
Chapter 3

Methodology

3.1 Introduction

This chapter provides a description of the methodology used in this study. In my attempt to understand the phenomena being studied, I firstly discuss my research paradigm and assumptions as the lenses through which I view the world. I then explain the rationale for choosing qualitative research as my approach and case studies as the design used for my study. The research site, sample selection and data collection techniques are carefully described followed by the data analysis strategies. Lastly I discuss critical issues such as the trustworthiness of the study and ethical considerations applicable to the study.

3.2 Research paradigm and assumptions

In my research endeavour to obtain knowledge and understanding of the phenomenon being studied, I need to mention *the way in which [I] view the world, by what [I] view understanding to be and by what [I] regard as the purpose of understanding* (Cohen et al., 2001, p. 3). This study's research paradigm and ontological, epistemological and methodological assumptions are discussed below.

3.2.1 Research paradigm

My research paradigm is social constructivism which suggests that all knowledge is constructed and based upon not only prior knowledge, but also the cultural and social context. According to Nieuwenhuis (2007) the origins of mathematics are social or cultural and the justification of mathematical knowledge rests on its quasi-empirical basis. Constructivism implies a subjective approach that is *concerned with the uniqueness of each particular situation (idiographic)* (Nieuwenhuis, 2007, p. 51). The focus is *on the social construction of people's ideas and concepts, on how and why they interact with each other, and their motives and relationships* (Nieuwenhuis, 2007, p. 54). What forms the basis for a social constructivist philosophy of mathematics are the facts that *knowledge is not passively received but actively built up by the cognizing subject and the function of cognition is adaptive and serves the organization of the experiential world, not the*

discovery of ontological reality (Ollerton, 2009, p. 78). Ernest (1988) also believes knowledge is acquired by oneself and that it cannot be transferred from one person to another. Ollerton's (2009) opinion is that people working individually *is not the way most of us operate for the vast majority of the time* and that *students might be encouraged to work individually in the first instance and later share and compare their information* (p. 77-78), a view with which I strongly agree. These stated principles of social constructivism have certain implications on teachers' approaches to teaching.

According to Koehler and Grouws (1992) teaching based on constructivism as learning theory is viewed *on a continuum between negotiation and imposition, and the teacher's role is to find and adjust activities for students* (p. 123). Social interaction where learners have the opportunity to communicate and work in collaboration with their peers is a critical part of knowledge construction (Koehler & Grouws, 1992; Ollerton, 2009). Social interaction, group work, problem solving and learner-centred approaches play significant roles in learners' construction of their own knowledge. I believe that although formal instruction has some influence on learners' understanding, learners do not directly assimilate knowledge or understanding from the teacher, but build their own understanding in the ML classroom through experience and maturation. The role of the teacher is therefore to guide and mentor the learners in developing understanding.

3.2.2 Paradigmatic assumptions

The nature of my study is based on three assumptions, namely the ontological, epistemological and methodological assumptions. Ontology and epistemology have direct implications for the methodological assumption as it demands different research methods (Cohen et al., 2001). The nature of my study is subjective as I am personally involved in the process of making sense of the uniqueness of the situation being studied (Nieuwenhuis, 2007). I hold the nominalist position as ontological assumption where I understand reality through words and regard reality as the product of individual consciousness (Cohen et al., 2001). Regarding the epistemological assumption, my study holds an interpretive position where knowledge is of a softer or transcendental kind and based on experience and insight of a personal nature. This nominalist and interpretive position demands an idiographic methodological preference where the focus is on the subjective experience of individuals who create, modify and interpret the world they are in (Cohen et al., 2001).

3.3 Research approach and design

The table below provides a synopsis of the research methodology components of my research.

