Chapter 3

Research Design

3.1 Introduction

A research design is a plan or strategy that moves from the underlying philosophical assumptions to specifying the selection of respondents, the data-gathering techniques to be used and the data analysis to be done (Nieuwenhuis, 2010).

Within the qualitative approach, the design chosen for this research study is a case study design. According to Cohen, Manion and Morrison (2005) a case study provides a unique example of real people in real situations. Nieuwenhuis (2010) argues that case studies offer a multiperspective analysis in which the researcher considers not just the voice and perspective of one or two participants in a situation, but also the views of other relevant groups and the interaction between them. A key strength of the case study method is the use of multiple sources and techniques in the data-gathering process, which includes interviews, observation and field notes.

In this chapter I firstly discuss the paradigmatic assumptions and perspectives underlying my research. I then reveal the research site and sampling of this research study, followed by a discussion of the data-gathering procedures. Subsequently the strategies for data analysis, quality assurance and ethical considerations that guide this study are discussed. Lastly I mention perceived limitations of this research study.

3.2 Paradigmatic assumptions and perspectives

A paradigm is a set of assumptions or beliefs about fundamental aspects of reality which give rise to a particular world-view (Nieuwenhuis, 2010). In defining my paradigmatic perspective as a qualitative researcher, I am aware that I approach my research with certain basic assumptions about the world and how it should be studied. In this section I address my fundamental assumptions about the nature of reality (ontology), the relationship between knower and known (epistemology) and my assumptions about human nature.

3.2.1 Ontological assumptions

This research study seeks to explore the nature of mathematics teachers' reflection in their classrooms and in the lesson study group. I believe that teachers' construction of reality lies in their sense-making and negotiation of the external world (the context of classroom, school

and community) and their interpretation of this world. This research study therefore follows a qualitative research approach that focuses on teachers' reflections on their classroom practice. Qualitative research is based on a philosophy that views reality and truth as subjective, multifaceted and a shared social experience (McMillan & Schumacher, 2006). Its goal is to understand the situation from the participants' perspective. I am undertaking this research in the belief that human life can only be understood from within and not as a form of external reality, and that the human mind is the purposive source of meaning (Nieuwenhuis, 2010). The focus of this study is therefore on teachers' subjective experiences and how they share these experiences with their fellow teachers.

3.2.2 Epistemological assumptions

In terms of epistemology an underlying assumption I bring into the inquiry is that people create reality by learning from others, teaching others and reflecting with others on their own knowledge. In my research study I allow for a rich understanding of social reality by using the context of lesson study, which allows teachers to share their ideas about their classroom practice with one another. Lesson study provides teachers with the opportunity to learn from one another's experiences, thus building up a shared body of knowledge. I do not believe that precise, systematic and theoretical answers to complex human behaviour are possible, and that is one of the reasons why this research study will be qualitative. According to Nieuwenhuis (2010) knowledge should emerge from the local context and should privilege the voice of the *insiders* (p. 56), taking into account what people say, do and feel, and how they make meaning of the phenomena under investigation. In the context of the lesson study group my role as researcher is to understand the teachers' reflections from their point of view, and not from my own.

Because this research study seeks to understand the nature of teachers' reflection and their reflective practice it is situated within an interpretive paradigm. The central endeavour in the context of the interpretive paradigm is to understand the subjective world of human experience (Cohen, Manion & Morrison, 2005). It is characterized by a concern for the individual and efforts are made to get inside the person and to understand from within (*ibid.*, 2005).

3.2.3 Assumptions about human nature

As a researcher I share my participants' frame of reference and try to understand how their views shape the action which they take within that reality (Beck, cited in Cohen, Manion & Morrison, 2005). The experiences of teachers regarding their reflective practice are investigated against the social context of interaction between fellow teachers as well as in the social context of mathematics classrooms. I acknowledge that an interactive relationship between me as researcher and the participants exists. The experiences and narratives of the teachers are the medium through which this research study explores their reflective practice.

These assumptions impact on my methodological choices and require consideration of different research methods. Because this study addresses teachers' reflective practice, I wish to adopt an approach that has been described by various authors as "reflective" (Evans, 2002). According to Alvesson and Sköldberg (2002) reflective research has two basic characteristics: careful interpretation and reflection. Reflection means interpreting one's own interpretations, looking at one's own perspectives from other perspectives, and turning a self-critical eye onto one's own authority as interpreter and author (Alvesson & Sköldberg, 2002).

