A STUDY OF EFFECTIVE TECHNOLOGY INTEGRATION INTO TEACHING AND LEARNING: A CASE STUDY.

by

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DECLARATION

I declare that **A STUDY OF EFFECTIVE TECHNOLOGY INTEGRATION INTO TEACHING AND LEARNING: A CASE STUDY** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

..... August 2010

MMANKOKO ZIPHORAH RAMOROLA

DEDICATION

To the memory

of my father

Jeffrey Moeketsi Morolo

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This research project was successfully completed thanks to many persons who helped and supported me at various stages. I especially thank Prof Pretorius FJ, my promoter, for his numerous inspirational comments, suggestions and general guidance.

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ACRONYMS

ARCS	**Attention, Relevance, Challenge and Satisfaction**
ASSURE	**Analyse, State, Select, Utilise, Require and Evaluate**
CAT	**Computer Application Technology**
DBSA	**The Development Bank of Southern Africa**
DoE	**Department of Education**
FET	**Further Education and Training**
GDE	**Gauteng Department of Education**
GET	**General Education and Training**
GOL	**Gauteng online**
GSSC	**Gauteng Shared Services Centre**
ICTs	**Information and Communication Technologies**
IT	**Information Technology**
LAN	**Local Area Network**
LTSM	**Learner Teacher Support Material**
SGB	**School Governing Body**
TIP	**Technology Integration Plan**
VSAT	**Very Small Aperture Terminal**
WAN	**Wide Area Network**

ABSTRACT

The ability to utilise information and communication technologies (ICTs) has become a new literacy for the twenty first century. This literacy raises a number of challenges for teachers' vis-à-vis their technical ability, knowledge and expertise in ICTs. These challenges are also identified by the White paper on e-Education as: participation in the information society, impact of ICTs on access, cost effectiveness and quality of education, and integration of ICTs in the teaching and learning process. There is a gap in the ability of learners and teachers to use ICTs effectively, to access online content, to create content of their own, to communicate and collaborate, and to integrate technology into teaching and learning. There is also little evidence of technology integration into classroom activities such as systematic planning and implementation of lessons. This study describes barriers to effective technology integration in senior secondary schools.

This was a qualitative case study conducted in technology rich senior secondary schools in the Tshwane North District, Gauteng Province. Data was collected from semi-structured interviews with office-based and school-based officials, focus group interviews with learners, lesson observations and document study. The findings point to lack of ICT specialist teachers to teach students computer skills, lack of teaching experience with ICTs, lack of support from the Department of Education, insufficient technology resources and absence of desired integration of ICTs in the curriculum. The long term aim of the study is to make substantive recommendations on the integration of ICTs in teaching and learning.

In conclusion, this study clearly indicates that there are schools around Gauteng Province with computer technologies that are not used for teaching and learning. Based on the research findings and suggestions for further research, a national strategy for designing and implementing computer technology policy should be developed in Tshwane North Region to integrate technology effectively into teaching and learning. This will help teachers to plan and teach with technology and assist learners to become technologically compliant with 21st century demands.

Key words: Technology; technology integration; information and communication technologies; curriculum, computer literacy; information literacy; integration literacy.

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CHAPTER 1

INTRODUCTORY ORIENTATION

1.1 Introduction

Integration of information and communication technologies (ICTs) into teaching and learning has risen on the South African education agenda, particularly with the release of the White Paper on e-Education in 2003 (Wilson-Strydom, Thomson & Hodgkinson-Williams 2005:72).

According to Wilson-Strydom et al (2005:72), the adoption and integration of computers is a challenging and complex process for schools, particularly where there is limited previous experience in the use of ICTs to support teaching and learning. Wilson-Strydom et al (2005:72) further maintain that at many schools that have enjoyed access to ICTs, the focus has tended to be on learning about ICTs rather than learning with or through the use of ICTs.

This chapter presents a general overview of a study that investigated technology integration by exploring the lived experiences of curriculum specialists, principals, deputy principals, educators and learners in two purposefully selected information and communication technology-enriched senior secondary schools in the Tshwane North Region, Gauteng Province. The chapter also includes an introduction to the study problem, the research questions and purpose, scope and importance of the study. In addition, the methods of research are explained and unfamiliar terms are defined and clarified. The last section gives an overview of the organisation of the thesis.

1.2 Background to the study

This study deals with effective technology integration in teaching and learning focusing on senior secondary schools in the Tshwane North Region, Gauteng Province. Tshwane North is a region situated in the Northern part of Gauteng and its demographic composition is multi-racial. The dominant language in the region is Setswana; however, English is the official language of teaching and learning (LoLT) from primary grade three set-ups. There are two main types of senior secondary schools in Tshwane North Region: public (state) and independent (private) schools.

This set-up is applicable in the entire South African education context, whereby the South African Schools' Act (SASA), Act 84 of 1996 and the recent Funding Norms and Standards (1998) passed legislation in order to divide the schools into two categories (public and independent). The Funding Norms and Standards allow public schools to charge fees and specify a democratic procedure, which must involve a majority of the parents, for determining the fee levels (Hofmeyr 2000:3). In addition, families that can demonstrate financial need can qualify for exemption from school fees. No learner may be excluded from a public school for failure to pay school fees, but the school may take legal action against the parents. In contrast, independent schools are not supported financially by the government and rely entirely on fees paid by parents.

The study is informed by the manner in which computer as ICTs are distributed and used by schools in the Tshwane North Region. Several schools have already transformed their curricula to fit the technological environment in which learners are taught with the aid of technology. Educators are already using technology to plan their lessons, prepare and present their work. Where inhibiting factors exist, schools have taken it upon themselves to further this endeavour and the usage of technology by both educators and learners can be observed. Against this background, this study describes the challenges educators encountered as they integrated technology into the curriculum while at the same time assisting learners to acquire their own skills and knowledge.

Several authors (Yee 2000; Benson et al 2001; Osin 1998; Rice et al 2001; Butzin 2001; Russell et al 2000) have mentioned reasons for using computers in the classroom. According to these authors, computers were introduced into the school

systems of developing countries in response to parents' demands that learners become computer literate. Many reasons were presented by leaders and parents for the implementation of computer education as follows:

- Learners are prepared for full participation in future society by acquiring computer literacy skills that include learning of common business tools, such as word processing, spreadsheets and databases (Yee 2000:291).