Table 3.1: Synopsis of methodology

Research approach	QUALITATIVE		
Research design	<p>Case study: Exploratory</p> <p>A case can be a unit or group of people that are analysed and can also consist of another group(s) to enhance the trustworthiness of a study. This case study consists of ML teachers as a group. I observe their instructional practices and determine the nature of their knowledge and beliefs in order to explore the relationship between them. The nature of the data gathered is qualitative and the nature of the case study is exploratory (Cohen et al., 2001; Edwards & Talbot 1999; Nieuwenhuis, 2007).</p>		
Main question	<p>What is the relationship between ML teachers' knowledge and beliefs and their instructional practices?</p>		
Research sub-questions	<p>Question 1 How can ML teachers' instructional practices be described?</p>	<p>Question 2 What is the nature of ML teachers' knowledge and beliefs?</p>	<p>Question 3 How do ML teachers' knowledge and beliefs relate to their instructional practices?</p>
Objectives of the sub-questions	<ul style="list-style-type: none"> To determine what teachers do in their classrooms with respect to tasks given, discourse that takes place and the learning environment which is established. 	<ul style="list-style-type: none"> To comment on the teachers' level of MCK. To further explore teachers' beliefs regarding ML learners, the teaching of ML and the ML curriculum. 	<ul style="list-style-type: none"> To explore what the relationship is between teachers' instructional practices and their knowledge and beliefs. To consider the extent to which teachers use PCK in their lessons. To determine why teachers do what they do in their ML classrooms.
Participants	One Grade 11 ML teacher from five different secondary schools		
Data collection techniques	<ul style="list-style-type: none"> Three observations per teacher Three semi-structured interviews per teacher: one each before the second and third observed lessons and one after the observations. 		
Techniques per question	Observations	Observations Interviews	Observations Interviews
Data analysis	<p>DEDUCTIVE-inductive approach for data analysis (uppercase denotes the preference given to the style of analysis)</p> <ul style="list-style-type: none"> Establish units of analysis of the data Create a 'domain analysis' Use ATLAS.ti 6 to analyse the video and audio data Establish relationships and links between the domains Making speculative inferences Summarising 		

3.3.1 Research approach

The research approach for this study is qualitative. Qualitative research seeks ... *to gain better understanding of intentionality (from the speech response of the researchee) and meaning (why did this person/group say something and what did it mean to them?) ... to describe and to understand, rather than to explain and predict* (Babbie & Mouton 2001, p. 49). Hogan et al. (2009) point out that qualitative research is about researching *specific meanings, emotions and practices that emerge through the interactions and interdependencies between people* (p. 4). Similarly White (2005) emphasises that qualitative research is concerned with conditions or relationships that exist, beliefs and attitudes that are held, effects that are being felt and trends that are developed. It also provides opportunities for marginalised groups to voice their opinions on matters that are of concern to them and which may have been overlooked in conventional research. The focus of my study is to describe ML teachers' instructional practices, their knowledge and beliefs and the relationship between their knowledge and beliefs and their practices *within their naturally occurring context with the intention of developing an understanding of the meanings imparted by the [ML teachers] – so that the phenomena can be described in terms of the meaning that they have for the [ML learners]* (Nieuwenhuis, 2007).

3.3.2 Research design

This is a case study. According to Cohen et al. (2001) *case studies can establish cause and effect and observe effects in real contexts, recognising that context is a powerful determinant of both causes and effects* (p. 181). Edwards and Talbot (1999) define a case study as a unit of analysis such as an individual or work team where *each case has within it a set of inter-relationships which both bind it together and shape it, but also interact with the world*. The idea of a case study is to *allow a fine-tuned exploration of complex sets of inter-relationships* (p. 51). Edwards and Talbot (1999) further distinguish between three uses of case studies, namely explanatory, descriptive and exploratory cases. This is an exploratory case study where the focus of the study has already been decided on and explained in the conceptual framework. The focus is *the case itself and its own very particular features, therefore was used to examine complex phenomena* (Edwards & Talbot, 1999, p. 53). The ML teachers are regarded as the 'unit' that is studied in order to explore the relationship between ML teachers' instructional practices and the driving forces behind their practices. My involvement in the case study gives *a sense of being there* (Cohen et al., 2001, p. 79). The analysis of the data enhances my understanding of the phenomena which will be reflected in an improved ML teacher preparation programme and will hopefully add value to theory building.

3.4 Research site and sampling

A case study requires intensive data collection as well as high quality data and it is preferable to work in-depth with a small number of teachers. The inductive approach also requires sampling to be small and information-orientated, but representative (Edwards & Talbot, 1999). The population consists of the ML teachers in South Africa which include Mathematics and non-Mathematics teachers from urban and rural government and private schools. Due to this wide variety of teachers it is not possible to choose a representative sample. Convenience and purposive sampling were implemented to select five different secondary schools in Tshwane. Listed below in Table 3.2 are the criteria that justify the inclusion and exclusion of schools and teachers in the sample:

