CHAPTER 4

RESEARCH DESIGN

4.1 INTRODUCTION

This chapter describes the research methodology used to investigate an approach for the implementation of Technology education in the North West Province. It explains the rationale behind the methodology employed, how the research was conducted and what steps were taken to ensure the reliability and validity of the study. According to McMillan and Schumacher (2001:9), research methodology refers to a design according to which the researcher selects data collection and analysis procedures to investigate a specific research problem.

The qualitative epistemology was based on an interpretive method. Human beings are qualitatively different from objects of study in the natural sciences. This according to Neuman (1997:62) implies that a special science is required to study the social life of people. Grounded theory as qualitative approach to inquiry was used. This comprised of the systematic procedures and constructivist approaches. They provided for the generation of an approach based on the data collected from individuals (Creswell, 2007:63).

4.2 RESEARCH DESIGN AND METHODOLOGY

A research design is a blueprint or detailed plan for how a research study is to be conducted (De Vos, Schurink & Strydom, 1998:166). According to McMillan and Schumacher (2001:9), a research design shows which individuals will be studied, as well as when, where and in which context. The design is either qualitative, quantitative or a combination of the two designs, referred to as triangulation. In this study quantitative and qualitative research designs were carried out independently.

Quantitative and qualitative research designs were employed to gather evidence about the implementation of Technology education in the North West Province. A survey (quantitative) was conducted to establish the perception and profile of Technology educators. A learner questionnaire was also administered to determine the attitudes and concepts of learners towards Technology. Interviews (qualitative) were conducted with provincial education specialists and Technology experts as well as educators in charge of Technology as a learning area.

According to Leedy (1993:121), methodology refers to merely an operational framework within which the facts are placed so that their meaning may be seen more clearly. Hussey and Hussey (1997:54) view methodology as an overall approach to the research process, from the theoretical underpinning to the collection and analysis of data. The said authors go on to say:

> *"Methodologies refer to the overall approach of the research process, from the theoretical underpinning to the collection and analysis of data. Like theories, methodologies cannot be true or false, only more or less useful."*

Neuman (1997:68) sees interpretive methodology as:

> *"the systemic analysis of socially meaningful action through the direct detailed observation of people in natural settings in order to arrive at understandings and interpretations of how people create and maintain their social worlds".*

For interpretive researchers, social reality is based on people's definition of it. They see social reality as consisting of people who construct meaning and create interpretations through their daily social interaction. Neuman (1997:73) argues that the interpretive methodology is the foundation of social research techniques that are sensitive to context. Gultig, Lubisi, and Wedekind (1999:80) are of the opinion that interpretivism has a local rather than global orientation that is concerned more with the nature bound frameworks of particular institutions and the ways individuals understand and act in the particular social contexts.

In this study, working from the interpretivist paradigm enabled the researcher to interpret and explore the following:

- Technology implementation challenges in the North west Province;
- Impact of policy symbolism on Technology implementation issues; and
- Socially constructed meanings.

4.2.1 The quantitative research approach

According to Patton (1990:20), quantitative research is a formal, objective, systematic process in which numerical data are utilized to obtain information about the world. In the quantitative approach, standardized measurement procedures are used to assign numbers to observations, and statistics are used to summarise the results (Dooley, 1990:288; Neill, 2004:1). The quantitative researcher believes that the best way of measuring the properties of a phenomenon (e.g. the attitudes of individuals towards certain topics) is through quantitative measurement (Babbie and Mouton, 2001: 49). Quantification makes the observation more explicit (Babbie, and Mouton 2001:32). In this study, questionnaires were used for quantifying the attitudes of educators and learners towards Technology.

4.2.2 The qualitative research approach

Qualitative research involves methods of data collection and analysis that are non-quantitative (Lofland and Lofland, 1984:31). Webb (1981:3) is of the opinion that qualitative research focuses on quality, a term referring to the essence or ambience of something. In the qualitative approach, observations are collected and reported in everyday language (Dooley, 1990:288; Neill, 2004:1). Qualitative research contributes to the theory, educational practice, policy making and social consciousness (Mc Millan and Schumacher, 2001:393). In this study, interviews were used to collect data in a less technical everyday language. Babbie and Mouton (2001:270) identify the following features regarding qualitative approach:

- Research is conducted in the natural setting of social actors;
- Emphasis is on the actor's perspective;
- A primary aim is at in-depth descriptions and understanding of actions and events;
- A main concern is to understand social action in terms of its specific context, rather than an attempt at generalizing on some theoretical population;
- It is a research approach that is often inductive in its approach, resulting in the generalization of new hypotheses and theories; and
- A qualitative researcher is seen as the main instrument in the research process.

Taking the above factors into cognizance, the interviews were conducted in the natural setting of the interviewees. Interviews for the educators in charge of the Technology learning area (Heads of Department) were conducted in the workshops they attended at the Area Project Offices and some in schools where they are based. The departmental officials (education specialists and curriculum planners) were interviewed at the Departmental workshops after working hours and some in their offices. Technology experts send in their comments through e-mails. The main aim of these interviews was to get the in-depth descriptions and understanding of actions surrounding the implementation of Technology education.