- The computers are required for instructional support. They can manage data, reinforce instruction in a random learning environment, promote multimedia concept learning that addresses multiple learning modes, and deliver on demanding learning programs over multiple types of e-systems (Benson, Farnsworth, Bahr, Lewis and Shaha 2001:121).

- Educational systems are resistant to change, and a transformation that purports to accelerate the solution of the problems just stated requires the support of educational technology (Osin 1998:2).

- The use of computers helps to bring changes in classroom practice in order to improve subject matter teaching (Rice, Wilson & Bagley 2001:211).

- Technology can be more effective when used in a transformed learning environment than when used in a traditional learning environment (Butzin 2001:372).

- Educators also enjoy using technology. It helps to improve their skills in teaching (Russell, Finger and Russell 2000:158).

These potential advantages have led developing countries to adopt computers to enhance teaching and learning in the classroom. South Africa, together with other African countries, has followed the footsteps of the developed countries and introduced computers into its education system.

As already stated, Tshwane North Region comprises of private and public schools. Private schools tend to be far ahead of their counterpart, public schools, in the usage of computers and have already been teaching learners various computer skills.

This reminds us of the history of education in South Africa during the pre-industrialised era. During the 'apartheid' era, Black South Africans were disfranchised and their education lagged behind that of Whites (Nkomo 1990:40). Several objectives of the political policy of this period can be identified, such as the notion of unequal distribution whereby black intellectual underdevelopment was promoted through maximising the allocation of educational resources for whites. According to Mohlakwana (2002:71), the accumulative effect of this policy led to high failure rates, resistance towards and the rejection of education, high rates of illiteracy, poor training of black educators leading to poor instruction and performance, unequal distribution of resources and a general dissatisfaction about the apartheid education doctrine.

Unequal distribution of resources in South African education presented a challenge to the national Department of Education established in 1994. In order to provide a uniform standard of technology education in secondary schools, the Department of Education (DoE) produced computer syllabi specifically for Computer Applications Technology (CAT) which was lately followed by the introduction of Information Technology (IT). Although the Department of Education made it possible for schools to introduce the computer education syllabus, many challenges were experienced in the integration of this technology into teaching and learning. Among others, challenges included: uneven utilisation of computers and patterns of use, lack of trained educators and lack of computer textbooks and relevant software packages.

Nonetheless, many schools continued to purchase computer hardware and it was not clear if schools were using this hardware for the purposes and objectives intended by the Department of Education.

Several assumptions formed the theoretical basis for this study of technology integration. My first assumption is that the limited integration of technology into teaching and learning is evident in both primary and secondary schools in South Africa. The teaching of basic computer principles and word processing skills forms the most important component in the acquisition of computer literacy. Access is a major obstacle but there is a gap in the ability of learners and educators to use these technologies effectively, to access high quality and diverse content, to create content of their own, to communicate and collaborate and to integrate technology into teaching and learning.

A second assumption is that the present government is strongly committed to ICT in education. To accelerate the realisation of nationwide educational goals, South Africa has embraced e-Education. E-Education concerns connecting learners electronically to other learners and educators to professional support services, thus providing platforms for learning. According to the Department of Education (DoE 2003:17):

> Every South African learner in the general and further education and training bands will be ICT capable (that is, use ICT confidently and creatively to help develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community) by 2013.

Further, I assumed that a qualitative research methodology with interviews, observation and document review as data collection methods was a valid means of acquiring a description of the lived experiences of educators in ICT-enriched senior secondary schools.

My final assumption is that my knowledge and experience in the field of computer integrated education (CIE) strengthened this study. My experience as a lecturer in the abovementioned field assisted in formulating questions for the participants, establishing a relationship of trust with them and understanding what was heard and seen during data gathering and data analysis.

1.3 Motivation and rationale

ICTs have grown increasingly universally, powerful and adaptable. They change the world we live in and how we learn to live. In this regard, South Africans are faced with formidable challenges. The latter are clearly stated in the White Paper on e-Education, as follows: participation in the information society, impact of ICTs on access, cost effectiveness and quality of education and integration of ICTs into the learning and teaching process (DoE 2003:8).

Most of the educational programmes that are meant to support and educate learners are programmed for computers. For the learners to benefit optimally and acquire information that is at their disposal, they need to understand how to operate computers in a web-based learning environment. From my observation as a computer educator, I noticed the learner' struggle to use computers to search, find, analyse and use information for their projects. This struggle motivated me to investigate the effective usage of computers at school level. The findings from this study may be useful to:

- Educators in planning, implementing and integrating information technology into their instruction.

- Learners in meeting the demands of the 21st century technology skills.

- Curriculum designers to develop a user friendly plan for technology integration into the curriculum.

- Curriculum specialists to bridge gaps between schools in integrating technology into the teaching and learning environment.

If all the stakeholders (educators, learners, curriculum designers, curriculum specialists) play their role and participate fully in the information society, South Africa will reap the full benefit of technology in education. This notion is supported by the Department of Education (2003:17) which states that full participation in the information society is enabled by successful e-Education, which incorporates learner-centred pedagogy, inquiry-based learning, collaborative work and the development of higher level thinking skills. For these reasons, and to achieve other policy goals reflected in the White Paper, the adoption of ICTs in schools in general and the integration of ICTs into teaching and learning practices in particular, is being encouraged.

1.4 Research problem and sub-questions

In spite of the debate about the technology integration in teaching and learning, few practising educators know exactly how to proceed as real integration requires change in classroom practice. What is lacking is a model that educators can use to guide the changes they need to make for the successful integration of new technology into their classrooms (Johnson & Liu 2000:4).

Based on this information, one notices that the young generation is entering a changing technology-oriented and knowledge-based global economy and society in which national economies are becoming more globalised, with an increasing flow of information, technologies, products, capital and people between nations. Socio-economic change therefore demands new knowledge and skills in the workplace and further pose a challenge to education systems to provide learners with the relevant knowledge and skills.

Based on these challenges, South African schools are therefore confronted with the serious problem of integrating ICTs into a coherent framework at the school level. A direct implication of this is the accusation that South African schools are not providing learners with the knowledge and skills they will need to succeed in the 21st century.

Several research findings on technology integration in developed countries have reported the general effectiveness of technology as a method of instruction (McRobbie & Thomas 2000:142; Zhang 2000:467). Although educators are equipped with skills, there is little evidence of information technology integration into classroom activities, such as systematic planning and implementation of lessons that require learners to think critically, work collaboratively and integrate technology in support of this kind. No previous study has been done to determine how technology can be used effectively for instructional purposes in the schools in the Tshwane North Region.