Table 3.2: Criteria justifying inclusion and exclusion in the sample

	Inclusion	Exclusion
Criteria	<ul style="list-style-type: none"> • Mathematics teachers • Non-Mathematics teachers • Male and female teachers • Teachers with at least one year's experience of teaching ML • Different races • Schools with different performance levels • Section 21, formerly disadvantaged and independent schools 	<ul style="list-style-type: none"> • Private schools • Schools situated far from my work • Not more than one poor performance school

The sampling is partly convenient as the five schools were chosen from schools in Tshwane that were easily accessible. Through purposive sampling three traditional black (formerly disadvantaged and independent), one predominantly white (Section 21) and one predominantly black (Section 21) schools were chosen. From each school only the Grade 11 teacher participated with the prerequisite that the teacher had taught ML for at least one year. My rationale for using the Grade 11 teachers in my study is that I presume some problems or challenges experienced by both teachers and learners either diminish or increase from Grade 10 to Grade 12. This allows for a kind of 'middle of the road' scenario where the impediment of data, due to possible problems experienced by Grade 10 and 12 teachers and learners, is reduced. From this sample valuable information was collected regarding the ML teachers' instructional practices, their knowledge and beliefs.

3.5 Data collection techniques

Case studies are normally time-consuming and not an easy option as the focus is on meanings and the complexity of interrelations which demand high quality data (Edwards & Talbot, 1999). Cohen et al.

(2001) argue that the purposes of case studies are *to portray, analyse and interpret the uniqueness of real individuals and situations ... and to catch the complexity and situatedness of behaviour* (p. 79). The use of observations and interviews as data collection techniques improve the quality of this study's data and increase the trustworthiness of the study. The classroom observations and personal interviews allowed me to explore reality by becoming part of the participants' lives. These data collection techniques were informed by predetermined categories derived from the study's conceptual framework.

The process of data collection for each teacher consisted of three observations in an effort to obtain a relatively true account of the teachers' instructional practices. Interviews were conducted with the teachers the period before the second and third observations were made. These interviews were based on the teachers' planning of the lessons in order for me to obtain information regarding their PCK. This was followed by one in-depth interview, based on their lessons presented, as well as their PCK and beliefs. Following Figure 3.1 below on the data collection process, the observations and interviews are discussed.

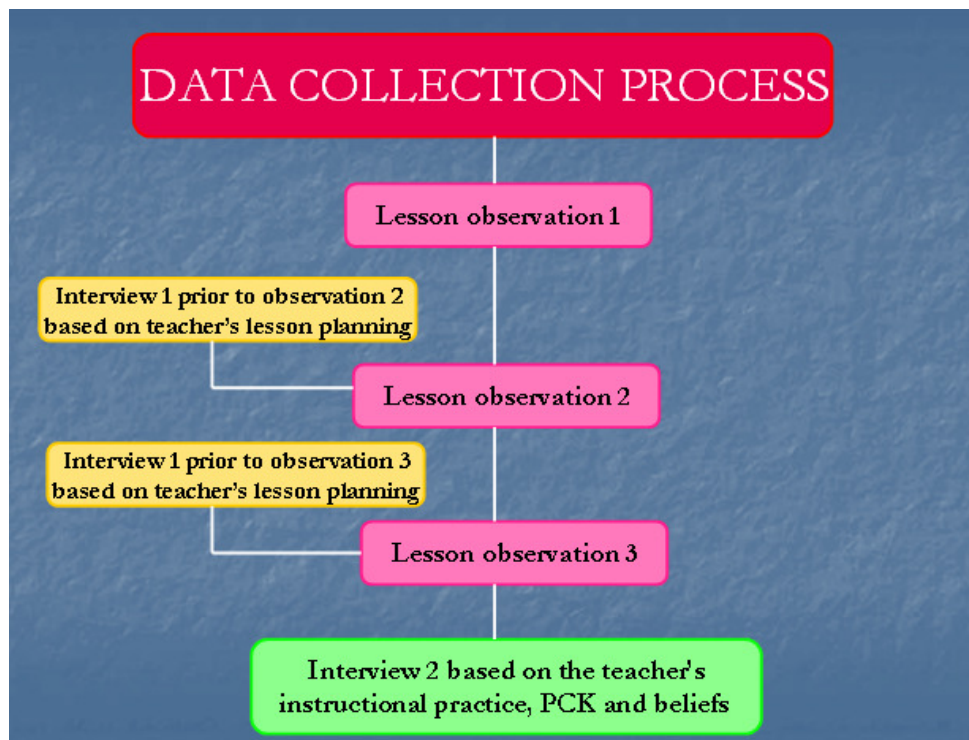


Figure 3.1: The data collection process

3.5.1 Observations

Cohen et al. (2001) believe that case studies are typified by observations as the purpose of observations is *to probe deeply and to analyse intensively the multifarious phenomena that constitute the life cycle of the unit with a view*