Neuman (1997:329) highlights the differences shown in Table 4.1 between quantitative and qualitative research:

QUANTITATIVE	QUALITATIVE
Test hypothesis that the researcher begins with.	Capture and discover meaning once the researcher becomes immersed in the data.
Concepts are in the form of distinct variables.	Concepts are in the form of themes, motifs, generalizations, taxonomies.
Measures are systematically created before data collection and are standardized.	Measures are created in an adhoc manner and are often specific to the individual setting or researcher.
Data are in the form of numbers from precise measurement.	Data are in the form of words from documents, observations, transcripts.
Theory is largely causal and is deductive.	Theory can be causal or non-causal and is often inductive.
Procedures are standard, and replication is assumed.	Research procedures are particular, and replication is very rare.
Analysis proceeds by using statistics, tables, or charts and discussing how what they show relates to hypotheses.	Analysis proceeds by extracting themes or generalizations from evidence and organizing data to present a coherent, consistent picture.

Table 4.1: Differences between Qualitative and Quantitative Research

According to Holland (2004:133) many researchers in Technology education are recognizing the benefits of using qualitative approaches for inquiry in the classroom. She suggested that the predominance of quantitative descriptive research reinforces the marginality of qualitative interpretive studies. This predominance informs only a limited range of problems within a limited context and depth of understanding.

As researchers select areas of inquiry that are compelling and valuable to them, Lewis (1999: 6) reminds them that Technology education research must relate fundamentally to

the basic claims of the field; ultimately be about learning and teaching and the primary actors in that enterprise must be brought into sharper focus; and share and conform to conceptual frameworks, such as situated cognition and constructivism, that unite technology education with other school subjects.

4.2.3 Philosophical assumptions and paradigms of qualitative research

According to Babbie and Mouton (2001:645), a paradigm is a model/framework for observation and understanding, which shapes both what we see and how we understand it. Creswell (2007:19) is of the view that a paradigm is a set of beliefs that guide action. He goes on to say that they may also be called philosophical assumptions; epistemologies; ontologies; research methodologies; broadly conceived and alternative knowledge claims. Paradigms address fundamental assumptions taken on faith, such as beliefs about the nature of reality (ontology), the relationship between knower and known (epistemology) and assumptions about methodologies shaped by the researcher's experience (Guba and Lincoln, 1994:105; Creswell, 2007:18).

In ontological perspective, qualitative research is underpinned and guided by the principles of interprevist philosophy. It rejects positivist thinking and refuses to reduce human behaviour to a mere number. This tradition of interprevism holds that people may or may not experience social or physical reality in the same way (Neuman, 1997:70). It sees social reality as consisting of people who construct meaning and create interpretations through their daily social interaction.

In the epistemological assumption, the longer the researcher gets to know participants, the more they know what they know (Creswell, 2007:18). He goes on to say that researchers bring values to a study, but qualitative researchers need to make those values explicit. This is in total agreement with what Wyssusek, Schwartz and Krallman (2002:7) espoused that the sociological paradigm encompasses the entire constellation of beliefs, values, and techniques shared by members of a given community.

It is real that paradigms serve as a lens or organizing principles by which reality is interpreted. They enable the researcher to relate a comprehensive account by depicting a world that is meaningful and functional but subjective to culture.

4.2.4 Worldviews that inform qualitative research

Cobern (1991:3) is of the opinion that a worldview defines the self. It sets the boundaries of whom and what I am. It also defines everything that is not me, including my relationships to the human and non-human environments. It shapes one's view of the universe, one's conception of time and of space. Lincoln and Guba (1985:15) assert that:

> *"Paradigms represent what we think about the world (but cannot prove). Our actions in the world, including the actions we take as inquirers, cannot occur without reference to those paradigms: as we think, so we act".*

A paradigm guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways (Guba and Lincoln, 1994:105). According to Creswell (2007:20) social constructivism as a world view is often combined with positivism. Individuals develop subjective meanings directed towards certain objects/things. However, the meanings are varied and multiple. Meanings are formed through interaction with others (hence social constructivism) and through historical and cultural norms that operate in individuals' lives. The said author goes on argue that the researcher's intention in social constructivism is to make sense (interpret) the meanings others have about the world (Interpretive research). Against this background, social constructivism is about post-modern thinking which is related to constructivism.

4.2.5 Grounded theory as qualitative approach to inquiry

According to Creswell (2007:63) grounded theory is a qualitative research design in which the enquirer generates or grounds a general explanation of a process that is shaped by the views of a large number of participants. The intention of grounded theory study is to discover a theory. This theory is grounded in data from participants who have

experienced the process. In this study grounded theory was used to discover an approach for the implementation of Technology in schools in the North West Province.

