Chapter 3: Research design and methodology

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Research design and methodology

3.1   Introduction

Research is a process of gaining a better understanding of the complexities of human experience. The goal of research is to describe and understand a field, practice or activity (Brown & Dowling, 2001, p. 7). McMillan and Schumacher (2001, pp. 5 - 6) regard educational research to be imperative as it provides valid information, knowledge and principles to guide the decision-making, thinking and discussion process in education. Through planned and systematic collection, interpretation and analysis of data (Cohen & Manion, 1994, p. 40; Marshall & Rossman, 1999, p. 21; McMillan & Schumacher, 2001, p. 35), the emphasis falls on inductive analytical strategies (McMillan & Schumacher, 2001; Ritchie & Lewis, 2003).

Recent literature accentuates the critical role of the principal in the effective and sustainable development of ICT integration in schools (Di Benedetto, 2005, p. 4; Thomas, 2006, p. 31). It is therefore important to clarify this position (role) that contributes to teachers' effective use of ICT in their teaching and learning practices, as well as to increase the understanding of how principals develop and unfold effective ICT practice in their managerial environments through TPD.

The conceptual framework and the literature review presented in Chapter, 2 together with the research design and methodology outlined in this chapter indicate the approach to address the research questions listed in Chapter 1 (§ 1.6).

3.2   The nature of this study

As indicated in Chapter 1 the perceptions of the respondents related to personal experiences in their particular school environments will be investigated. This indicates that the research is exploratory, explanatory and descriptive in nature (Babbie & Mouton, 2001, pp. 79 - 81; Marshall & Rossman, 1999, p. 33).

This exploratory research aims to investigate the under-researched phenomena and the prime purpose is to develop understanding in an area that is little understood. This research can generate ideas for further research and lead to the identification and/or determination of

categories of meaning. This adds to identify plausible relationships shaping the phenomenon (Marshall & Rossman, 1999, p. 33). The study is also descriptive of nature as it documents and describes the complexities of the phenomena, the influence of personalities, the differences of opinions on issues and how the difference influences the results (Merriam, 1998, pp. 30 - 31), as well as the process and us of data that was collected (Marshall & Rossman, 1999, p. 33). The explanatory side of this research is mainly concerned with causes. The focus is on seeking, providing and evaluating the influence that two or more phenomena have on each other, explaining a fundamental relationship that is important or meaningful.

The research design is the researcher's plan of enquiry (Bogdan & Knopp Biklen, 2006, p. 54; McMillan & Schumacher, 2001, p. 72) that puts paradigms of interpretation into motion (Denzin & Lincoln, 2000, p. 22) on how to proceed in gaining an understanding of a phenomenon in its natural setting (Ary et al., 2002, p. 426). The purpose of a research design is to provide, within an appropriate mode of inquiry, the most valid and accurate answers possible to the research question (Denzin & Lincoln, 2000, p. 22; McMillan & Schumacher, 2001, p. 31). An effective research design outlines the defined purpose in which there is coherence between the research questions and the methods or approaches proposed that generates data that is credible and verifiable (McMillan & Schumacher, 2001, p. 74). This research design encourages the process of strategic thinking and reflection (Mason, 2002, p. 25) from the start and continues throughout the whole research process which calls for constant review of decisions and approaches (Ritchie & Lewis, 2003, p. 47).

3.2.1   Unit of analysis

The unit of this analysis was the principals' role in developing effective ICT at their schools through TPD. The data captured from interviews and the researcher's field notes (§ 3.6.1) were analysed to identify the principals' influence on TPD for the integration of ICT in schools (Addendum 3.1). The respondents were handpicked on the basis of their typicality. Cohen and Manion (1994, p. 89) state: "In this way the researcher will build up a sample that is satisfactory to her specific needs." In this approach, the selection of respondents are criterion-based (Mason, 2002). The respondents have been chosen because they have "... particular features or characteristics that will make possible detailed exploration and understanding of the central themes and puzzles that the researcher wishes to study" (Ritchie & Lewis, 2003, p. 78). The respondents encompassed all the elements that could impact on the outcome of the study to provide understanding and insight into the research problem. Ritchie and Lewis (2003, p. 83) indicate that qualitative samples are usually small

because a phenomenon has to appear only once to be part of an analytic map. There is no point in increasing the sample size when no new evidence is obtained. The sampling will be terminated when a point of saturation or redundancy is reached (Mason, 2002, p. 134; Merriam, 1998, p. 64).

The use of inductive reasoning allows the researcher to draw hypotheses (Cohen & Manion, 1994, p. 3). "Hypotheses are the relationships drawn among categories and properties" Merriam (1998, p. 18). McMillan and Schumacher (2001, p. 41) point out: "Inductive reasoning allows one to explore and discover with an emerging research design."