Against the above background, this study seeks to answer the following question:

What are the barriers to effective technology integration into teaching and learning?

Since educators play a pivotal role in determining the advantage to be gleaned from technology in the classroom, this research requires more than mere descriptive summaries to understand how technology is being integrated. To provide rich content in understanding the integration process, the following sub-questions were formulated:

- To what extent do educators and learners have access to technology?
- What is the frequency of technology usage at school?
- What is the degree of technology training and professional development of educators?
- What are the challenges faced by both educators and learners in the technology integration process?

It is claimed that computer usage has grown dramatically in South African schools due to the assistance of many private sector companies, parastatal institutions, Non Governmental Organisations (NGO's) and institutions of higher education (DoE 2003:8). This claim is based on the realisation that traditional methods of education alone will not meet these massive learning and training requirements. According to DoE (2003:8), ICT creates new possibilities, dilemmas, and directions and encourages educators to harness the new opportunities that ICT offers to make teaching and learning more meaningful and rewarding.

1.5 Aim and objectives of the study

Central to the research problem, the general aim of this study is to explore and describe the experiences of educators and learners to integrating technology effectively in teaching and learning in senior secondary schools. Therefore, the study aims to achieve the following objectives:

- To describe the extent to which educators and learners have access to technology.

- To explore the frequency of technology usage at schools.

- To identify the degree of technological training and professional development of educators.

- To provide evidence on the challenges met by educators and learners when integrating technology into teaching and learning.

1.6 Research method and design

A research design is a plan that governs what will be done, to whom, what will be measured, how and when data will be collected and how the results will be interpreted (Schuyler 1995:36; Bless & Higgson-Smith 1995:63). Babbie (1998:89) states that a research design addresses the planning of scientific inquiry – designing a strategy for finding out something.

There are two well-known and recognised approaches to research, namely; qualitative and quantitative approaches. Merriam (1998:17) highlights the difference between the two methods by explaining

> "...in contrast to quantitative research, qualitative research assumes that there are multiple realities, that the world is not an objective thing out there but a function of personal interaction and perception. It is a highly subjective phenomenon in need of interpretation rather than measuring beliefs and facts from the bases of perception."

The research approach chosen for this study as explained further in Chapter 3 is qualitative. This study is about the experiences of educators and learners; in this regard, Grove (1993:65) comments: "I wanted to describe experiences as they are lived." Moreover, Mertens (1998:169) elaborates that qualitative research is used to understand and describe an event from the participants' point of view.

Merriam (1998:5-8) and Creswell (1994:181-182) highlight the characteristics of qualitative research in education. These are highlighted below:

- Qualitative researchers are concerned primarily with process, rather than with outcomes or products.

- Qualitative researchers are interested in understanding the meaning that people have constructed.

- The researcher is the primary instrument for data collection and analysis.

- Qualitative research involves fieldwork as a research strategy. The researcher builds abstractions, concepts, hypotheses and theories from details.

- The product of a qualitative study is richly descriptive. These descriptions are derived from participants' responses and documents.

For the purpose of this study, I conducted semi-structured interviews with curriculum specialists, principals, deputy principals and technology educators; focus group interviews with learners; and observed lessons in the classroom. I also reviewed relevant documents from the individual schools, such as, technology lessons, textbooks and policy documents, learners' activities and records of learners' progress.

Interviews were recorded using an audio recorder. In order to refine the subsequent data collection and analysis, I transcribed the interviews verbatim and quickly returned transcripts to the participants for editing. Telephone calls and e-mails were also used to clarify issues that arose. Thus, data analysis was a recursive process that occurred across all phases of the investigation rather than a distinct final stage of research.

1.6.1 Field research procedures

The field research was conducted in five phases. The first phase was a visit to the Provincial Director of Education in Gauteng Province. The purpose was to seek permission to visit senior secondary schools to arrange for interviews with school based personnel (technology educators, deputy principals and principals of schools).

The second was a visit to senior secondary schools to conduct semi-structured interviews with principals, deputy principals and technology educators. The third phase was to visit schools to observe technology lessons taking place. The fourth phase was to conduct focus group interviews with learners at the sampled senior secondary schools. The fifth phase was to visit the Tshwane North District office and conduct interviews with the e-Learning curriculum specialists.

1.6.2 Data collection techniques

Data collection is a detailed description of the data gathering procedures for the planned investigation. This description covers the specific techniques to be employed (De Vos 1998:100). The following qualitative data collection instruments were used: semi-structured interviews, focus group interviews, observations and document review. Following is the description of each technique.

1.6.2.1 Semi-structured interviews

The first phase of fieldwork was an investigation using semi-structured interviews to collect data from principals, deputy principals and educators who use technology in their schools. I used semi-structured interviews because they allow the use of a detailed topic guide and a number of predetermined questions on special topics; while at the same time the participants are allowed to digress and the interviewer may employ unscheduled probes (Bell 1993:33).

1.6.2.2 Focus group interviews

De Vos, Strydom, Fouchė and Delport (2002:306) define a focus group interview as a research technique that collects data through group interaction on a topic determined by the researcher. Furthermore, a focus group is a group of people who are brought together in a room to engage in a guided discussion (Babbie & Mouton 2001:248; Edenborough 2002:109). From the two statements, a focus group interview thus collects data from a guided discussion that is determined by the researcher.

The guided discussion is based on sharing a controlled experience (Keats 2000:16). In this study the shared experience is technology integration. Two focus groups were planned from each of the sampled schools. The following aspects are considered when sharing a controlled experience (Hult 1996:69):

- Questions are written down and asked exactly as worded.
- Any unclear or incomplete answer is probed.
- Inadequate or brief answers are not probed in a biased manner.

The researcher should be aware that the following criteria should be met when collecting data:

- Exhaustion of sources – the participants should give their perceptions until they have nothing more to say.
- Saturation of data – continuing to collect data (Maykut & Morehouse 1994:144).
- Emergence of regularities – the sense of “integration.”
- Over extension – new information does not contribute usefully to the emergence of additional viable categories (Merriam 1998:164).
- The researcher should have as many groups as are required to provide a trustworthy answer to the research question.
- Data described should be rich (De Vos et al 2002:312).