Within grounded theory studies, there are two main competing types: systematic procedures and constructivist approach. In systematic procedures, the researcher seeks to systematically develop a theory that explains a process (for example the development of a Technology curriculum). The investigator will conduct 20 to 30 interviews based on several visits to the field to collect interview data to saturate the categories (Creswell, 2007:64). The participants are theoretically chosen (theoretical sampling) to help the investigator best discover the theory. In constructivist approach, more emphasis is placed on views, values, beliefs, feelings, assumptions, and ideologies of individuals than methods of survey (Creswell, 2007:65). The said author goes on to say that once a theory has been discovered, it may be tested later for its empirical investigation if can be generalized to a sample and population. The study may also end with the generation of a theory as the goal of the research. In this study, the aim was to come up with an approach for implementing Technology educations in schools in the North West Province.

4.3 POPULATION

Gay and Airasian (2000:122) are of the view that the population is the group of interest to the researcher, the group to which he or she would like the results of the study to be generalisable. Generalisability is regarded as the extent to which the results of one study can be applied to other populations or situations. In this study a population of 7149 educators and 216489 learners was used.

4.4 SAMPLING

A sample may be described as a subset from a larger population (Sudman, 1976:11). This would mean that, before thinking of the samples, one must have a clear picture of the population from which the sample is to be selected. According to Gay and Airasian (2000:121) a sample comprises of individuals, items or events selected from a larger

group referred to as a population. The purpose of sampling is to gain information about the population by using the sample. Sampling methods are broadly divided into two categories, namely probability and non-probability sampling methods. The concept probability is defined as the ultimate proportion of times a certain event occurs if the experiment concerned, of which the event is a possible outcome, is to be executed repeatedly (Stoker, 1989:103).

4.4.1 Probability sampling

In probability sampling, each element of the population has a known positive probability of being selected as an element of the sample (Stoker, 1989:103). According to Gay and Airasian (2000:123), probability sampling includes the following:

- **Simple random sampling**: This is a process of selecting a sample in such a way that all individuals in the defined population have an equal and independent chance of being selected for the sample. Every individual has the same probability of being selected, and the selection of one individual in no way affects selection of another individual (Gay & Airasian, 2000:123). In this study, the selection of educators followed a simple random sampling, based on the number of educators in each region. The list of all Technology educators was requested from the area project offices of each of the five education regions. Based on the list supplied per region they were randomly sampled. In region 1, the number of educators required to complete the questionnaire was 45. The population of educators in region 1 (892) was divided by 45 to give the sampling interval of 20. So every 20^{th} educator in region 1 list was sampled. The same principle was applied for the remaining four regions.
- **Systematic sampling**: It is sampling in which individuals are selected from a list by taking the k^{th} name. If K = 2, selection involves taking every 2^{nd} name, if K = 6, every 6^{th} name, and so forth. What K actually equals depends on the size of the list and the desired sample size (Gay & Airasian, 2000:131). In this study the learners who were selected to take part in the survey were systematically selected

from the class list using a table of simple random numbers. In each of the selected schools, using an alphabetical class list for each of the grades 7, 8 and 9 learners a sample was selected. In a classroom with 44 learners, the administrators used a random table under column (R44) to select the number of learners required to participate in the study. The random table automatically calculated the sampling interval (K). Neuman (1997:211) asserts that in most cases, a simple random sample and a systematic sample yield virtually the same results.

4.4.2 Non Probability sampling

Non probability methods are cheaper and faster to apply than probability methods. According to Stoker (1989:103), the basic difference in the application of the two classes of procedures is that in non-probability procedures no indication can be given of possible bias and of the error bounds of estimates in respect of population characteristics. Non-probability approaches include:

- **Convenience/Accidental/Haphazard sampling**: It involves including in the sample whoever happens to be available (Gay & Airasian, 2000:137). In this study the education specialists who were available in the offices during the time of interviews were included in the sample. They were four in number.
- **Purposive/Judgement sampling**: A researcher selects a sample based on his/her experience or knowledge of the group to be sampled (McNeill, 1995:39). According to Anonymous (2006:1), the importance of purposive sampling is to select information rich cases from which one could learn much about issues that are important to the study. The said author further asserts that in purposeful sampling the sample size is very small. In this study purposive sampling was applied in the selection of participants for interviews. This involved the Technology experts. These were also four in number.
- **Theoretical sampling**: According to Creswell (2007:64) the participants are theoretically chosen to participate in the study through interviews to help the

investigator to discover a theory. In this study, seven subject heads were requested to participate in the interviews.

In this study the sampling frame consisted of 100 schools offering Technology in grade 7 to 9 from the five education regions in the North West Province. Both educators and learners were sampled from 5% of the schools in each region to respond to the questionnaires. Seven educators in charge of the Technology learning area (Heads of Department) were interviewed including eight Technology experts as well eight subject specialists for Technology. Tables 4.2 – 4.4 show the distribution and response rate for each of the instruments administered.