3.2.2 Selection of research respondents

The sampling strategy I used in this qualitative research study was a purposeful sampling strategy. As I am a part time lecturer at the University of Pretoria, I have access to principals who also give lectures. This provided me with the opportunity to identify appropriate principals from different environments during contact sessions at different venues. The principals themselves also put me into contact with other principals who they knew would fit in with the selection criteria. Merriam (1998, p. 61) emphasis that: "Purposeful sampling is based on the assumption that the researcher wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned. The logic and power of purposeful sampling lies in selecting information-rich cases for in-depth study." I therefore selected respondents non-randomly for a particular reason (McBurney, 1994, p. 203), to generate meaningful and relevant data that will enable me to address the research question and form grounded arguments to support the findings (Mason, 2002, p. 121).

The two types of purposive sampling used in this study provided maximum variation sampling, as well as snowball sampling. In maximum variation sampling, units are included that represent diverse variations of specified characters and important common patterns are identified (Ary et al., 2002, p. 429; Marshall & Rossman, 1999, p. 33; Merriam, 1998, p. 63). Respondents were selected because they have particular features or characteristics that enable detailed description and exploration in this research study. Members of a sample are chosen with a purpose to represent a location or type in relation to a key criterion and have a principal aim to ensure that within each of the key criteria. Diversity is included so that the impact of the characteristics can also be explored (Ritchie & Lewis, 2003, p. 79). Snowball sampling was also employed by asking respondents to point out other members of that population whom they know. Snowball refers to the process of accumulation as each located subject suggests other subjects whom they know are information rich (Babbie & Mouton,

2001, p. 647; Cohen & Manion, 1994; Marshall & Rossman, 1999; Merriam, 1998). A summary of the profile of the respondents are available in Table 3.1.

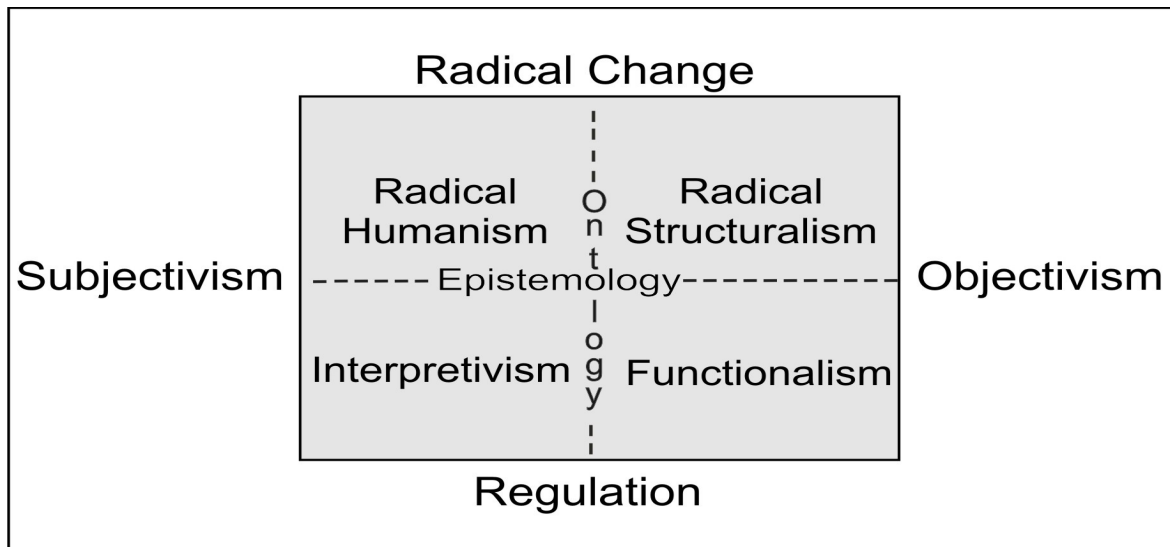**Table 3.1   Summary of the profile of the respondents**

Interview	Location	Learners		Computers & centres		Principal	Advancement towards ICT integration	Resources
		White	Black					
1	Urban	X	X	4	40 in class	White male	Exceptional advanced	Very good
2	Urban	X	X	2	28 in class 18 in media	White male	Semi advanced	Poor
3	Rural	X	X	4	40 in class	White male	Exceptional advanced	Very good
4	Rural	X	X	2	35 in class	White male	Semi advanced	Good
5	Rural		X	1	24 in class	Black male	Good advanced	Poor
6	Rural		X	2	20 in class	Black male	Poorly advanced	Very poor
7	Urban	X	X	1	35 in class	White female	Good advanced	Good