3.3 Research site and sampling

The research site for this study is in the Thabo Mofutsanyana district in the Free State. Permission to access a school in this district was obtained from the Free State Education Department. A meeting with the principal of the school was arranged and permission from him was obtained to meet with potential participants. The participants in this research study are five mathematics teachers, teaching Grades 8 - 11. One participant teaches Mathematical Literacy. The criteria for selection as a participant include the factors of convenience, access, and willingness to participate. The expectations of the study were presented to potential participants verbally and in writing. Meetings with these teachers took place in the teachers' school environment.

3.4 Data-gathering procedures

This research study takes place in the context of lesson study. Underlying the practice of lesson study is the idea that teachers can best learn from and improve their practice by seeing other teachers teach (Stephens & Isoda, 2007). There is an expectation that teachers who have developed deep understanding of and skills in subject matter pedagogy should be encouraged to share their knowledge and experience with colleagues (*ibid.*, 2007). Whereas

the focus appears to be on the teacher, the final focus is on the cultivation of learners' interest and on the quality of their learning (*ibid.,* 2007).

The lesson study cycle involves a planning phase, a teaching phase and a feedback (reflection) phase. In this research study the participants decided to cooperatively plan a lesson on equations, which is one of the topics that is covered by Grades 8 – 12. The planning phase will last two weeks. The lesson study group will plan a lesson on linear equations for Grade 8. Each teacher will then adapt the Grade 8 lesson to the grade that he/she teaches, taking into account that the content and context of each grade should show progression from simple to complex. During the teaching phase of the lesson study cycle the planned lesson will be taught by the Grade 8 teacher. This lesson will be observed by the researcher together with an assistant who will manage the video recorder. During the feedback (reflection) phase of the lesson study cycle the participants of the lesson study group will view the video-recorded lesson the same afternoon in a post-conference to improve on the lesson plan. The focus will not only be on the teachers' presentation but also on the learners' understanding of the concepts that were taught. Figure 3.1 illustrates the lesson study cycles for this research study.