The responses of participants in this study were recorded on audiotape and thereafter transcribed (Edenborough 2002:109; McMillan & Schumacher 2000:165). The verbatim transcription of recorded interviews provides the best database for analysis (Merriam 1998:88; McMillan & Schumacher 2001:450; Barbour & Kritzinger 1999:15).

1.6.2.3 Observation

The third phase of field work involved observation of lessons conducted by the technology educator in the classroom. According to Marshall and Rossman (1999:107), observation is a systematic noting and recording of events, behaviours and objects in a social setting chosen for the study. Marshall and Rossman (1999:107) add that observation is a fundamental and highly important method in all qualitative inquiry.

1.6.2.4 Document review

Documents were also used as a data gathering technique. Maree (2007:82) mentions that when using documents as data collection technique, the researcher have to focus on all types of written communications that may shed light on the phenomenon that is investigated. Maree (2007:82) further states that data sources may include published and unpublished documents, and also make a distinction between two types of sources: primary and secondary sources. He describes secondary sources as any materials that are based on previously published works.

For the purpose of this study primary sources were examined. In this study I examined sources such as policy documents, learning schedules and lesson plans as they are used in the day to day running of the teaching and learning activities.

1.6.3 Sources of data

The investigation focused on curriculum specialists from the Department of Education (Tshwane North Region), principals, deputy principals, educators and learners in senior secondary schools. The schools included both private and public senior secondary schools. The criteria for the selection of institutions were based on:

- Schools with technology for teaching and learning.
- Private and public schools.
- Principals, deputy principals and educators' willingness to participate in the investigations.

Two senior secondary schools were selected for this study to enable me to conduct a comparative analysis of the patterns of use and integration of technology and to collect qualitative data.

1.6.4 Population and sampling

According to Babbie and Mouton (2001), a study population is the aggregate of elements from which a sample is selected. Bless and Higson-Smith (in De Vos 2002) refers to a population as the set of elements that the researcher focuses on and to which the obtained results should be generalised. Additionally, Polit and Beck (2006:506) describe the population as an entire set of individuals having some similar characteristics. The accessible population in this study were curriculum specialists, principals, deputy principals, educators responsible for the technology education and learners in senior secondary schools.

Sampling refers to the process used to select a portion of the population for the study (Maree 2007:79). Qualitative research is generally based on non-probability and purposive sampling. For the purpose of this study, purposive sampling was used, because I handpicked the cases to be included in the sample on the basis of the cases' judgment (Cohen, Manion and Morrison, 2000:103). In addition, Patton (2002 cf. Maree 2007:257), explains that in purposive sampling, the sample size is small and is purposefully selected from those individuals who have the most experience with the studied phenomenon. For this reason the field research included two ICT-enriched senior secondary schools (public and private).

1.6.5 Data analysis

Data analysis is defined by Burns and Grove (1997:521) as "a method to reduce, organise, and give meaning to data gathered or construction that emerged and these are constructed into a meaningful whole." The recorded interviews and observations were transcribed and analysed in the following order:

- Collected data was coded through a process of grouping responses into categories that brought together similar ideas, concepts of themes one had discovered.

- After coding was completed, data was grouped into categories that allowed for comparison of what different participants said, what themes were discussed and how concepts were understood (Rubin & Rubin 1995:228).

1.7 Review of literature

Technology integration is defined as "employing the Internet, computers, CD-ROMs, interactive media, satellites, teleconferencing, and other technological means in instruction to support, enhance, inspire and create learning" (Redmann & Kotrlik 2004:2).

There are numerous factors that may affect the integration of technology in the teaching and learning process. These factors are highlighted by Redmann and Kotrlik (2004:2) as:

- Support for educators' use of technology has evolved over the last decade from minimal or non-existent support in many schools, to a wider acceptance by administrators and communities and the belief that technology is now a necessity. This support comes in many different forms including public support, availability of technology for both educator and student use, educator training, release time for planning and learning of appropriate instructional materials.

- The integration of technology may also be affected by the barriers encountered by both educators and learners. Those barriers include funding or cost, lack of training or expertise, lack of time, access to technology, resistance to change, educators' attitudes and the organisational structure of schools.

- Technology anxiety may be a factor that influences technology integration. The placement of technology into classrooms without educator preparation and curriculum considerations can produce high levels of anxiety among educators.

Based on these factors, van der Merwe and Mouton (2005:35-36) explain that adding value to teaching and learning activities through the integration of ICTs is impossible without the proper technology tool, which has to be supported by a stable IT infrastructure and flexible support and training programmes for both educators and learners. Woodbridge (2004:1) concurs with this notion and states that technology integration varies according to individual teaching beliefs, perceptions towards technology innovations, and how the educator practises and puts technology to work in the classroom.

In light of the above, various authors (Wilson-Strydom et al 2005; Hardman 2005; van der Merwe et al 2005; & Molope 2007) have touched upon the concept of technology integration in the South African context. In their studies they discovered that the effects of technology use in both primary and secondary school classrooms are growing rapidly. Most of what is known about barriers to technology integration follows from surveys (Wood, Muller, Willoughby, Specht, & Deyoung 2005:187), or is derived from empirical studies typically addressing one or two specific concerns, such as multidimensional characteristics and the synergy between two types of epistemic influences: the source as well as the nature of the processes (Levin & Wadmany 2008:256). These studies suggest a number of potential variables that can affect the effective integration of technology in the classroom. One thing that these studies do not provide, however, is a context-rich consideration of how these variables are perceived by educators and how educators believe that these variables impact on their practice. In order to provide a rich context for exploring and understanding the barriers that educators face, it is critical that educators be allowed to share their stories and reflect on their ICT integration experiences.

Therefore, a large section of this study is based on a review of related literature. References were obtained by searching relevant indexing and abstracting services. Below is a summary of studies conducted on technology integration literature in South Africa (See table 1.1).