Exceptional advanced:	Various ICT strategies in place for effective and sustainable integration
Good advanced:	Various ICT strategies in place for effective integration
Semi advanced:	Current ICT strategies need to be amended
Poorly advanced:	No ICT strategies in place for effective and sustainable integration
Very good:	Exceptional resources available for teachers and learners
Good:	Resources available for teachers and learners
Poor:	Restricted resources available for teachers and learners
Very poor:	Minimum resources available for teachers and learners

From Table 3.1 it becomes evident that the unit of analysis is multi-racial and that it includes both genders. The sample relates to both urban and rural areas; different levels of resourcing of the selected schools, as well as of the different levels of resourcing available for the advancement of ICT integration.

3.3   Research methodology

The methodological design is the logic through which a researcher addresses the research questions (Mason, 2002, p. 30), and gains data for the study (Denzin & Lincoln, 2000, p. 157). Research methodology encompasses the complete research process: the research approaches, procedures and data-collection or sampling methods used (McMillan & Schumacher, 2001, p. 74). Therefore, the aim of research methodology is to understand the processes and not the product of scientific inquiry (Cohen & Manion, 1994, p. 39). According to Burrell and Morgan (1979, p. 22), social research paradigms can be classified in the four categories indicated in Figure 3.1.

Figure 3.1   Four paradigms of social research*

Radical Change

Radical Humanism   Radical Structuralism

Subjectivism   ------Epistemology---------   Objectivism
Ontology

Interpretivism   Functionalism

Regulation

*   Adapted from Burrell and Morgan (1979, p. 22).

I followed an interpretive approach to explore, explain and describe the principals' influences on TPD for the integration of ICT in schools. Mason (2002, p. 56) indicates that the interpretive approach not only sees people as primary sources of data but also seek the meaning and interpretation that people give to their social world. Cohen and Manion (1994, p. 36) state: "Efforts are made to get inside the person and to understand within." According to Flick, Von Kardoff and Steinke (2004, p. 5) the qualitative research approach: "Is more open and thereby 'more involved' than other research strategies and forms the starting point for the construction of a grounded theoretical basis." Cohen and Manion (1994, p. 37) maintain that: "Theory should not precede research but follow it" as the "theory becomes sets of meanings which yield insight and understanding of people's behaviour." Qualitative research is therefore grounded in a philosophical position that is broadly interpretive in the sense that it is concerned with how the social world is interpreted, understood, experienced, produced and constituted. Methods of data generation are used that are flexible and sensitive to the social context in which data are produced. Emphasis is placed on 'holistic' forms of analysis and explanation (Mason, 2002, p. 3).

3.4   Qualitative research approach

Qualitative research is an umbrella concept that includes several research strategies (Bogdan & Knopp Biklen, 2006, p. 2; Merriam, 1998, p. 5). Research strategies are flexible combinations of techniques to obtain valid and reliable data. Qualitative methods emphasise aspects of meaning, process and context: the 'why' and the 'how', rather than the 'how many' (Cohen & Manion, 1994; Litoselliti, 2003). Qualitative research has an unravelling capacity

to generate data that have richness, depth, nuance, context, multi-dimensionality and complexity (Denzin & Lincoln, 2000, p. 10; Flick et al., 2004, p. 3; Mason, 2002, p. 1).

Research questions are formulated to investigate topics in all their complexity (Bogdan & Knopp Biklen, 1992, p. 2). As the respondents' perceptions direct their actions, thoughts, and feelings, it is necessary to analyse the contexts and narrate the meaning they attach to particular processes, situations and events (McMillan & Schumacher, 2001, p. 396). Qualitative research enables the researcher to produce cross-contextual generalities (Mason, 2002, p. 1). Merriam (1998, pp. 11 - 18) describes five types of qualitative research: generic, ethnographic, phenomenology, grounded theory and case studies. Generic refers to the discovery and understanding of a phenomenon, a process, perspective and view of people. My study is of an ethnographic nature as I employed interviewing to collect data that lead to socio-cultural interpretation. In this study I identified and clarified principals' perceptions, attitudes and practices relating to the challenges and preferences for TPD that contribute to teachers effective use of ICT in their teaching and learning practices. This will increase an understanding of how principals develop and unfold effective ICT practices through TPD in their schools. This research can also be seen as phenomenological. As Merriam (1998, p. 15) states: "The focus would be on the essence or structure of an experience (phenomenon)." This research is based on the assumption that principals exert particular influences on TPD for the integration of ICT in their schools. The experiences of the different principals are analysed and compared to identify the essence of the phenomenon. This study included a grounded theory as the researcher assumed an inductive stance and strived to derive meaning from the data in order to develop theory. Merriam (1998, p. 17) indicates: "The end result of this type of qualitative research is a theory that emerges from, or is 'grounded' in, the data." The comparative method is used to compare data determining the similarities and differences. Data with similar dimensions are grouped together as categories. The object of this analysis is to seek patterns in the data that are then arranged in relationship with one another in building a grounded theory (Merriam, 1998, p. 18).