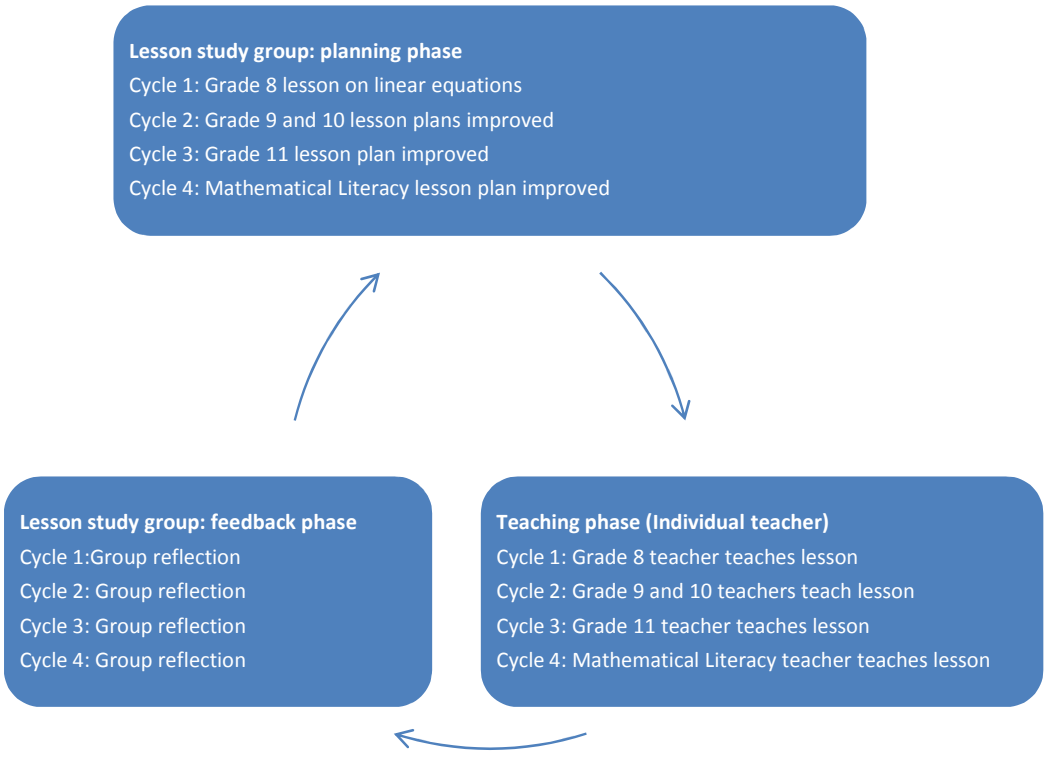

Figure 3.1 Illustration of the lesson study cycles for this research study

The figure illustrates the continuous cycles of lesson study: planning, teaching and reflection. This research study will have four lesson study cycles. The first cycle will involve the planning of a Grade 8 lesson on linear equations, the teaching of the lesson and the post-conference during which the group will reflect on the learners' understanding of the equation concepts. The second lesson study cycle will involve the adaptation of the Grade 8 lesson plan to Grades 9 and 10. The teaching of this revised lesson will be followed by a reflection session during which the participants will try once more to improve the lesson plan. This cycle is repeated again by the Grade 11 teacher and lastly by the Mathematical Literacy teacher.

My principal concern is with understanding the way in which the teachers in the lesson study group create, modify and interpret the social context in which they function as they plan, teach and reflect on the lesson. Therefore a qualitative inquiry with an epistemological perspective of the interpretive paradigm will underpin this study as I seek to explore the nature of these mathematics teachers' reflective practice.

In this research study my role as researcher will be that of participant observer. Participant observation is useful when the focus of interest is how activities and interactions within a setting give meaning to beliefs or behaviours. This fits in with the assumption that everyone in a group or organization is influenced by assumptions and beliefs that they take for granted. It is therefore considered the qualitative method of choice when the situation or issue of interest is obscured or hidden from public knowledge and there are differences between what people say and what they do.

My role as researcher will also take on a reflective stance: interpreting my own interpretations, looking at my own perspectives from other perspectives, and turning a self-critical eye onto my own authority as interpreter and author.

3.5 Data-gathering instruments

A discussion of the methods of data collection follows. The link between the research questions posed by this study and the method of data collection is provided after the discussion.

3.5.1 Interviews

The aim of qualitative interviews is to see the world through the eyes of the participant in order to obtain rich descriptive data that will help to understand the participant's construction of knowledge and social reality (Nieuwenhuis, 2010). According to Bernard and Ryan (2009) probing is the key to successful in-depth interviewing and they mention the following probing techniques (which I will keep in mind while interviewing the participants in my study):

- The silent probe (waiting for a response
- The echo probe (repeating the last thing someone has said and asking them to continue)
- The uh-huh probe (making affirmative statements)
- The tell-me-more probe (asking questions like "Could you tell me more about that?" or "Why do you say that?")

I will conduct a semistructured interview[4] with each of the five teachers individually before the research study commences. A list of prepared questions will be used as a guide to explore these teachers' understanding of reflection. During this interview I will also use a lesson plan from each teacher as a discussion document to probe whether, how, when and on what they reflect when teaching their lessons.

A second individual interview[5] with each teacher will be conducted after each lesson observation to probe their experiences while teaching the lesson, as well as to understand any deviations from their lesson plan (reflection-in-action and on-action).

A final group interview[6] with all the participants will be conducted after the last lesson study cycle to establish how the reflexive processes of lesson study affect their classroom practice. This group interview will take place during the final phase of the research study.

3.5.2 Observations

Observation is an essential data-gathering technique which allows the researcher to hear, see and begin to experience reality as participants in the research group do (Nieuwenhuis, 2010). Bernard and Ryan (2009) argue that observation behaviour should be recorded as accurately as possible, in order to produce unique valuable qualitative data.

[4] See Appendix D
[5] See Appendix D
[6] See Appendix D

3.5.2.1 Individual teacher observation

Each teacher will be observed while teaching the planned lesson. I will observe this lesson which will be video-recorded by an assistant. The video-recording will be viewed afterwards by the lesson study group to determine whether the goal of the lesson (improving learners' understanding of equations) was met. It might be necessary to view the video-recording more than once in order to focus on the teacher's reflection-for, on- and in-action. I will take field-notes during this group reflection.