Table1.1: Summary of studies conducted on technology integration in South Africa

Author	Problem statement	Main findings	Main recommendations
Van der Merwe & Mouton (2005)	What lecturers perceive as the major barriers and challenges related to the integration of ICTs as well as what type of incentives they prefer.	Time remains the number one barrier to the integration of ICTs in teaching and learning activities. The perception that teaching and learning in general	Caution should be taken not only to reward the “e” part of the teaching and learning process, but the ultimate goal is to value and reward teaching and learning in general

		are not adequately rewarded. The extent of student access to computers on campus and student access to computers off campus.	and not just one aspect of the teaching and learning process. Higher education institutions should demonstrate its support and commitment for good teaching and learning practices with the appropriate use of ICTs, make a conscious effort to identify best practice examples of e-learning applications and do institutional research on the possible benefits for learner, and establish an educational faculty development unit that should, working closely together with the IT division, build confidence in the whole e-learning system and the people involved.
Hardman (2005)	Whether the introduction of a new tool – the computer into the classroom	The introduction of a computer as a novel tool may indeed lead to shifts in	How educators deal with and overcome these contradictions will determine how

	shifts an educator's pedagogical practice.	pedagogical practice.	this novel tool is appropriated by educators within our schools.
Wilson-Strydom, Thomson & Hodgkinson-Williams (2005)	Factors affecting ICT integration at the classroom level.	ICT use support the new ways of teaching and learning.	More attention needs to be paid to the pedagogical implications of ICT integration as well as to access to computers, especially in rural areas.
Moila (2007)	Whether or not Mathematics educators in Phusela Secondary School are using the available ICT in their teaching, and if so, how their use of ICTs relate to learners' learning outcomes.	There are no plans on the use of educational technology tools in Mathematics teaching and learning, inadequate educators' training on the use of educational technologies in teaching and learning and lack of relevant educational technology tools for rural schools.	How Phusela Secondary School can improve its usage of educational technology tools in Mathematics teaching and learning effectively for the development of higher order thinking skills.
Molope (2007)	Educators' emotional experiences in integrating ICT in the school curriculum.	Ten experiential response topics were identified: uncertainty, concerns, frustration, anger, anxiety, happiness,	In terms of successful use of ICT in the classroom, all educators and administrators must continually challenge the known and

		pride, sadness, helplessness and future vision.	embrace the unknown.

1.8 Measures to ensure trustworthiness

In qualitative research validity is concerned with the accuracy and truthfulness of the findings (Brink, 2006:118). According to Lincoln and Guba (in Johnson & Turner 2003:300), trustworthiness refers to the way in which the inquirer is able to persuade the audience that the findings in the study are worth paying attention to and that the research is of high quality. To achieve this goal, the work must be rigorous in terms of validity and reliability. Guba (1981:75) and Lincoln and Guba (1985:991) talk of trustworthiness as the general issue, with credibility (akin to internal validity), dependability (akin to reliability) and Confirmability (akin to objectivity) as aspects of creating trustworthiness.

1.8.1 Credibility

Credibility is the alternative to internal validity (De Vos et al 2002:351; Merriam 1998:201). Credibility ensures that the research participants were accurately identified and described. This study is credible in the sense that accuracy in identifying the participants is based on the judgement that participants are from technology-rich institutions, and technology is used for teaching and learning.

1.8.2 Dependability

Dependability is an alternative to reliability (Mason 1996:51; Merriam 1998:205; De Vos et al 2002:532). Dependability ascertains whether the study will yield the same results if repeated and the reliability and accuracy of the research methods and techniques (Mason 1996:24; Merriam 1998:205; Babbie 1998:129). If this study is repeated, taking a purposive sampling into considerations, the same results can be yielded. The research methods and techniques are accurate and

reliable, because they afford the participants the opportunity to share how they perceive the process of technology integration in teaching and learning.

1.8.3 Confirmability

Confirmability is an alternative to objectivity (De Vos et al 2002:352; Miles & Huberman 1994:278). The questions that need to be answered are:

- Do the data assist in confirming the general findings and lead to the implications?

- Can someone confirm the results as being objective?

The emphasis on Confirmability is on the replicability of the study by others (Miles & Huberman 1994:278). If someone else undertakes this research, using the same participants or participants from the same area and using the same methods, the findings can be confirmed. This study is based on the facts gleaned from the participants' perceptions (feelings, beliefs) about technology integration in teaching and learning.

1.9 Ethical considerations

Ethics in research are the principles of right and wrong that a particular group accepts (Bogdan & Biklen 1992:49). Ethical codes are developed with the intention of serving as guidelines for practice to ensure that participants in research projects are protected from harm and are not deceived. Rossman and Rallis (2003:73) mention and explain the following ethical issues:

1.9.1 Deception and consent

Gaining the informed consent of participants is crucial for the ethical conduct of research. The ethical principles underlying informed consent are: participants are as fully informed as possible about the study's purpose and audience, they understand what their agreement to participate entails, they give that consent willingly, and they understand that they may withdraw from the study at any time without prejudice. This means that the participants are not deceived about the study and that their participation is voluntary.

Informed consent also serves to protect the identities and privacy of participants. Participants are aware that their names and/or identifying information such as specific roles will not be used in any discussions or written documents about the research. Before interviews were conducted, participants were informed about the purpose of the study and the whole process regarding their willingness to participate in the study, and they were given the latitude to withdraw their participation if willing to do so. Consent forms were distributed to participants and signed before they participated.

1.9.2 Privacy and confidentiality

Qualitative research takes place in the field, with real people who live and work in the setting. If the researcher promises confidentiality to the participants, s/he must be sure that s/he can deliver confidentiality. This challenge has two elements: protecting participants' privacy and holding in confidence what they share with one. It is also important to remind participants that their words will be used as direct quotes in a written report.

In this study, privacy and confidentiality were maintained throughout. Pseudonyms were used in place of participants' real names as a way of protecting their identity. They were also promised that their responses would not be disclosed to other

people; their responses would remain between themselves and myself as the researcher.

1.9.3 Trust and betrayal

Qualitative research involves building and sustaining relationships with people. It is therefore important that the researcher builds trust with the participants so as to gain reliable data. In this study I built and maintained a relationship of trust with participants from the first visit to the site until the present. Telephone conversations and e-mails were used, for example, when seeking clarity in some of the data provided.

1.10 Clarification of terms

To assist readers to understand the terminology used in this study, it is important to provide clarity of these terminologies. A list of terminology clarifications is provided in table 1.2 below.