Qualitative research provides rich narrative descriptions of the respondents' perspectives on the construction of the reality of their social world. The purpose of qualitative research is to understand social phenomena of multiple realities from respondents' perspective. The interviews took place in natural settings and no attempt was made to manipulate the respondents' behaviour. The researcher is the primary agent for the gathering and analysis of the data. The general characteristics of qualitative research is summarised in Table 3.2.

Table 3.2   Characteristics for qualitative research

Characteristics	Description
Concern for content	• Human experience takes its meaning from social, historical, political and cultural influences • Reality is socially constructed and constantly changing
Purpose	• To understand social phenomena of multiple realities from respondents' perspectives
Rich narrative description	• Data are in the form of words • Subjects' experiences and perspectives • Detailed context-bound generalisations • Rich detailed description • In-depth
Sample	• Small, non-random and purposeful
Method	• Interviews
Natural setting	• Takes place in natural setting • No attempt to manipulate behaviour • No artificial constraints or controls
Human instrument	• Researcher is the primary agent for the gathering and analysis of data • Studies human experiences and situations, require an instrument to capture complexity of the human experience • Becomes immersed in social situation • Relies on fieldwork methods
Emergent design	• Design emerges as the study proceeds • Self-questioning throughout research in order to think critically – reflexive acts • Flexible and evolving • Interaction and developmental
Inductive analysis	• Data collection and data analysis take place simultaneously • Holistic form of analysis • Identification of recurring patterns • Proceeds from data to hypothesis to theory

*   Adapted from Ary Jacobs and Razavieh (2002); McMillan and Schumacher (2001); McMillan and Wergin (2002); Merriam (1998); Ritchie and Lewis (2003).

3.4.1   Qualitative data collection

Mills (2003, p. 4) indicates that: "Qualitative research uses narrative and descriptive approaches for data collection to understand the way things are and what they mean from the perspective of the research respondents." Mason (2002, p. 3) points out in order to use above mentioned approaches it "requires a data collection instrument that is sensitive to underlying meaning when gathering and interpreting them." The qualitative research methods used to generate data was in-depth interviews and field notes.

Interviews are one of the most common forms of qualitative research methods (Ary et al., 2002; Flick et al., 2004; Marshall & Rossman, 1999; Mason, 2002; Merriam, 1998; Ritchie & Lewis, 2003; Silverman, 2004, p. 140), and involve the construction or reconstruction of knowledge (Mason, 2002, p. 63). The interview is an intense experience for both parties involved. An interview is a flexible, interactive and generative tool to explore meaning and language in depth (Ritchie & Lewis, 2003, p. 142; Silverman, 2004, p. 126). The interview

generates much information that can be used to provide insight of the respondents' experiences. Qualitative interviewing refers to in-depth, semi-structured or loosely structured forms of interviewing (Ary et al., 2002; Mason, 2002) and requires asking veritably open-ended questions in a natural setting (Ritchie & Lewis, 2003, p. 141) in order to make analytical comparisons (Mason, 2002, p. 65).

The in-depth interview was used in this study. McMillan and Schumacher (2001, p. 42) state that the "in-depth interview merely extends and formalises conversation and is often characterised as a conversation with a goal." The open-ended nature of this research method allows the respondents to answer the questions according to their own frame of reference (Bogdan & Knopp Biklen, 1992, p. 3). With this method I was able to use the data to substantiate my hypothesis (McMillan & Schumacher, 2001, pp. 273 - 274). The in-depth interview focuses on the individual. It provides an opportunity to address complex experiences and investigates each principal's personal perspective using a range of probes and other techniques to achieve in-depth understanding of the personal context within which the research phenomenon is located. This type of data collection method generates data that adds richness, depth and roundedness to a study. The researcher and principals interacted intensely; allowing for detailed subject coverage, clarification and understanding of motivations and decisions; and also generative in the sense of creating knowledge or thought. Structure was combined with flexibility and data were captured in their natural form. The data were tape-recorded for accurate transcription and analysis. The key features of the interviews are summarised in Table 3.3.