Region	No. of questionnaires Distributed	No. of questionnaires Returned	Percentage return Rate	Percentage non-return rate	No. of schools
1	45	45	100	0	20
2	96	81	84	16	20
3	100	100	100	0	20
4	61	61	100	0	20
5	58	58	100	0	20
Total	359	344	96	4	100

Table 4.2: Distribution and response rates of educator questionnaires

Table 4.2 reveals that out of a sampled population of 359, only 344 (96%) usable questionnaires were returned. According to Babbie (1989:242), a response rate of 60% is good. This good response rate indicates the importance of requesting some time to the authorities to allow the subjects to complete the questionnaire and take it on the very day.

Region	No. of questionnaires Distributed	No. of questionnaires Returned	Percentage return Rate	Percentage non-return rate	No. of schools
1	2166	1514	69.8	29.2	20
2	2166	1425	66	34	20
3	2166	1518	70	30	20
4	2166	1524	70	30	20
5	2166	1653	76	24	20
Total	10830	7634	70	30	100

Table 4.3: Distribution and response rates of learner questionnaires

Table 4.2 shows the response rate of learners to the questionnaire. According to Babbie (1989:242), a response rate of 50 percent is adequate for analysis and reporting. A response rate of 60 percent is good and a response rate of 70 percent is very good.

Interviewer	Interviewee	Date of interview	Venue
Researcher	7 x Subject heads	March 2006	School library; Regional Area Project Offices and classrooms
Researcher	4 x Education specialists	May 2006	Regional and Area Project Offices
Researcher	4 x Technology experts	June 2006	E-mails

Table 4.4: Description of respondents and dates of interviews

4.5 RESEARCH METHODS

4.5.1 Literature Study

In this study, a thorough review of primary and secondary sources was made with the view of gathering information on critical issues and curricular models regarding the implementation of Technology. A DIALOG-search was made on the internet with the following terms: curricular approaches; Technology education; critical issues and implementation of Technology education. The search was also made through SABINET on-line journals to find out if there were similar topics researched by other authors. There were no research publications on approaches to Technology Education. Archives and Technology textbooks as well as learning area descriptive documents were consulted in the review of literature.

In this study literature review was conducted due to the reasons advanced by Legotlo and Teu (1998:17). It helped the researcher to:

- Look at the problem under investigation from different perspectives;
- Link his/her study to existing knowledge;
- Scrutinize what has been done in the area of study in different cultural settings in developed countries (e.g.USA, UK, Canada, Australia) and developing countries (African countries e.g. Nigeria, Ghana, Botswana and South Africa);
- Define terms and concepts more clearly; and
- Identify areas for further research

4.5.2 Survey Methodology

Schnetler (1989:1) describes survey as "*an empirical and logical study involving the systematic and impartial collection of data from a sample of cases as well as the statistical analysis of the findings*". He further asserts that it is a method that is free from personal bias because information obtained is isolated from the values, convictions and

pre-suppositions of the researcher. Figure 4.2 illustrates the position of the survey methodology.

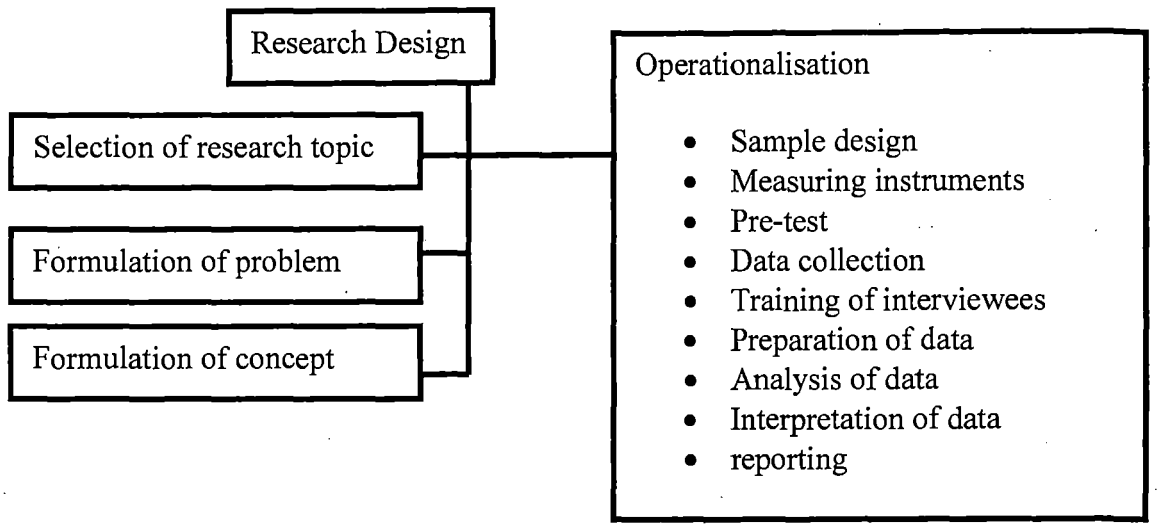

Figure 4.1: The survey methodology (Schnetler, 1989: 7)

In the above diagram, the following methodological considerations in the operational phase were important:

- **The sample design is defined** (What type of sample unit should be used to carry out the study/investigation?). In this study the simple random sampling was used to select educators and the systematic sampling was used in the selection of learners. Purposive sampling was used to select interviewees.
- **The measuring instruments are defined**. The following questions were considered when defining the measuring instruments:
  - What measuring instruments should be used to measure concepts/theories most effectively?
  - What type of questions should appear in the measuring instruments?
  - Which principles of instruments construction should be considered in this regard?; and
  - What effects can the measuring instrument induce?