Table 1.2: Clarification of terms

Term	Definitions
Information and Communication Technologies (ICTs)	Technology resulting from increasing convergence and integration of computing, electronics and telecommunications, allowing the exchange of messages by telephone (fixed or mobile) and e-mail, access to information and public debate on several issues through the Internet, television, radio, video conferencing and delivery of high speed wide band services (Howie, 2005:xiv).
Technology Integration	Integration by itself is defined as bringing different parts together into a whole, therefore, technology integration, also called curriculum integration, is the combination of all technology parts, such as hardware and software, together with each subject related area of curriculum to enhance learning. Furthermore, technology integration is using technology to help meet the curriculum standards and

	learner outcomes of each lesson, unit, or activity (Shelly, Cashman, Gunter and Gunter, 2008:327).
Computer	In basic or traditional terms, a computer is an electronic device, operating under the control of instructions stored in its memory, that can accept data, process the data according to specific rules, produce results, and stores the results for future use. In other words, a computer is a computational device (Shelly et al, 2008:4).
Computer lab	A computer lab or technology lab usually is a designated classroom filled with computers and technology for learner to use individually or in group (Shelly et al 2008:328).
Curriculum	An organised set of intended learning outcomes presumed to lead to the achievement of educational goals (Posner & Rudnitsky 1982:67).
School	A school is a place where children go to be educated (Gillard 2003 115). Furthermore, Cassell's Pocket Dictionary (1995:741) stresses that a school is an institution for education or instruction. The working definition in this study is that a 'school' means public or an independent school which enrols learners in one or more grades from grade R (Reception) to grade twelve.
Secondary school	Secondary is defined as relating to the education of children between the ages of approximately eleven and eighteen years old (Gillard 2003:1126). Cassell's Pocket Dictionary (1995:750) defines secondary as a 'place where education is provided for children who have received elementary education'.
Public school	Public means a state and national thing (Kirkpatrick 1998:652). A school is public when it is governed by the state. Wevell (1996:870) defines public as 'for the use of everyone'. This means that if an institution is a public school, it dictates that everyone can use it and all learners should have access to that school.
Educator	Any person who teaches, educates or trains other persons or who provides professional educational services, including

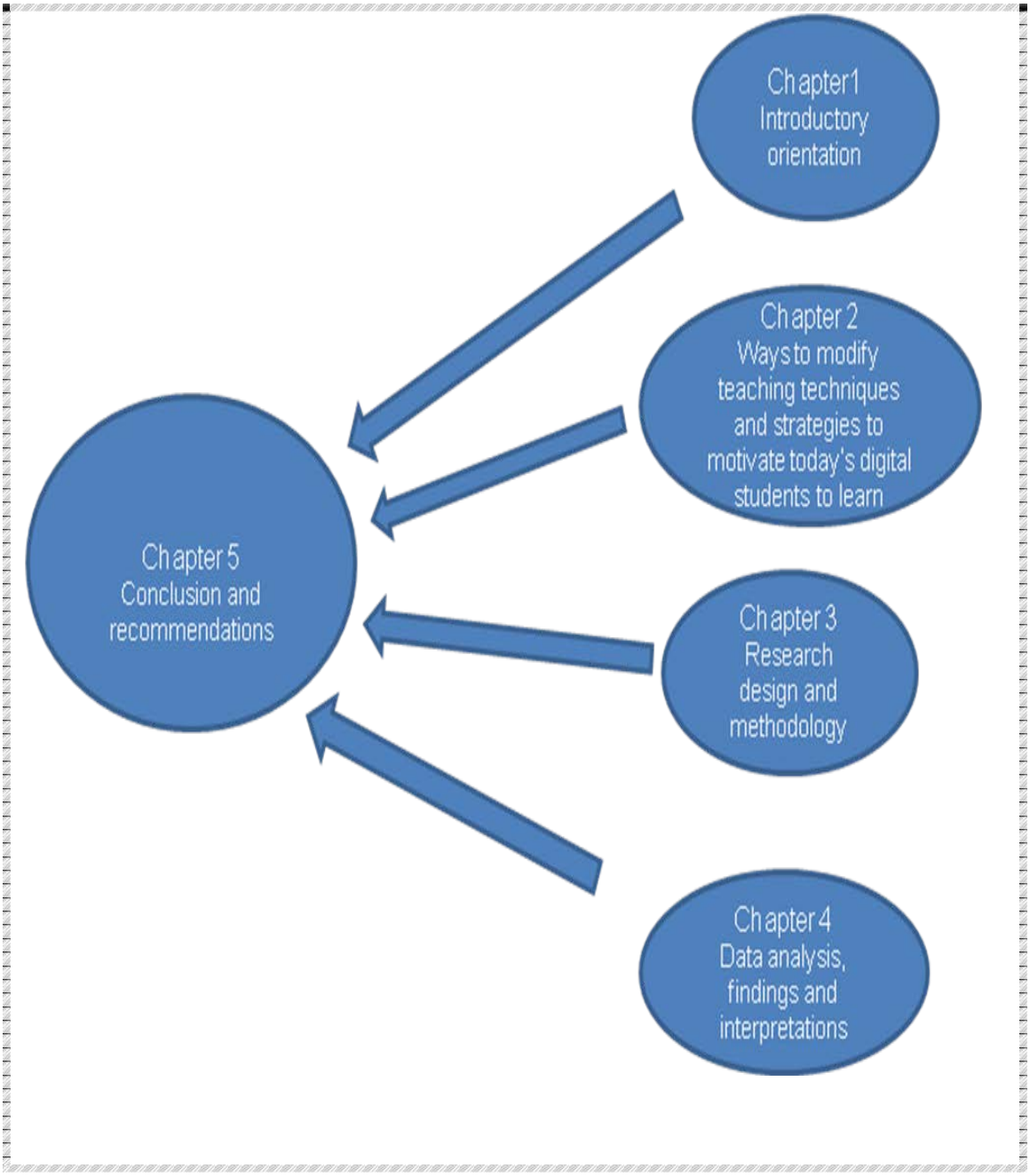
	professional therapy and psychological services, at any public school, Further Education and Training institution, departmental office or Adult Basic Education centre and who is appointed in a post on any educator establishment (Brunton & Associates 2003: C-3). Furthermore, an educator is a person who teaches people (Gillard 2003:390).
Learner	Anyone who accesses information to increase his or her skills and knowledge (e-Learning Frames 2001).
Teaching	Teaching is a systematic, planned sequence of events that facilitates the communication of an idea, concept, or skill to a learner (Lever-Duffy & McDonald 2008:25).
Learning	Heinich, Molenda, Russel and Smaldino (1996:8) describe learning as the development of new knowledge, skills or attitudes when the individual interacts with information and the environment. Kozma (1994:8) feels that learning is "an active, constructive, cognitive and social process by which the learner strategically manages available cognitive, physical and social resources to create new knowledge by interacting with information in the environment and integrating it with information already stored in memory." According to Killen (2000: xiiia) "learning is a process of acquiring new information and abilities."
e-Learning	Flexible learning using ICT resources, tools and applications focusing on accessing information and propagating interaction among educators, learners and the online environment (Department of Education 2003:13).
Barrier	A barrier is defined as any condition that makes it difficult to make progress or to achieve an objective (Schoepp 2005:2). According to Shelly, Cashman, Gunter and Gunter (2006:366) barriers have been distinguished into primary and secondary. Both primary and secondary barriers can be described as being intrinsic and extrinsic. Primary barriers include lack of access to computers and software, insufficient time to plan instruction, and inadequate technical and administrative support. Secondary barriers include beliefs about teaching, beliefs about computers, established

	classroom practices and unwillingness to change.