to establishing generalisations about the wider population to which that unit belongs (p. 185). The type of observation I used was that of the observer as participant, not directly influencing the teaching process in the class situation (Nieuwenhuis, 2007). The purpose of the classroom observations was to describe the ML teachers' instructional practices according to three different dimensions of their lessons, namely tasks given, discourse and the learning environment²¹. I also observed the teachers' classroom performances with a view to studying demonstrations of their knowledge regarding the ML learners, the teaching of ML and the ML curriculum.

I decided to undertake three observations, preferably of different classes, to obtain a general impression of the teacher's instructional practice. The first observation was before any interviews were conducted so that the teacher could not be influenced by the questions from the interviews. An observation sheet was compiled in advance to cover the predetermined categories (Cohen et al., 2001). Figure 3.2 below provides a clarification of the lesson observations in terms of the teachers' instructional practices²² and knowledge and beliefs.

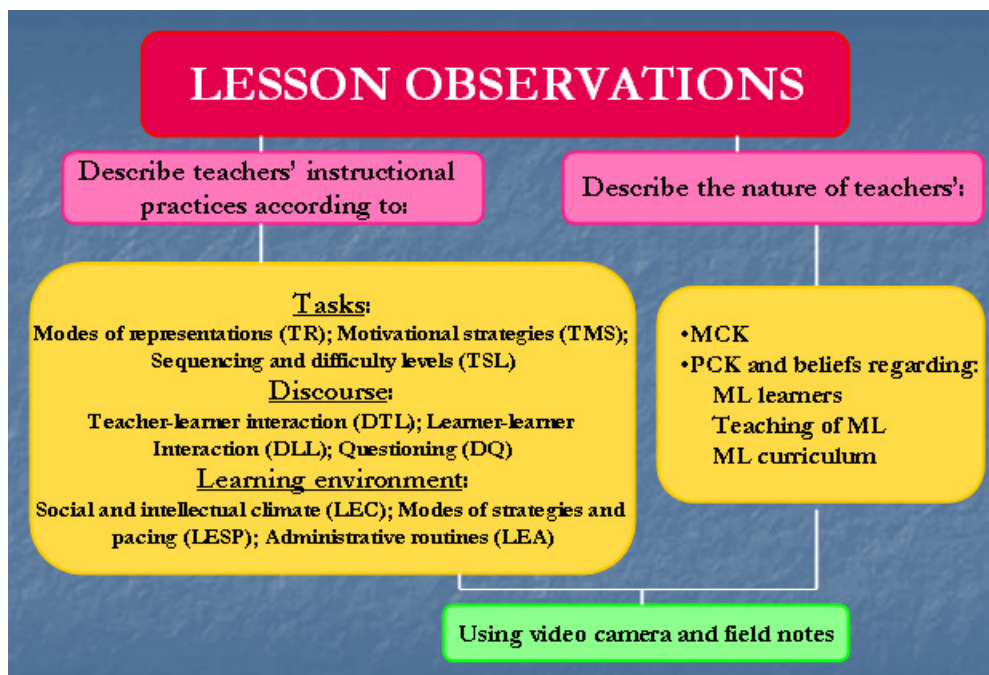


Figure 3.2: Elucidation of the character of the lesson observations

The lessons were video-taped and transcribed afterwards. Field notes were made regarding any unexpected valuable data that had emerged. Classroom observations are essential since lesson preparations can provide direction to a lesson, but can never predict exactly what will happen in class,

²¹ See Section 2.5.5: Teachers' instructional practices.

²² See Section 2.5.5: Teachers' instructional practices for complete discussion.

as learners' participation, contribution and interaction with the content, teacher and peers allow for that dynamic aspect in class from which valuable data can be collected.

3.5.2 Interviews

According to Nieuwenhuis (2007) *[t]he aim of qualitative interviews is to see the world through the eyes of the participant* (p. 87) and to learn more about the participants' behaviours, beliefs and views. In these two-way conversations I tried to remain sensitive to responses of the participants and to identify new aspects to be discussed (Nieuwenhuis, 2007). Table 3.3 below provides an elucidation of the character of the interviews.