Table 3.3   Key features of in-depth interviews*

Features	Description
Naturalistic	• Interview data is captured in its natural form
Researcher	• Plays a key role in development of data and meaning • More concerned with process than outcome • Captures perspectives accurately
Data	• Data is descriptive in the form of words • Includes field notes • Theory is grounded in data • Direction of research is determined after data is collected
Structure	• Makes use of different techniques, strategies and procedures • Responses are probed and explored to achieve depth of answer in terms of penetration, exploration and explanation • Researcher responsive to relevant issues raised spontaneously • Structure is flexible • Interview guide /schedule sets out the key topics and issues to be covered
Interactive	• Material is generated by interaction and collaboration between researcher and interviewee • Encourages interviewee to talk freely when answering questions
Generative	• Creates new knowledge and engenders clear thinking

Table 3.3   Key features of in-depth interviews*

Features	Description
Explanatory	• Explores respondents perspectives for example reasons, feelings, opinions and beliefs
Analysis	• Use of quotations helps to illustrate and substantiate analysis • Analyses data inductively
Aim	• To achieve depth and coverage across key issues

*   Adapted from Bogdan and Knopp Biklen (2006); McMillan and Schumacher (2001); Ritchie and Lewis (2003).

I made use of an interview guide, different techniques, strategies, procedures to make the interviews as flexible as possible. Familiar settings allowed for interaction to take place between the interviewee and the researcher. I could explore and incorporate the interviewees' attitudes, attentions, perspectives and expectations on issues relating to the research question. I, the researcher was the key agent in the development of data and meaning, capturing the principals' perspectives accurately. Even though the interviews were recorded, the data were collected on the premises. This supplemented the understanding of the data as the location contributed to the understanding of the individual interviews. Ritchie and Lewis (2003), as well as Ary, Jacobs and Razavieh (2002) indicate various advantages for using in-depth interview as a data collection method.

- Providing undiluted focus of the respondents

- Providing opportunity for detailed investigation of respondents' perspectives and experiences

- In-depth understanding of the personal and research context

- Providing detailed subject coverage

- Clarification and detailed understanding of respondents' motivations and decisions

- Combining interview structure with flexibility

- Encouraging respondents to talk freely; allowing to explore impacts and outcomes

- Generating information through interaction between researcher and respondent

- Achieving depth in responding; opportunity to explore and explain

- Generating new knowledge and thoughts

- Capturing data in its natural form

- Audio recording of data and taking note of changes in the format when transferred to text

- Obtaining much data in a short period

- Providing insight to respondents' perspectives

- Allowing for immediate follow-up and clarification of respondents' responses

- Developing personal relationships in interacting with respondents.

Cohen and Manion (1994) and Ritchie and Lewis (2003) indicate various disadvantages for using in-depth interviews as a data collection method. To counteract these disadvantages, I took corrective actions during this study:

- **Prone to subjectivity and bias on the part of the interviewer:** I resisted supplying particular frames of reference for the respondents' responses. I maintained neutrality by encouraging expression, but not by helping in constructing responses.

- **Interviewee may feel uneasy and adopt avoidance tactics:** The interviews took place in a relaxed atmosphere and a neutral context conducive to open and undistorted communication. I approached the principals at the lecturing venues where I taught. This informal approach created a relaxed atmosphere and the principals were eager to share their experiences on ICT integration at their schools.

- **Time consuming, reluctance of respondent:** The interviews were conducted during the contact sessions and therefore demanded no additional time from the principals.

- **Expensive**: As the interviews were conducted during the contact sessions at learning centres, little additional travelling was necessary.

- **Trust between the interviewer and interviewee:** Due to existing relationships before the interviews, the climate of trust continued. Trust was also strengthened by the relationship of professionalism.

- **Audio taping of conversation, scared to speak:** The principals gave permission beforehand to be audio taped. The relaxed setting was conducive to the principals' willingness to share their experiences.

- **Personal and professional qualities of interviewer:** I listened carefully to fully comprehend the principals' responses. I then judged how to pose further probing questions. I also made notes during the interviews to elicit further discussion, clarification and elaboration.

- **Establish credibility with respondents:** I posed meaningful questions based on my knowledge and understanding of the topic.

- **Over-hasty interpretation of what researcher hears:** I paid special attention to the interview process; focusing on listening intently, and responding appropriately. As the interviews were audio taped, it provided me with the opportunity to review the interviews repeatedly to prevent hasty conclusions and interpretations.

- **Quality of questions:** I posed content-mapping and content-mining questions to generate an in-depth understanding of the respondent's experiences. I also avoided leading questions.

- **Reliability:** I audio taped the interviews, painstakingly transcribed the interviews and subsequently presented the transcription to the respondent as part of member checking

to verify the accuracy of the interview. Field notes made during the interviews supplied verification of interview data.