In this study, the researcher used the questionnaires and structured interviews as measuring instruments. Both the multiple choice and open ended questions were used on the measuring instruments. Other principles underpinning the design have been alluded to in paragraph 4.6 (research instruments). According to Schnetler (1989:8), the following methodological steps are regarded as crucial in the operationalisation phase:

- **Testing the measuring instruments**. What should be determined when the instruments are tested and what questions should be emphasized in the pre-test?
- **Definition of data collection method**. Which data collection method was used to obtain the information? (Personal interviews, group interviews, postal or telephone survey). What are the advantages and the disadvantages of the chosen method?
- **Planning and organization of data collection**. What plan of action for fieldwork was the most cost effective? What ethical factors should be used in conducting the survey?
- **Defining of interviewers and training**. What types of interviewers were gathered by the most suitable information during this survey? (sex, age group, profession). What type of information should the interviewers receive during their training?
- **Data preparation**. What methods will be used to prepare data? (post coding)
- **Definition of statistical analyses**. What statistical analyses should be used to measure the collected data? and
- **Definition of methods of interpretation**. What interpretation strategies were used to interpret results?

In this study the operational phase took place as described hereunder:

4.6 RESEARCH TOOLS

According to Borg and Gall (1989:430), questionnaires and interviews are the most common instruments for data collection in research. In this study, both the questionnaires and structured interviews were employed for data collection.

4.6.1 A Questionnaire as a research tool

A questionnaire is an instrument with open or closed questions or statements to which a respondent must react (Milne, 2006:24). Different kinds of questionnaires can be distinguished, such as mailed questionnaires, telephonic questionnaires or the group questionnaire. In this study, individual questionnaires were administered.

- **Advantages of questionnaires**

The learner and educator questionnaires were employed because of the following advantages (New Zealand Guideline Group, 2002:4; Milne, 2006:25):

- They are quick to administer;
- They are useful for screening large numbers;
- Little skill is needed in its administration;
- Interpretation is usually unequivocal;
- Can be statistically based on evidence;
- Large number of respondents possible;
- Representative sample is possible;
- Questions can be standardized;
- Statistical tests possible (depending on the nature of data collected);
- Respondents has time to consider questions;
- Inexpensive way to cover a large geographical area; and
- Questionnaires are replicable and could be used in later studies and if well constructed should be reliable, if properly piloted.

4.6.2 Interview as a research tool

A structured interview is a question and answer session, which is recorded in some way. The expert is given a series of questions and asked how to solve them. Most of the data collected is related, and this approach provides more detailed information on the problem (See, Slacks, Stanley, Tecllab, Tobin & Williams, 1997:3). In an interview, a strategy should be used in which in-depth interviews are conducted with the subject to gather qualitative data through questions (De Vos, Schurink & Strydom, 1998:253). In this study, structured interviews were used to explore the circumstances and challenges surrounding the implementation of Technology as a Learning area.

- **Advantages of Interviews**

The structured interviews were employed because of the following advantages (See, Slacks, Stanley, Tecllab, Tobin & Williams, 1997:3; Milne, 2006:34):

- When the interviewee lack in reading skills., the subjects would then struggle to interpret the questions if they were to be written down and there might be a communication breakdown that will results in invalid data;
- When researchers ask difficult questions. The participants have the chance to seek clarity;
- Opportunities to establish rapport unlike when they just read a text.;
- Researchers can probe and follow questions up;
- Interviews typically produce a higher response rate;
- Attention is focused on a given issue;
- Detailed information is gained on issue discussed;
- Insight into declarative knowledge used is provided;
- General rules and problem-solving strategies can be uncovered; and
- A representative sample is possible

4.7 QUESTIONNAIRE CONSTRUCTION

The construction of questionnaires requires considerable time and thoroughness. This calls for great care because the measuring instrument has the influence on the reliability of the collected data. McMillan & Schumacher (2001: 253 - 254) suggest the following guidelines for writing effective questions or statements:

- **Make items clear**. An item achieves clarity when all respondents interpret it in the same way. Often the perspectives, words, or phrases that make perfect sense to the researcher are unclear to the respondents. The item may also be too general, allowing different interpretations. In this study this was done by asking the language specialist to check the questionnaire.