Table 3.3: Elucidation of the character of the interviews

INTERVIEW 1 A semi-structured interview conducted prior to the 2 nd and 3 rd lesson observations	PURPOSE OF INTERVIEW
	<p>To gain insight into the participants' planning of their lessons and providing evidence of the teachers' PCK and beliefs regarding the ML learners, the teaching of ML and the ML curriculum.</p>
INTERVIEW 2 A semi-structured and structured interview conducted at the end of the data collection phase	EXAMPLES OF INTERVIEW QUESTION CONTENT
	<ul style="list-style-type: none"> • Teachers' predictions on which content the learners would and would not understand and the reasons for their understanding or not, • What possible misunderstandings could occur, • How they planned their lessons in order to bring learners to understanding the content and context, and • What prior-knowledge should be present in the lesson.
	PURPOSE OF SECTION A
INTERVIEW 2 A semi-structured and structured interview conducted at the end of the data collection phase	<p>I used clips from the video recordings from the three lessons presented to guide a discussion with the participants in order to obtain a better understanding of their practices. The discussion focussed on the three dimensions of their lessons, namely tasks, discourse and the learning environment.</p>
	PURPOSE OF SECTION B
	<p>The questions in this section were divided into three subsections, probing for teachers':</p> <ul style="list-style-type: none"> • Beliefs about the nature and value of mathematics as discipline and ML as subject, • Knowledge and beliefs regarding the ML learners, and • Knowledge and beliefs regarding the teaching of ML.
INTERVIEW 2 A semi-structured and structured interview conducted at the end of the data collection phase	PURPOSE OF SECTION C
	<ul style="list-style-type: none"> • This section consisted of a set of predetermined questions and allows for clarification of answers in writing. The questions were based on some of the official documents such as the NCS Grades 10-12 (General) Mathematical Literacy (DoE, 2003) as well as the new CAPS (DoE, 2011a). • The reason for including this section in the interview and not treating it separately in a questionnaire was to ensure that true data were captured as it was impossible for the teachers to discuss it with other teachers or to consult the relevant documents.

All interviews were audio-taped and the tape-recordings were transcribed verbatim and coded afterwards by me. The final aim was to integrate the findings from the observations and interviews to make sense of the reality and the complexity of the phenomenon, in other words to determine the relationship between ML teachers' knowledge and beliefs and their instructional practices.

3.6 Data analysis strategies

According to Cohen et al. (2001) data analysis *involves organising, accounting for, and explaining the data; in short, making sense of the data, noting patterns, themes, categories and regularities* (p. 147). They further suggest that early analysis will reduce the problem of data overload as huge volumes of data rapidly accumulate in qualitative research. Edwards and Talbot (1999) agree to this practice as they believe continuous analysis of data keeps control of the project and reflects on the approach and design of the project as well as informing the next data gathering process. To analyse interviews as qualitative data, one has to realise it is *more of a reflexive, reactive interaction between the researcher and the de-contextualised data that are already interpretations of a social encounter* (Cohen et al., 2001, p. 282).

In my study I use DEDUCTIVE-inductive (uppercase denotes the preference given to the style of analysis) qualitative data analysis as my analysis will initially be deductive and then inductive. My raw data were analysed according to the categories that have been identified in my study's conceptual framework (Figure 2.9). After this deductive phase of analysis, inductive analysis was done where I studied the organised data in order to explore *undiscovered patterns and emergent understandings* (Patton, 2002, p. 454). Edwards and Talbot (1999) believe that although case studies need a theoretical framework, *their strengths are their capacity to reveal new ways of seeing familiar and complex situations* (p. 131). Through inductive analysis new patterns, themes and categories in the data were discovered which contributed towards possible implications for teacher training and theory building. The inductive approach allows for correlating the study's purpose with the findings.

The following research questions guided my analysis process:

1. How can ML teachers' instructional practices be described?
2. What is the nature of ML teachers' knowledge and beliefs?
3. How do ML teachers' knowledge and beliefs relate to their instructional practices?
4. What are the possible implications of the findings from Questions 1, 2 and 3 for teacher training?
5. What is the value of the study's findings for theory building in teaching and learning ML?

For this purpose I adapted Cohen et al.'s (2001, p.148) seven-step analytic strategy. The purpose is to move from thematically describing the cases to explaining the phenomena to eventually generating theory:

Step 1: *Establish units of analysis of the data, indicating how they are similar and different* – ascribing codes to the data.