- **Validity:** I paid careful attention to all detail during the data collection and analysis of the data to ensure trustworthiness of the research process (Cohen & Manion, 1994; Ritchie & Lewis, 2003).
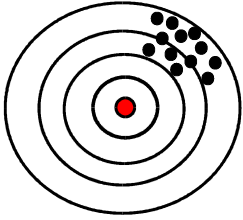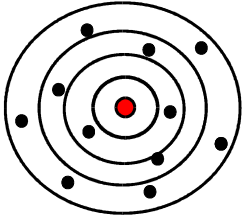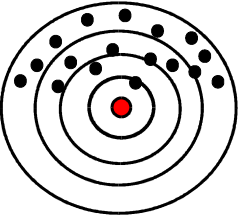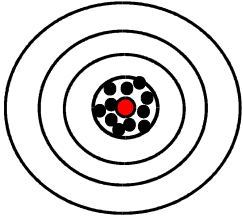
3.4.2   Field notes

Field notes presented an additional opportunity to collect data during in-depth interviews. I took notes during the in-depth interviews then later expanded on them to constitute extensive field notes. Field notes provide an opportunity for the researcher to record and comment on his/her thoughts about the setting, the respondents and activities. Such data can contribute to further steps in subsequent fieldwork and issues relevant during the analysis phase (Merriam, 1998, p. 106; Ritchie & Lewis, 2003, p. 133). Ary, Jacobs and Razavieh (2002, p. 431) indicate that field notes have two components: "The descriptive part which includes a complete description of the setting, the people and their reactions and interpersonal relationships, and accounts of events", and the second as the: "Reflective part which includes the observer's personal feelings or impressions about the events, comments on the research method, decisions and problems, records of ethical issues, and speculations about data analysis." I included my field notes as part of the analysis to provide understanding of the research setting, as well as on the experiences of the respondents (§ 3.6.1) (Addendum 3.1).

3.5   Trustworthiness

Silverman (2004, p. 283) states: "Validity and reliability are two important concepts to keep in mind when doing research, because in them the objectivity and credibility of research are at stake." To produce reliable and valid knowledge in an ethical manner, researchers should consider multiple methods to collect, analyse and interpret data. Validity is more important and comprehensive than reliability, as it is harder to evaluate or measure (Ary et al., 2002, p. 267). Trochim (2001, pp. 1 - 2) explains the relationship between reliability and validity as presented in Figure 3.2. Together they contribute to the study's trustworthiness.

Figure 3.2   Relationship between reliability and validity*

Reliable not valid	Valid not reliable	Neither reliable nor valid	Both reliable and valid
Consistently and systematically measuring the wrong value for all respondents	On average, getting the right answer for the group	Hits are spread across the target, consistently missing the centre	Consistently hitting the centre of the target and measuring the concept perfectly

*   Adapted from Trochim (2001, pp. 1 - 2).

3.5.1   Validity

Validity refers to the truth (or falsity) of prepositions generated by research. The researcher and respondents agree about the description or composition of events, especially the meanings of these events (Mason, 2002; McMillan & Schumacher, 2001; Mills, 2003). Validity is a test of whether the collected data accurately gauge what is being measured (Babbie & Mouton, 2001, p. 648; Denzin & Lincoln, 2002, p. 302; Mason, 2002, p. 39; Mills, 2003, p. 96). McMillan and Schumacher (2001) and Ritchie and Lewis (2003) point to strategies to enhance validity in the conduct of qualitative inquiry and the qualitative researcher can use as a combination:

- **Field work and long-term observation:** I conducted the research in a natural setting to promote the reality of the respondents' experiences more accurately. Interim data analysis and corroboration enhanced the validity of data collected over a period of time.
- **Constant comparative method:** I continuously checked and compared the findings.
- **Triangulation:** I used multiple literature resources to confirm and enhance my findings.
- **Respondent language; verbatim accounts:** I obtained verbally exact statements of respondents to provide concrete evidence of my findings.
- **Low-inference descriptors:** I made use of a computer-based qualitative data analysis programme (Atlas.ti™) to capture the text to ensure precise, literal and detailed descriptions of respondents and situations.
- **Record data:** I made use of audio recorders to obtain accurate data.
- **Respondent review:** I requested each respondent to review the transcribed interview to check for accuracy of presentation. They all agreed to the accuracy of the text documents (Addendum 3.2).

- **Negative or deviant cases:** I actively searched for, recorded, analysed, and reported negative cases or discrepant data that related to exceptions that modified patterns found in the data.

