my information confidential and safe and that my name and the name of my school will not be revealed. Yes/No

I know that I do not have to answer every question and can withdraw from the study at any time. Yes/No

I know that I can ask not to be audiotaped, photographed and/or videotaped. Yes/No

I know that all the data collected during this study will be kept in a secure place will be destroyed within 3-5 years after completion of my project

Sign: ………………………………….. Date: ____________________