1.11 Programme of the study

These subsequent chapters in this volume are briefly discussed and displayed in the figure below.

Figure 1.1: Programme of the study



CHAPTER 2 focuses on the ways to modify teaching techniques and strategies to motivate today's digital learner to learn as derived from a literature study and the theories of learning.

CHAPTER 3 is a detailed exposition of the qualitative study using interviews undertaken amongst curriculum specialists in the Tshwane North Region and principals, deputy principals, educators and learners in selected senior secondary schools in the Tshwane North Region.

CHAPTER 4 presents the findings of an analysis of the data and information captured during the empirical investigation.

CHAPTER 5 is based upon the discussion, recommendations and conclusions of the study.

1.12 Conclusion

This chapter has outlined the present study focus on the effective integration of technology in teaching and learning in the Tshwane North Region of Gauteng Province. An explanation of what is involved in the study included a brief discussion of the background to the study problem, the problem identified, the main objectives of the study, the research questions and basic assumptions guiding this research. An important section of the chapter described the research design, methods of data collection and analysis and provided definitions of various key terms related to technology integration.

Chapter two will present ways to modify teaching techniques and strategies to motivate today's digital learners to learn.

CHAPTER 2

WAYS TO MODIFY TEACHING TECHNIQUES AND STRATEGIES TO MOTIVATE TODAY'S DIGITAL LEARNER TO LEARN

2.1 Introduction

The use of computer technology in South African schools is a relatively new approach that is currently being included in the school curriculum. The introduction of computer technology for use in teaching is not always accepted by most educators (Tanui, Walaba & Nassiuma 2008:282). In light of this information, effective use of technology in the classroom has received much attention in education and educator training programmes are expected to produce computer literate educators (Regina 1999:128). It was recognised at the beginning of this study that barriers to effective technology integration into teaching and learning have been researched in a number of developed and developing countries. However, there is currently a dearth of research regarding barriers to effective technology integration in South African senior secondary schools.

In reviewing the literature that investigated the barriers to effective technology integration into teaching and learning, common factors were discovered. These factors include student access to technology, lack of training in the part of educators, insufficient funds to purchase hardware and software, lack of time for planning by educators, resistance to change, educators' attitudes and the organisational structure of schools (van der Merwe & Mouton 2005; Hardman 2005).

In the same vein, Woodbridge (2004) argues that technology integration varies according to individual teaching beliefs, perceptions towards technology innovations, and how the educator practises and puts technology to work in the classroom. Additionally, Oncu, Delialioglu and Brown (2008:42) found that educators' reasoning for the selection of technologies they use should be recognised. These authors further highlight that if an educator knows how to use technology, then he or she is more likely to implement a new technology successfully.

Furthermore, these authors state that educators weigh the relative benefit of using (or not) using the technology as part of their decision making process.

Finally, Levin and Wadmany (2008:256) explain that technology integration is affected by multidimensional characteristics and the synergy between two types of epistemic influences: the source of the processes as well as the nature of the processes and knowledge involved in ICT adoption, which represent two developmental continuums. The first continuum describes the human learning dimension that ranges from external authoritative influences, through dialogical processes, towards personal need and self-learning. The second continuum represents the knowledge in ICT adoption, which ranges from technical and organisational knowledge, through knowledge concerning the process of change, to knowledge restructuring processes involved in conceptual transformation.

This chapter is therefore devoted to a review of relevant literature on the integration of technology in teaching and learning. The purpose of the literature review is to identify the main lessons from previous research relevant to this study and to use them for a more detailed exploration of specific topics in this study (South African context - Gauteng Province). The chapter starts by discussing the development of ICTs and the Information age. This chapter will further discuss the national policies and practices on ICT in education, focusing on developed countries and developing countries. Lastly, this chapter will address the challenges of the digital divide in South Africa, the role of the educator in an ICT learning environment, strategies for integrating technology and looking into a theory underpinning the study.

2.2 The development of Information and Communication Technologies and the Information Age

Over the last decade, the world has witnessed the birth of a new period in its history, which most authors correctly call the Information Age. This new period came with a tremendous force that transformed human lives and activities.

Ifinedo (2005:1) compared the impact of this force to a global tidal wave which is sweeping over the world. This powerful combination of forces is changing the way we live and redefining the way organisations conduct business. In support of this notion, Herselman and Britton (2002:270) assert that the force driving this rapid revolution in communication and transforming the world from isolated islands to interconnected super highways is ICT. These authors further explain that people today experience a world of greater interconnectivity and an accelerated flow of data.

Based on the notion of interconnectivity and accelerated data, the world economy is presently in the centre of a profound transformation, spurred by globalisation and supported by the rapid development of ICT that accelerates the transmission and use of information and communication technology. In this respect, the development in ICTs over the last thirty years resulted in an information explosion which according to Chandrasekhar and Ghosh (2001:850) has heralded an information age and a knowledge revolution.

At the very centre of the opportunities that have been created by ICTs, one finds the unparalleled development in ICTs and the commensurate drop in ICT costs over the last thirty years. To be more precise, Chandrasekhar and Ghosh (2001:851) explain that these ICT developments include:

- The amazing increase in computing ability and commensurate, drastic decrease in cost offered by the emergence and evolution in microprocessor technology.

- The development of digital devices (for example, devices that record, organise, retrieve, display and disseminate information) that are able to exploit the computing ability achieved at a fraction of its previous cost.

The Information Age may not be a totally new concept, but it is one that is evolving daily. Information and communication technology that has underpinned the birth of the information age is changing every aspect of our lives. It impacts on the way in which people communicate and interact culturally with each other, obtain information, learn and conduct business. The Internet makes it possible for consumers to enquire about prices for products offered on the World Wide Web in almost a split second. Markets all over the world have become accessible through the Internet. It is now possible for businesses to deliver some of their products down a phone line all over the globe with the mere press of a button, 24 hours a day and 365 days a year.