3.5.2.2 Lesson study group observation

Teachers in the lesson study group will be observed during the reflection-on-action stage (while reflecting on the lesson in the post-conference phase). These observations will reveal the nature of the teachers' reflective practice. I believe that the lesson study process will foster the participant teachers' reflective awareness and hope to see evidence of this in their classroom practice. The lesson study group will be video-recorded and audio-taped while they reflect on the lessons. I will take fieldnotes while observing the participants.

Throughout all the observations, I will try to remain sensitive to the ethnographic data emerging from the participants' professional lives.

3.5.3 Document collection

Simply stated, document collection is about learning from things (Lehman, 2003). According to Hodder (cited in Lehman, 2003) document collection is important in qualitative inquiry for the following reasons: it provides easy and low cost access to information; the data may differ from what is interpreted from direct observation and interviewing, allowing the qualitative researcher to explore multiple voices and conflicting interpretations; and material culture is more permanent than the spoken word and can provide historical insight.

In this research study I will collect data from the participants' lesson plans.

3.5.3.1 Lesson plans

Lesson plans of teachers provide striking evidence of the whole nature of teaching and classroom life (Burton & Bartlett, 2005). A set of lesson plans from each teacher before participation in the research study will be analysed to establish levels and moments of reflection before participating in the lesson study group. The lesson plans might also reveal

their assumptions about their learners' mathematics knowledge and their own views on mathematics teaching. The lesson plans will provide additional data regarding the main research question.

The lesson plan of the lesson study group will also be analysed to reveal the quality of their collective reflection. I believe that reflection is better carried out in collaboration, but there might be limitations involved that I am unaware of at this stage.

3.5.3.2 Researcher diary

I will enter my own reflections in a researcher diary. In this diary I will reflect on my role as researcher during the research process, and record possible dilemmas or unanticipated incidents that might occur. Such reflections might help in framing my own dilemmas, and serve to clarify issues and keep the focus on the study. New understandings might emerge as previous views regarding the research process are re-assessed. I intend to reflect not only on issues concerning the participants involved but also on the process of the research in my own personal journal. Entries will be made during each lesson study session, and on the days that I meet with the teachers. It is important for me to reflect on: the progress of the study, my communication with the teachers, the reactions of the teachers to the study, and my observations of the congruencies in what I see in their teaching versus their reflections in the interviews. I will share some of my reflections with the teachers when they are beneficial to the study or if they are helpful to the individual teacher. Throughout the writing process I might become aware of what my biases and interests are, and that those biases might play a part in the reflections that the participants reveal to me.

The knowledge gained by this exercise might, together with the knowledge gained by analysing the teachers' reflective diaries, contribute to the existing body of knowledge that exists in the literature on teacher reflection.

Table 3.1 summarises the relationship between the research questions and the data collection techniques described in this section.

Table 3.1: Relationship between research questions and data collection techniques

Research question	Data collection technique	Purpose
Question 1: What is the nature of mathematics teachers' reflective practice?		
How do mathematics teachers reflect before, during and after teaching?	Interview Document collection (lesson plan) Observation Field notes	To investigate **whether** teachers reflect on their practice To explore **how** teachers reflect on their classroom practice To determine the moment of reflection (**when** do teachers reflect on their practice: before, during and/or after the lesson?) To examine the **content** of mathematics teachers' reflection (what they reflect on) To determine the **level** of teachers' reflection using Lee's levels of reflection (2005): R1: Recall R2: Rationalisation R3: Reflective
What is the possible relationship between mathematics teachers' reflection and their classroom practice?	Interview Observation Field notes	To explore possible **benefits** of being a reflective practitioner when teaching mathematics
Question 2: How do contextual factors influence mathematics teachers' reflective practice?	Interview Observation Field notes	To gain a sense of how the context of lesson study influences teachers' classroom practice. To explore other possible contextual factors that influence teachers' reflective practice
Question 3: What is the potential significance of mathematics teachers' reflective practice for theory building in mathematics teaching?	Researcher diary Field notes	To contribute to the body of knowledge on mathematics teachers' reflective practice

3.6 Strategies for data analysis

The data for this research study will be obtained through interviews with the participants, observations of both participants teaching a lesson and the lesson study group reflecting on the lessons, and document analysis. I intend to analyse the qualitative data using both an inductive and deductive approach. According to Nieuwenhuis (2010) the main purpose of an inductive analysis is to allow research findings to emerge from the frequent, dominant or significant themes inherent in raw data, without the restraints imposed by a more structured theoretical orientation.