- **Avoid double-barreled questions**. A question should be limited to a single idea or concept. Double-barreled questions contain two or more ideas. For example **do you have a good relationship with your colleagues and principal?** It would be possible that the respondent would agree with the first part of the questions and disagree with the second part. In this study, the researcher requested colleagues to check for double barreled questions.

- **Respondents must be competent to answer**. It is important that the questions ask respondents what is within their capacity to answer. In this study, the questions were pitched at the level of the learners, educators and specialists.

- **Questions should be relevant**. If respondents are asked to respond to questions that are unimportant to them, or about things they have not thought about or caring about, it is likely that the subjects will respond carelessly. In this study, questions were designed in relation to the research objectives.

- **Simple items are best**. Long and complicated items should be avoided because they are more difficult to understand, and respondents may be unwilling to try to

understand them. Assume that respondents will read and answer items quickly, and that it is necessary to write items that are simple, easy to understand, and easy to respond to. In this study the questions were pitched at the level of the senior phase learners with the assistance of senior phase practitioners.

- **Avoid biased items or terms**. The way in which items are worded, or the inclusion of certain terms, may encourage particular responses more than others. In this study, the familiarity of background of the researcher and the participants was addressed by sticking to questions that related to the objectives.

4.7.1 Development of questionnaire items

The main aim of the questionnaires was to gather information about the learners' attitudes and concepts of Technology as well as well as educators' perceptions about critical factors influencing the implementation of Technology. The first Pupil's Attitudes Towards Technology (PATT) project (Holland, 2004:83) was initiated in the Netherlands to understand the knowledge and attitudes learners have about Technology. These studies made it clear that learners' understanding of the concepts of Technology were limited and vague, particularly the relationship of Technology and science.

These studies further suggest that differences were observed between boys and girls in their attitudes towards Technology as well, with girls being less interested in Technology and seeing it as less important. Holland (2004:84) suggests that it is necessary to develop effective teaching strategies in Technology education. The said author asserts that it is important to consider learners' interest, opinions, and needs when developing the technological environment in which to foster learner technological literacy. She agrees it is logical that learners will develop positive attitudes about Technology, be more interested in Technology, have a greater interest in pursuing technological careers, and become more technologically literate if they have a positive experience in a Technology education programme.

The following strategies were employed in the development of the questionnaires:

- Critical issues and international curricular models were thoroughly examined in chapters two and three. The researcher had the opportunity to interview Professor Marc de Vries of Eindhoven University (Netherlands) during the South African Association for Research in Mathematics, Science and Technology Education conference that was held at the University of Pretoria in January 2006. Other Technology experts included Dr Khumalo and Dr Makgato was also interviewed on the implementation of Technology education in South Africa.

- The learner questionnaire was derived from a number of sources. The instrument "What do I think of Technology?" Originated in the Netherlands and has since applied in many countries, and is designed to measure attitudes toward Technology. Similar instruments were used for the evaluation of the North West Science Technology Education Project conducted by the University of London in 1999 (Kimbell and Stables 1999:2). The concepts and attitudes literature were consulted to come up with the relevant questions pertaining to the North West Province.

4.7.2 Format and content of the educator questionnaire

The questionnaire was divided into four sections (see Annexure B), according to the following focus:

SECTION A: (questions 1-9). The purpose of this section was to gather the biographical and demographic information about each respondent as well as to document the profiles of Technology educators.

SECTION B: (questions 10-19). The main aim of these questions was to assess and determine the level of support received by Technology educators. Respondents had to choose the most appropriate answer that is applicable to their situation.

SECTION C: (questions 20-38). The aim of these questions was to determine the perceptions of educators towards Technology. In this 18-item instrument, respondents

were asked to indicate their perceptions on a four-point scale (1 = Strongly disagree; 2 = Disagree; 3 = Agree; 4 = Strongly agree). The four point scale was chosen to avoid the central tendency error. The researcher wanted learners to commit themselves either positively or negatively to each statement.

SECTION D: (questions 39.1-39.17). The objective of these questions was to determine the specific tools, equipment and other resources that exist in the school. Respondents had to simply put a cross on the block that applies to them.

4.7.3 Format and content of the learner questionnaire

The questionnaire was divided into two sections (see Annexure C), according to the following focus:

SECTION A: (question1-5). The purpose of this section was to gather the biographical and demographic information about each respondent. This information included the age, location of school, region, grade and gender of the respondent.

SECTION B: (questions 6-43). The aim of these questions was to determine the attitudes and construct of learners towards Technology. In this 38-item instrument, respondents were asked to indicate their perceptions on a four-point scale (1 = Strongly disagree; 2 = Disagree; 3 = Agree; 4 = Strongly agree).