Step 2: *Create a domain analysis* – dividing my data into groups, patterns and themes according to my conceptual framework.

Step 3: *Writing a case study narrative* – giving a description of each case, thus providing the reader with *all information needed to understand the case in all its uniqueness* (Patton, 2002, p. 450) **(Research question 1 and 2)**.

Steps 1 to 3 are indicated in Table 3.4 below:

Table 3.4: Collection, analysis and reporting data

OBSERVATIONS		
Three observations per teacher to obtain a general impression of their instructional practices		
DATA COLLECTION MODE	DATA ANALYSIS MODE	REPORTING DATA
Observe lessons <u>focussing on</u> : <ul style="list-style-type: none"> • Tasks • Discourse • Learning environment <u>using</u> : <ul style="list-style-type: none"> • Video recordings • Field notes 	<ul style="list-style-type: none"> • Transcribe video data verbatim to text data • Add field notes to above transcripts • ATLAS.ti 6 to code video data: <u>CODES:</u> I used the codes from Artzt et al.'s (2008) Framework for the examination of instructional practices. They referred to these codes as lesson dimensions. <ul style="list-style-type: none"> Tasks: Representations (TR) → Teaching Tasks: Motivational strategies (TMS) → Learners Tasks: Sequence and level (TSL) → Teaching Discourse: Teacher-learner (DTL) → Teaching and learners Discourse: Learner-learner (DLL) → Teaching and learners Discourse: Questioning (DQ) → Teaching and learners Learning environment: Climate (LEC) → Teaching and learners Learning environment: Strategies, pace (LESP) → Teaching Learning environment: Administrative (LEA) → Teaching 	<ul style="list-style-type: none"> • Describe teachers' instructional practices according to tasks, discourse and learning environment. (Research question 1) • Describe nature of teachers' knowledge and beliefs as observed during lesson presentations. (Research question 2)
INTERVIEW 1		
Semi-structured interview conducted prior to observations 2 and 3 and based on the teacher's planning of that day's lesson.		

DATA COLLECTION MODE	DATA ANALYSIS MODE	REPORTING DATA
Finding evidence of PCK and beliefs regarding the: <ul style="list-style-type: none"> • ML learners • Teaching of ML • ML curriculum <u>using:</u> <ul style="list-style-type: none"> • Clips from the video recordings • Tape recordings 	<ul style="list-style-type: none"> • Transcribe audio data verbatim to text data • ATLAS.ti 6 to code audio data: <u>CODES for PCK and beliefs:</u> ML learners (L) Teaching of ML (T) ML curriculum (C)	Describe nature of teachers' PCK and beliefs as new information from interviews could be compared with findings from observations. (Research question 2)
INTERVIEW 2 Semi-structured interview conducted after all three observations and based on teachers' personal experiences to gain deeper insight in their practices		
DATA COLLECTION MODE	DATA ANALYSIS MODE	REPORTING DATA
Section A: Discuss outstanding incidents from their lessons to obtain a better understanding thereof. <u>using:</u> <ul style="list-style-type: none"> • Tape recordings Section B: Discussion according to a set of predetermined questions <u>based on:</u> <ul style="list-style-type: none"> • Beliefs about nature of mathematics as discipline and ML as subject • PCK and beliefs regarding the ML learners • PCK and beliefs regarding ML teaching <u>using:</u> <ul style="list-style-type: none"> • Tape recordings Section C: A set of predetermined questions answered in writing based on the NCS and CAPS to determine teachers' knowledge of the curriculum.	For all three sections: <ul style="list-style-type: none"> • Transcribe audio data verbatim to text data • Use ATLAS.ti 6 to code audio and written data (using same codes as with observations and interview 1) 	Further describe nature of teachers' PCK and beliefs as new information emerges from the second interview in addition to observations and first interview. (Research question 2)

After the process discussed above, I continued with Cohen et al.'s (2001, p. 149) steps of data analysis, namely:

Step 4: *Establish relationships and linkages between the domains* – the data were put in context by establishing relationships and links between the domains and also between the sets of data from the

observations and interviews. This was done by *identifying confirming cases, by seeking 'underlying associations' and connections between data subsets.* **(Research question 3)**

Step 5: *Summarising* – reporting on the main features of the research so far indicating the major themes, issues and problems that have arisen from the data, also seeking negative and discrepant cases.