3.5.2   Reliability

According to McMillan and Wergin (2002, p. 10) reliability refers to: "The degree of error that exists when obtaining a measure of a variable. No measure or instrument is perfect; each will contain some degree of error. The error can be because of the individual (general skills, attitudes, motivation) or because of the way the instrument is designed and administered. Reliability is the estimate of the error in the assessment." Ritchie and Lewis (2003, p. 271) indicate a distinction between external and internal reliability. External reliability relates to the level of replication that can be expected if similar studies are undertaken, while internal reliability relates to the extent to which assessments, judgements and ratings, internal to the research conducted, are agreed upon or replicated between researchers. Both are important in terms of reliability. The reliability of findings depends on the likely recurrence of aspects in the original data, as well as the way the data is interpreted. Reliability is to determine the extent to which measures are free from error. If an instrument is void of any such elements, it is considered as reliable. According to Merriam (1998, p. 206) reliability in the traditional sense of repeated measures to obtain similar results are problematic when it comes to qualitative research because of human behaviour involved. Reliability in qualitative studies should be determined by the results that are consistent with the data collected. I used the following strategies were used to ensure that my findings were reliable:

- **Replication logic**: I conducted the study with multiple respondents up to the point of data saturation
- **Code-recode strategy:** I coded the data over an extended period of time to ensure consistency of coding strategy
- **Observation by multiple observers:** I consulted peers in the field of ICT to check on the consistency of my coding strategies
- **Stepwise replication**: I approached peers in the field of ICT to check on the consistency of compiling the patterns (networks) in the computer-based qualitative data analysis program
- **Researcher's position**: I have explained my position as researcher and have declared my biases relating to the data collection and analyses
- **Triangulation**: I used more than one method to collect data and continuously ensured my understanding of what was presented

- **Audit trail**: I have explained all the procedures followed during this study. The transcribed data is available as an integrated dataset in (Addendum 3.1) (Ary et al., 2002, pp. 435 - 436; Merriam, 1998, pp. 204 - 207).

3.6   Data analysis

Data analysis is the: "Process of making sense and meaning from the data that constitute the finding of the study" (Merriam, 1998, p. 178). Therefore, data analysis is the process of making the data more manageable by organising the collected data into categories and interpreting data, searching for recurring patterns to determine the importance of relevant information (Bogdan & Knopp Biklen, 1992, p. 153; Marshall & Rossman, 1999, p. 150). In qualitative research the collecting of data and analysis takes place simultaneously to build a coherent interpretation of the data (McMillan & Schumacher, 2001). The data analysis starts by coding each incident into as many categories as possible and as the research continues the data is then placed in existing categories or existing categories are modified if not, and new categories emerge (Marshall & Rossman, 1999, p. 151; Seale et al., 2004, p. 475). Without continuous analysis, the data can be unfocused, repetitious and overwhelming. Merriam (1998, p. 11) indicates that: "The analysis usually results in the identification of recurring patterns that cut through the data or into the delineation of a process." I first read all the interviews repeatedly to gain a sense of the whole and to facilitate the interpretation of smaller units of data. I compared and contrasted the text segments to identify context-bearing data segments, and naming and classifying categories (McMillan & Schumacher, 2001, p. 464).

The data of this research study were analysed inductively to allow categories and patterns to emerge from the data leading to sets of smaller and similar data that are more workable. I used the comparative method to compare one unit of information with another looking for recurring regularities and patterns in the data to assign the information into categories. The categories were then also subdivided. The names of the categories reflected the focus and purpose of my study. The use of the inductive process helped me to determine links between the categories enabling me to form tentative hypotheses that lead to the development of theory (Merriam, 1998, pp. 180 - 192). I double-checked, refined my own analysis and interpretations to ensure validity and reliability.

Data saturation is used to describe the point in qualitative research when the issues contained in data are repetitive of data collected previously (Somekh & Lewin, 2005, p. 345).

3.6.1　Use of Atlas.ti™ to prepare the data analysis

A computer-based qualitative data analysis program, Atlas.ti™ was used to analyse data and identify and synthesise patterns. After transcribing the transcribed interviews, I imported them into Atlas.ti™ as a hermeneutic unit (HU) titled 'interviews' (Addendum 3.1). The HU became the prime data to be analysed to determine principals' influence on TPD for teachers' ICT integration. The interviews and field notes converged as one dataset and consisted of seven primary documents (Addendum 3.1). The primary documents represented the seven interviews of the principals. Many comments were added to the hermeneutic unit of additional information pieces.

In Chapter 4 use was made of the Atlas.ti™ numbering system to identify quotations from the primary documents. Therefore "(4:37 (10))" indicates that the quotation originates from primary document four, quotation number 37 line 10 of the particular primary document. Some interviews were conducted in Afrikaans as it was the principal's choice. Such quotations are translated into English, but the original versions are appended in footnotes.