4.7.4 Pre-testing the questionnaires and structured interview schedule

According to Leedy (1989: 27), questionnaires should be pre-tested on a small population. The main aim is to detect any flaws in the instrument (Legotlo & Teu, 1998: 34). Legotlo and Teu (1998:34) are of the opinion that only after the necessary modifications have been made following the pilot test should the questionnaire be presented to the full sample. In this study the educator questionnaires were administered to the North West University students who are currently teaching Technology in schools. They were twelve in number. The learner questionnaires were pre-tested in Lehurutshe Area Project Office schools comprising of 90 learners (30 grade 7; 30 grade 8 and 30 grade 9). The structured interview schedule was piloted with three education specialists

responsible for Technology education. There were no changes effected for the educator questionnaire as well as the interview schedule. In the learner questionnaire location of school was added as a variable.

4.7.5 Quality Assurance

The question of validity is notoriously difficult but very important. The questionnaires and interview schedules were developed through a rigorous quality assurance process. Apart from the guidance provided by the two promoters, one Chief Education Specialist (CES) and two Deputy Chief Education Specialists (DCES) were requested to look at the instruments. These are mature practitioners who have published research papers in accredited journals and are knowledgeable about the Technology learning area. They are also knowledgeable about the context of North West Province learners. This was done to ascertain the face validity of the instruments.

4.7.6 The final questionnaires and interview schedule

After obtaining permission from the Deputy Director General of the North West Education Department, data was collected (see Annexure D). The educator questionnaires were administered to 359 respondents from the five education regions of the North West Province. The learner questionnaires were administered to 10830 respondents across all the five regions of the North West Province. A total of 15 subjects were interviewed regarding their perceptions on the implementation of Technology. This included Technology learning area heads, subject specialists and Technology experts.

4.7.7 The cover letter

A covering letter accompanied the questionnaires. It gives respondents direction in the completion of the questionnaire, directions about the questionnaire and guarantees anonymity (Legotlo, 1994:168). According to Nelson (2006: 2-3), the following points were considered when the cover letter was written:

- An effective cover letter ensured respondents that their privacy and anonymity are maintained;
- The cover letter made an appeal to the importance of the respondent's cooperation;
- A word processor was used so that the letters looked as if they were individually typed;
- The researcher identified himself by name and position;
- Since the study is part of a thesis, my supervisor's name was given;
- Respondents were promised to be provided with the summary of the results if they wished to;
- The cover letter requested that the questionnaire be returned by a certain date (this information was attached to the questionnaire).

4.8 TRUSTWORTHINESS OF THE STUDY

Whitbeck (1995:403) argues that the scientific enterprise is built on a foundation of trust; Trust that the results reported by others are valid and trust that the source of novel ideas will be appropriately acknowledged in the literature. According to Smith (2003:1; Harrison, 2001:7) a key issue for qualitative research is developing a shared understanding of appropriate procedures for assessing its credibility or trustworthiness (validity).

Credibility or internal validity refers to how truthful particular findings are (Smith, 2003:2). It is also referred to as the internal validity or truth value of an investigation (Reitsma & Mentz, 2006:609). In this study, credibility was attained by triangulation and extended involvement in the field. An extensive literature review was also conducted which enhanced the credibility of the study.

Transferability or external validity refers to how applicable or generalizable the research findings are to another setting or group (Smith, 2003:2; Tobin & Bagley, 2004:389). It indicates the applicability of the research. In this study, detailed descriptions of the

participants in the specific contexts and description of results could be applied in other contexts.

Dependability or reliability refers to how one can be sure that one's findings are consistent and reproducible (Smith, 2003:2). In this study the strategy applied to ensure dependability was in coding data and verifying each step of the process from literature as well as getting advice from expert researchers. Conformability or objectivity refers to how neutral the findings are in terms of whether they are reflective of the subjects and the inquiry and not a product of the researchers' biases and prejudices (Smith, 2003:2); Tobin, & Begley, 2004:389). In this study, proof was shown on how the findings emanated from qualitative and quantitative data. Problems that were encountered were identified and explained.

4.9 ADMINISTRATIVE PROCEDURES

The researcher distributed the educator questionnaires during the Technology training sessions and collected on the very day they were administered. Five Technology subject advisors were trained on how to administer learner questionnaires. They were drawn from each of the five education regions of the North West Province.

The training of the administrators took place on the Thursday morning prior to the week of data collection. Using a group of students selected in the central region, the researcher ran the test activity to demonstrate how it works and what the requirements were of the administrator. The team observed the activity and the researcher had a preparation workshop in which all the issues that were believed to be essential for the effective administration of the task were discussed and resolved. This training session was essential to ensure the standardized administration of the instrument in all sampled schools. At the end of the workshop questionnaires were distributed and finalized and arrangements for the week ahead were made.

During the following week the administrators visited 20 schools across the regions, testing 2166 learners; 722 in grade 7, 722 in grade 8 and 7,722 in grade 9. This exercise

alone took six weeks because of vast distances between schools. The researcher monitored this data collection process. At least three schools per region were monitored.

4.10 DATA ANALYSIS

4.10.1 Quantitative data analysis

According to Neuman (1997:294), a researcher provides tables, graphs and charts to give the reader a condensed picture of the data. The author goes on to say that in the analysis of quantitative data, the researcher need to organize and manipulate the quantitative data to get them to reveal things of interest about the social world. In this study, graphs and tables have been used to present data.