Step 6: *Making speculative inferences* – from the analysis I could draw certain conclusions and could consider the implications of those findings for teacher training. **(Research question 4 and 5)**

All video and audio data were transcribed verbatim to text data immediately after the data were collected. Following the transcribing process, I coded the transcriptions by using ATLAS.ti 6 which allows for codes to be easily accessed, sorted and merged. My transcripts are synchronised with associated files in order to jump from a particular part in the transcript to the original recording.

3.7 Quality assurance criteria

To conform to the quality assurance criteria for qualitative research, I considered aspects such as the trustworthiness, validity and reliability of my study and also bore in mind the Hawthorne and Halo effect. Being aware of the use of different terminology (trustworthiness, validity and reliability) by different researchers, I use the terms interchangeably as all these terms are referring to valuable aspects of quality assurance applicable to my qualitative study.

3.7.1 Trustworthiness of the study

Nieuwenhuis (2007) uses the term trustworthiness and states that *when qualitative researchers speak of research 'validity and reliability' they are usually referring to research that is credible and trustworthy* (p. 80). By using multiple data collection strategies such as multiple observations and interviews, the researcher as data gathering instrument, enhances the trustworthiness of the study. I acquired the services of a peer researcher with years of experience to assist me with the coding and interpretation of the data to further enhance trustworthiness (Nieuwenhuis, 2007).

Two factors affecting the trustworthiness of the study are the small sample and number of lessons observed influencing the extent to which the sample is representative. There is also no agreement on how PCK and beliefs are to be evaluated. Nespør (1987) reasons that *belief systems often include affective feelings and evaluations, vivid memories of personal experiences, and assumptions about the existence of entities and alternative worlds, all of which are simply not open to outside evaluation or critical examination in the same sense that the components of knowledge systems are* (p. 321).

3.7.2 Validity and reliability of the study

Cohen et al. (2001) refer to validity and reliability in qualitative research and do not use the terms “credibility and trustworthiness”. They regard validity as an important aspect of both quantitative and qualitative research to ensure that a particular instrument measures what it is supposed to measure. A study may be declared reliable if findings from a particular group are replicated when a similar group in a similar context is investigated. Reliability then refers to the *consistency and re-applicability over time, over instruments and over groups of respondents. It is concerned with precision and accuracy* (Cohen et al., 2001, p. 117). Prompted by these views I came to the conclusion that the validity of my qualitative study was addressed through the ... *honesty, depth, richness and scope of [my study’s] data* ... (Cohen et al., 2001, p. 105). Factors that contributed to a degree of bias were the subjectivity of respondents, their opinions, attitudes and perspectives. I enhanced the reliability of my study by the *stability of observations* meaning that I *would have made the same observations and interpretations [if the ML teachers] had been observed at a different time or in a different place* (Cohen et al., 2001, p. 119). I facilitated inter-rater reliability by inviting a researcher with many years’ experience in analysing qualitative data to act as my external coder.

3.7.2.1 The Hawthorne effect

During the data collection stage I took the Hawthorne effect (Cohen et al., 2001) into consideration: the credibility of my data may be influenced due to my presence in class possibly influencing teachers’ behaviour during observations. To reduce this effect, the first observation was done without a prior interview or discussion as the interview questions prior to the second and third observations could influence teachers’ behaviour in the classroom. I emphasised the fact that I was interested in the uniqueness of each teacher and my purpose was not to report their performances in class to their superiors. To further enhance the trustworthiness of the observations the lessons were video-taped, field notes were taken and after each observation the teacher had to verify my field notes (Nieuwenhuis, 2007).

To enhance the trustworthiness²³ of the interviews, it was important that the interviewees be honest and open in their responses. The data from the two interviews prior to the lessons were compared with the classroom observations. The same interview schedules, including the same questions and sequence thereof were used for all interviewees. The questions were short and concise in order to avoid confusion or misunderstanding. Section C of the last interview where teachers answered the questions in writing was completed in my presence as part of the interview. This was to ensure that the data

²³ Note that for the purpose of my study I use trustworthiness, validity and reliability interchangeably as discussed under Section 3.7.

obtained were credible as the teachers were not able to consult another teacher or the relevant documents. I considered the fact that some teachers might have preferred to complete it in writing instead of orally as they might have felt less threatened or pressured. This allowed for more time to think about the questions and to provide valuable responses.