Nieuwenhuis (2010) claims that the data analysis in a qualitative study tends to be an ongoing and iterative process, implying that data collection, processing, analysis, and reporting are intertwined. I will therefore continuously consult my fieldnotes to verify conclusions, as well as solicit feedback from the participants to clarify gaps which have been noticed. My goal is to summarise what I see and hear in terms of words, phrases, themes or patterns, to help my understanding and interpretation of what emerges from the data. Throughout this process I will keep my research questions in mind.

The data gathered during the lesson study cycles will be analysed during and after the data-gathering process, based on Creswell's (2003) approach. I plan to inductively analyse the gathered data using content analysis and conversation analysis to develop themes, patterns and categories that identify and describe the participants' reflectivity whilst planning and teaching lessons. I will use the computer software program Atlas.ti 6 to assist me with the data management, the coding, categorisation, abstracting and conceptualising stages of the analysis. Atlas.ti 6 allows for the analysis of textual, graphical and audio data.

1) Data will be obtained through interviews (individual and group), observations (video-recorded), field notes and document analyses (lesson plans).
2) I will organise and prepare the data for analyses. Interviews (individual and group) will be transcribed *verbatim.* My goal is to summarise what I see and hear in terms of common words, phrases, themes or patterns that would aid my understanding and interpretation of that which is emerging (Nieuwenhuis, 2010).
3) The transcripts of the interviews will be read and re-read and I will watch and re-watch the video recordings to familiarise myself with general patterns that emerge and to gain information about the depth, reliability and usability of the information.

4) I will then assign codes to meaningful segments of text in a transcript, using the computer programme Atlas.ti 6. Coding is the process of reading carefully during the transcribed data, and dividing it into meaningful analytical units (Nieuwenhuis, 2010).
5) The next phase of the data analysis process involves the organisation or combination of related codes into themes or categories (known as "families" in Atlas.ti 6).
6) Interpretation and explanation of the data follow. All conclusions reached will be based on verifiable data.

According to Nieuwenhuis (2010) computer-aided data analysis can, on face value, appear deceptively easy, where the coding, clustering and searching functions make data analysis quick and satisfying. He argues that there are no short cuts to the demanding process of reading and rereading the data, and searching to unfold the meanings constructed by the participants of the study (Nieuwenhuis, 2010). I will take this argument into account when using the computer-aided data analysis programme.

3.7 Quality assurance: data verification

It is important in any study to ensure that the research is valid and reliable. The analogous criterion in naturalistic inquiry to establish validity and reliability is *trustworthiness* (Lehman, 2003).

3.7.1 Trustworthiness

According to Nieuwenhuis (2010) trustworthiness is of the utmost importance in qualitative research. The qualitative data being collected from this research study is in the form of observations, interviews and document analysis. The observations and interviews will be electronically recorded and transcribed. Participants will have the opportunity to review these transcriptions at the end of the entire data collection period to ensure accuracy and provide additional research data.

To enhance the trustworthiness of qualitative research studies Nieuwenhuis (2010, pp. 113-115) suggests that the following steps be taken:

1) Using multiple data sources
2) Verifying raw data
3) Keeping notes on research decisions taken
4) Greater trustworthiness in coding data
5) Stakeholder checks
6) Verifying and validating your findings

7) Controlling for bias
8) Avoiding generalisation
9) Choosing your quotes carefully
10) Maintaining confidentiality and anonymity
11) Stating the limitations of your study upfront.

To ensure the trustworthiness of this research study, data from multiple sources will be used to help me verify my findings. For example data collected through interviews will be verified with information gathered from the observations and the document analysis. In addition, the transcripts and fieldnotes will be submitted to the participants to correct factual errors. During the second interview the participants will be asked to verify whether my interpretation of what they have shared with me during the course of the study is correct. I will write down my thoughts and decisions during the research process and document the category labels I create. Any revisions I make to categories and any observations I note concerning the data will be written in my researcher diary.