3.6.2　Establishing theoretical and conceptual codes

According to Ary, Jacobs and Razavieh (2002, p. 466) categories allow for the classification of similar ideas, concepts and themes. Each unit of meaning (category) is recognised by a word or phrase that describes the essence of the category, these are then the codes for the categories. The goal is to generate a set of categories that represent a realistic reconstruction of the collected data. The conceptual codes of principals' influence on ICT integration obtained from the interviews were associated with the theory codes documented in the literature. Merriam (1998, p. 183) states: "Categories should reflect the purpose of the research. In effect, categories are the answers to your research questions." The following preliminary categories (theory and conceptual codes) were identified:

- ICT enabling strategies
- Leadership and management styles
- Principals' attitudes towards ICT integration
- Principals' strategic thinking of TPD
- Teacher enabling strategies
- TPD enabling strategies.

McMillan and Schumacher (2001, p. 476) state: "The ultimate goal of qualitative research is to make general statements about relationships among categories by discovering patterns in the data." The process of searching for patterns lead to an in-depth analysis to understand the complex link between the principals' attitudes, leadership and management styles,

strategic thinking and implementation of enabling strategies towards effective and sustainable ICT integration (Chapter 4).

3.7   Ethical considerations

Ethics are generally considered to deal with beliefs about what is right or wrong, proper or improper, good or bad (McMillan & Schumacher, 2001, p. 196). It is the responsibility of the researcher to ensure that ethical standards are adhered to. The following measures were taken while planning and conducting my study to ensure that the rights and welfare of each subject would be protected, and that nobody was harmed or hurt in any way during the research procedures:

- I received informed consent from every respondent before the interviews (Addendum 3.3). I informed the respondents of the goals of the study and what I hoped to achieve (Ary et al., 2002, p. 438; Denzin & Lincoln, 2002, pp. 138 - 139; Ritchie & Lewis, 2003, pp. 66 - 67; Seale et al., 2004, pp. 231 - 232).

- I was always open and honest with the respondents and respondents were never mislead during the study (Denzin & Lincoln, 2000, pp. 138 - 139).

- Information obtained from the respondents remain confidential (Denzin & Lincoln, 2000, p. 139; Seale et al., 2004, p. 233).

- Collecting of data was anonymous and confidential. I will link no names or identity to my findings (Denzin & Lincoln, 2000, p. 139; McMillan & Schumacher, 2001, pp. 366 - 367; Ritchie & Lewis, 2003, pp. 67 - 68).

- I posed no physical or mental discomfort to the respondents in my study (Ary et al., 2002, p. 438; McMillan & Schumacher, 2001, p. 377; Ritchie & Lewis, 2003, pp. 68 - 69).

- I will take care during the disseminating of findings to pay special attention to accuracy, and there will be no bias about any opinion (Denzin & Lincoln, 2000, p. 140). Research findings will be made available to all respondents.

- My study adheres to the ethical considerations of the Faculty of Education, University of Pretoria. My approved ethical and research statement is available on the CD-ROM as (Addendum 3.4).

3.8   Limitations of this study

There may be inhibiting factors in carrying out this research. Merriam (1998, p. 20) states: The human instrument is as fallible as any other research instrument." The researcher as human instrument is limited by being human – mistakes are made, opportunities are missed, personal bias interferes. McMillan and Schumacher (2001, pp. 23 - 24) point out that an institution such as a school is a public enterprise and is influenced by the external

environment. The institutions themselves change: legislative mandates and judicial orders change, the structure of schools change and programmes are added or deleted continuously. Different respondents process ideas differently and the situational elements also have to be considered indicating the complexity of the research. The respondents without realising use particular words to express their ideas that are used as an indication of their attitudes towards ICT integration. I did not test the different leadership and management styles I only refer to them as they have been identified in the literature as the most appropriate and used styles by principals. The cultural diversity of the principals especially those who had to express themselves in their second language such as English can be an inhibiting factor as the words used can have different meanings for the researcher and the respondents.

3.9   Summary

This chapter dealt with the research design and methodology of this study. The nature and methodology of this research was indicated. The qualitative data collection method was discussed and substantiation was given for choosing this particular research approach. The strategies implemented to ascertain trustworthiness was pointed out. The data analysis process was outlined and the use of Atlas.ti™ acknowledged. The preliminary theory and conceptual codes were given.   The ethical considerations taken into account and the limitations of this study were outlined. The next chapter gives a comprehensive description of the data analysis and findings from the interviews with the seven principal's as well as the field notes and comments I made.

3.10　References used in this chapter

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