The data was coded before computing it. Coding data, according to Neuman (1997:295), means "*systematically reorganizing data that is computer readable*". He asserts that the coding procedure is a set of rules stating that certain numbers are assigned to variable attributes. In this study, both the educator and learner questionnaires were coded in the following way, using biographical data of the educator questionnaire as an example:

1. Gender

Male	1
Female	2

2. Age

Below 25 years	1
26 - 30 years	2
31 - 40 years	3
Above 40 years	4

3. Teaching experience

1-5 yrs	1
5-10 yrs	2
11-15 yrs	3
Above 16 yrs	4

4. Experience in Teaching Technology

1-5 yrs	1
5-10 yrs	2
11-15 yrs	3
Above 16 yrs	4

5. Highest education level

Teachers' certificate	1
Diploma	2
Bachelor's degree	3
Hons/Bed. Degree	4
Masters degree	5
Doctorate	6

6. Highest Educational level in Technology

Less than one year of teacher training	1
One year of teacher training	2
Two years of teacher training	3
Three years of teacher training	4
More than three years of teacher training	5
None	6

7. Position Held

Principal	1
Deputy Principal	2
Head of Department	3
Educator	4

8. School Category

Primary school	1
Middle school	2
High school	3
Combined school	4

9. Type of settlement

Rural	1
Urban	2

After coding the researcher checked for the accuracy of the coded data (cleaning data) and afterwards it was entered into the computer (capturing data). Statistical procedures using the Statistical Programme for the Social Sciences (SPSS Version 12.0 for MS Windows) were used to analyse responses to the Learner attitude toward Technology survey and the educator questionnaires. To begin the data analysis for this study, data from the learner attitudes toward technology survey were entered into an excel spreadsheet (Microsoft), transferred to SPSS files, and recoded for statistical analysis. The same was done with the educator questionnaire. The first step in the analysis was to compute descriptive data for each respondent in the study for both learner and educator questionnaires. These included statistics like frequency distribution and percentages; demographic frequencies; cross tabs of age, gender, region, settlement and teaching Technology. The chi square values were computed to determine the level of significance on various variables on the learner questionnaire.

4.10.2 Qualitative data analysis

Neuman (1997:327) is of the view that social researchers systematically collect and analyse empirical evidence to understand and explain social life. He goes on to say that when data is in the form of words, sentences, and paragraphs rather than numbers, researchers need to use different research strategies and data collection techniques. Data analysis will therefore involve examining, sorting, categorizing, evaluating, comparing, synthesizing, and contemplating the coded data as well as the raw data (Neuman, 1997:427).

The interview instrument was analysed by identifying the most common trends into themes. Reflective notes about what was learned from the data were made and this process is termed "*memoing*" (Johnson, 2006:2). Data was transcribed by typing the text from interviews into word processing documents. Data was also read by the researcher

line by line and divided into meaningful analytical units. This process is termed coding and it is defined by Johnson (2006:2) as "marking the segments of data with symbols, descriptive words, or category names. In this study data was coded using descriptive words.

Neuman (1997:329) asserts that a qualitative researcher focuses on subjective meanings, definitions, metaphors, symbols, and descriptions of specific cases. Against this background, coding becomes imperative. The researcher will now analyse data by organizing it into categories on the basis of themes and concepts. (Neuman, 1997:421). The following types of coding were used in this study:

- Open coding: the researcher locates the themes and assigns initial codes or labels in order to streamline the mass of data (Neuman 1997:422). The researcher looked at the critical terms and noted them. The researcher was aware that he had the opportunity to create new themes in the subsequent analysis.
- Axial coding: the second stage of the coding process involved looking for the categories or concepts that cluster together (Neuman, 1997:422). The said author argues that axial coding stimulates thinking about the linkages between concepts or themes and it also raises new questions. In this study, some of the themes were dropped and existing ones were examined in more depth. In this way axial coding helped reinforce the connections between evidence and concepts/theme

The successive method of qualitative data analysis was employed (Neuman, 1997:425). Using this method, the researcher started with research questions and a framework of assumptions and concepts/themes. The researcher probed into the data to establish how the themes fit the evidence and reveals features of the data. In this way new themes were created so as to fit the evidence better. Neuman (1997:425) suggest that the said method is termed successive approximation because the modified concepts/themes and the approach approximate the full evidence and are modified over and over to become successively more accurate.

4.11 SUMMARY

In summary the survey questionnaires were used as the main instruments in the collection of data because of their advantages mentioned in paragraph 4.6.1 and 4.6 .2. With the help of the statistician from North West University, both descriptive and inferential statistics were employed to verify the status of the implementation of Technology education in North West Province schools. Qualitative procedures, including systematic coding and categorization via content analysis were used to analyse responses to the individual interview questions. Chapter five presents the analysis and interpretation of data as collected from the different respondents.