3.7.2 Triangulation

Qualitative inquirers use several major procedures to ensure that their research produces highly credible findings. Triangulation is a general term in naturalistic inquiry, incorporating the use of multiple methods, various investigators, diverse theories, and different resources to establish credibility in a qualitative study (Cohen, Manion, & Morrison, 2005). According to Terre Blanche and Durrheim (cited in Maree & Van der Westhuizen, 2009, p. 34) *triangulation is essential to ensure* ***interpretive validity*** *and establish* ***data trustworthiness***. In this study I will use observation, interviewing, and document collection as multiple sources to ensure that the trustworthiness of the data. I will also compare patterns that emerge from the data with other theories found in the literature review.

3.7.3 Crystallisation

Crystallisation refers to the practice of "validating" results by using multiple methods of data collection and analysis (Maree & Van der Westhuizen, 2009). Different perspectives that all reflect the unique reality and identity of participants are necessary to provide for a complex and deeper understanding of the phenomenon (Nieuwenhuis, 2010). Richardson (2005) proposes the use of the term "crystallisation" rather than "triangulation" in qualitative research, asserting that the central image for qualitative inquiry should be the crystal, not the triangle, because *crystallization provides us with a deepened, complex and thoroughly partial understanding of the topic* (p. 963).

To establish the trustworthiness of this research study, various techniques will be employed to gather data and peer debriefing will be used to provide feedback on my notes and to verify my evolving interpretations of the study.

3.8 Summary of the layout of the research design

Table 3.2 summarises the layout of the research design for this research study.

Table 3.2 Summary and layout of research design

Purpose	Data gathering	Data analysis	Participants	Trustworthiness
Qualitative investigation	29-07-2010 and 30-07-2010: • Initial semi-structured individual interview with each teacher 24-02-2011 until 05-05-2011: • Lesson plan analysis • Classroom observations, video recorded • Post-lesson individual interview with each teacher • Lesson study group feedback sessions on each observed lesson • Final group interview	Analysis of data during and after the data-gathering process using Atlas.ti 6 Follow the seven steps for data analysis proposed by Creswell (2003): • Gathering data • Organising data • Overview of data • Coding • Creating categories • Report writing • Interpretation and crystallisation • Final report	Five practising mathematics teachers teaching Grade 8 – 11 of whom one teaches Mathematical Literacy	Key criteria of trustworthiness (Lincoln & Guba, 1985, cited in Nieuwenhuis, 2010) are: credibility, applicability, dependability and confirmability. The following steps are necessary: • Engaging in multiple methods of data collection (observation, interviews and document analyses); • Describing those findings which crystallise from the data will add to the trustworthiness of the research (Nieuwenhuis, 2010).

3.9 Ethical considerations

According to Bogdan and Biklen (2003) two issues dominate traditional official guidelines of ethics in research with human participants: informed consent and the protection of participants from harm. These guidelines ensure that participants enter research studies voluntarily, understand the nature of the study and the dangers and obligations that are involved, and are not exposed to risks that are greater than the gains they might derive.

I verbally briefed each participant and presented the following information in writing using Butke's guidelines (2003): 1) the purpose of the study; 2) risks involved in the study, which may include the discomfort of analysing a teaching practice and the loss of time for other facets of life; 3) general procedures of the study; 4) demands upon participants' time in the study; 5) timeline of the study; 6) confidentiality concerning anonymity of participants in the study, which include the use of pseudonyms (however the five participants would know each other and would be intertwined in the reflective process via the lesson study meetings); 7) rights of participants in the study which include one that determines that the participant is acting in a voluntary role and may withdraw at any time without penalty; 8) the phone numbers of the researcher; and 9) benefits of the study to the participant and the profession. I have asked each teacher to sign a permission contract indicating consent to participate in the study. In addition, the following principles will guide my process of ensuring ethical research (University of Pretoria, 2010): the principles of respect for personal autonomy, benevolence and justice.

3.10 Limitations

One limitation of this research study relates to the lack of generalisability of case studies. It is, however, not my intention to generalise these results of individual cases but to add to the body of knowledge on the nature of mathematics teachers' reflective practice as well as to generate new research questions and hypothesis.

A second limitation of this research study relates to fact that the five participants are of the same cultural and language group, teaching at the same school. I would have preferred a more diverse sample, excluding ethnic and geographical biases.

3.11 Conclusion

In this chapter I have described the research design and methodology that will guide this research study. In Chapter 4 I will discuss the research results obtained using this qualitative research design.