3.7.2.2 The Halo effect

The Halo effect also needs to be considered during the data collection stage: *where the researcher's knowledge of the person or knowledge of other data about the person or situation exerts an influence on subsequent judgements* (Nieuwenhuis, 2007, p. 116). To ensure trustworthiness of the observations, a pilot study was conducted during the assessment period of one of my internship ML students *to ensure that the observational categories themselves are appropriate, exhaustive, discrete, unambiguous and effectively operationalise the purposes of the research* (Nieuwenhuis, 2007, p. 129). To enhance the trustworthiness of the interviews, I avoided the tendency to seek answers that would have supported my preconceived ideas. The peer researcher who assisted me with the coding and transcribing of the data pre-empted this problem. The interviewees were asked exactly the same questions and after each interview I gave a summary of my interpretation of the interview for them to verify or modify. The interviews were also piloted to refine *contents, wording, length etc.*, to ensure that questions were interpreted the same way by different teachers and that it did not take too much time, as the teachers' demanding schedules had to be taken into account (Nieuwenhuis, 2007, p. 129).

3.8 Ethical considerations

Ethics involves the moral issues implicit in the research work with respect to people directly involved in or affected by the project. To ensure that the study adhered to the research ethics requirements, application for ethical clearance was requested from the Ethics Department at the University of Pretoria as well as the Gauteng Department of Education. These applications were submitted after the proposal was successfully defended at faculty level and before fieldwork was conducted. Issues addressed in the application involve the sensitivity level of the research activities, the research approach, design and methodology, including full detail regarding the participants, voluntary participation, informed consent, confidentiality, anonymity and risk.

The participants were invited to take part in the study and were informed of the purpose of the study and their participative roles. They were not obliged to take part in the study but instead had a choice to participate knowing that they could withdraw at any stage. After joining the study, the participants signed a letter of informed consent. The letter explained the purpose of the study, the procedures to be

followed during the investigation, the possible advantages and disadvantages as well as information regarding confidentiality, anonymity and possible risks involved in taking part in the study.

This study has a medium level of sensitivity as the participants were video-taped during their lesson presentations and the interviews were audio-taped in order to have a clear and accurate record of all events and verbal communication. It is highly unlikely that any of the participants was physically or psychologically harmed during this research. The only possible harm participants might have experienced is the invasion of their privacy by video-taping the lessons they presented or feelings of anxiety and discomfort in sharing their knowledge and beliefs during the interviews that were audio-taped. To lower the level of discomfort when questions were asked about their PCK of the curriculum, I gave them the option to rather answer the questions in writing. In this manner they had sufficient time to think and to avoid a situation where they could have felt threatened or even embarrassed if they could not answer a question. I am also aware that teachers are very busy and seldom have free periods, and time used for the interviews was also part of the intrusion into their lives.

It is important to notice that *a respondent may be considered anonymous when the researcher cannot identify a given response with a given respondent* (White, 2005). Confidentiality means *that although researchers know who has provided the information or are able to identify participants from the information given, they will in no way make the connection known publicly; the boundaries surrounding the shared secret will be protected* (Cohen et al., 2001, p. 62). To ensure anonymity and confidentiality the participants were not expected to identify themselves publicly and if their names were known, it was kept confidential at all times. No names were mentioned of any school or participant during the dissemination phase of the study when the research report was written, but instead the schools were numbered and pseudonyms were used. The signed consent letters served as a further guarantee to the participants regarding the anonymity and confidentiality of the study. The interviews took place in a private environment. The video-tapes of the observations and audio-tapes of the interviews by means of which the participants can be identified are accessible only to me. Participants were asked to review the draft report before it was finalised.

3.9 Conclusion

In this chapter I discussed social constructivism as my research paradigm, stated the nature of my study being subjective and taking up an interpretive position. A qualitative research approach is used and the research design is an exploratory case study. The research site is secondary schools in Tshwane and the sample comprises five grade 11 ML teachers. Observations were used to access teachers' instructional practices and to determine the nature of their MCK and the extent to which they apply their PCK

during their instructional practice. Interviews were used to describe the ML teachers' beliefs about mathematics as a discipline as well as their PCK and beliefs about the ML learners, the teaching of the subject and the ML curriculum. ATLAS.ti 6 was used to analyse the video and audio data in order to establish a relationship between teachers' instructional practices and their knowledge and beliefs. I lastly discussed the trustworthiness of the study and ethical considerations that were taken into consideration. In the next chapter the results of the study are presented and discussed.