To add the cherry on the top, Letseka (2001:67) points out that the processing output dissemination and storage of data also look totally different in the Information Age. He further explains:

> There has been a radical (paradigm) shift in the manner in which offices, companies, institutions of learning (especially tertiary institutions), families and individuals manage their data. It is a shift that is characterised by a move away from relying on paper, files and filing cabinets for storing and disseminating information to the use of electronic media – the Internet and electronic mail (e-mail), CD-ROMs, computer hard-drives and diskettes.

In respect to these ideas, a recent study by Acikalin and Duru (2005:1) showed that the use of computers in education opens a new area of knowledge and offers a tool that has the potential to change traditional and ineffective educational methods. The use of computers in education are currently considered as crucial to “modernized educational systems on the basis of information and communication technologies” as globalization and transformation to the information society “call for new literacy for the information society” (Orhun 2003:1).

2.3 Technology integration

Historically the concept of ICT integration as an approach evolved as a reaction to early computer-in-schools programmes where the emphasis lay on developing computer literacy or technical knowledge of computers and the use of various computer applications (Wilson-Strydom et al 2005:73). More recently, ICT integration has been recognised as "using computers to learn, rather than learning to use computers" (UNESCO/COL 2004:45).

According to Woodbridge (2004:1), technology integration means viewing technology as an instructional tool for delivering subject matter in the curriculum already in place. Redmann and Kotrlik (2004:2) define technology integration as "employing the Internet, computers, CD-ROMs, interactive media, satellites, teleconferencing, and other technological means in instruction to support, enhance, inspire and create learning."

On the same note, Shelly et al (2008:339) describe integration as bringing different parts together to combine into a whole. These authors further look at the integration of technology in two aspects: firstly, as the combination of all technology parts, such as hardware and software, together with each subject-related area of the curriculum to enhance learning; secondly, as using technology to help meet the curriculum standards and learner outcomes of each lesson, unit, or activity.

Findings of a recent study (Redman & Kotrlik 2004:2) about analysis of technology integration in the teaching and learning processes indicated that technology was integrated by educators in several ways: using technology for classroom instruction, using computer applications, using practice drills, requiring research using the Internet, requiring learner to use technology to solve problems and analyse data, requiring learner to conduct research using CD-ROMs, assigning learner to produce multimedia reports and projects, assigning graphical presentations of materials, assigning demonstrations and simulations, and assigning learner to correspond with others over the Internet.

These authors further highlight numerous factors that may affect the integration of technology in the teaching and learning process. These factors include: support for educators' technology integration in the form of technology training; the availability of

technology; barriers to the integration of technology; technology anxiety; and educators' perceived teaching effectiveness.

According to Redmann and Kotrlik (2004:2), support for educators' use of technology has evolved over the last decade from minimal or non-existent support in many schools, to a wider acceptance by administrators and communities and the belief that technology is now a necessity. They further state that this support comes in many different forms including public support, availability of technology for both educator and student use, educator training, release time for planning and learning, technical support, administrative support and availability of appropriate instructional materials. Subsequently, the authors mention that the integration of technology may also be affected by the barriers encountered by both educators and learners. These barriers include funding, lack of time, access to technology, resistance to change, educators' attitude and the organisational structure of schools.

Similarly, Crandall and Loucks (1982:8) contend that if educators are to implement an innovation successfully, they need the support of the school principal and if the principal is to support educators as they attempt to implement the innovation, then he or she must possess appropriate knowledge and skills. Crandall and Loucks (1982:8) criticise the continuing use of the 'Hello, good-bye, God bless you' type of professional development workshops that schools and school districts provide educators. The authors cite research that supported that claim that, when educators are provided with one short workshop and left to implement an innovation, subsequent evaluations show that no real change takes place in the classrooms and that the primary outcome of the innovation's implementation is frustration and cynicism in both educators and principal. These authors further posit that research and experience indicate the need for more sustained training for educators that exceeds one short workshop.

In addition to Grandall and Louck's views, Dawson and Rakes (2003:31) point that the school's principal is expected to act as the instructional leader and see that educators are provided with the necessary preparation and interventions. In this respect, Grandall and Loucks (1982:6) reported that principals in facilitator roles range widely in the skills and understanding required for success. The authors further stressed that preparation of facilitators should begin with a careful assessment of where each individual is and how far each one should change roles and behaviours. As a consequence, the need for personalised and individualised training is stressed. In their study, Crandall and Loucks (1982:8) found that educators who returned to the classroom and routinely practised the skills they had learned during training experienced more change and became more comfortable with the innovation than those who practised the skills less often.

According to Dawson and Rakes (2003:33), the leadership in a school largely determines the outcome of technology integration; however, administrators cannot fully or effectively support technology if they do not understand it. In the same note, Mecklenburger (1989:7) spelled out the critical need for school leaders to become knowledgeable about technology stating:

> "Administrators must understand both the capabilities and limitations of technology. Only then can they plan for, budget for, purchase carefully, install properly, maintain dutifully, schedule adequately, distribute appropriately, and replace systematically the electronic technology best suited for their needs."

2.4 Strategies for integrating technology into teaching and learning

As we enter the 21st century, researchers agree that all educators will be faced with the challenge of knowing how to use computes (Regina 1999:129). Different definitions of computer literacy prevail. Computer literacy is defined by Shelly, et al (2006:4) as knowledge and understanding of computers and their uses.

Regina (1999:129) concurs and states that computer literacy involves not only the knowledge, understanding and values of technology that are required for educators to feel confident with classroom integration, but also having a positive attitude in the educators' abilities to apply the theory-related concepts in real classroom instruction.

The International Society for Technology in Education (ISTE) (2000) provides guidelines for applying technology in educational settings as follows:

- The pacing of instruction must be modified in order to include technology experiences in a methodology course. It simply takes more preparation time and often more time to implement. The instructor needs to be ready for the unexpected: hardware that fails, software that will not open, servers that crash, computer labs that are double-booked, and so forth. The instructor needs to be comfortable with modelling flexibility, troubleshooting, and problem-solving approaches when technology difficulties arise.

- The instructor must be very sensitive to the concept of accommodation for individual differences and must continually monitor instructional pace, explanation, and feedback when implementing and requiring technology use. Inequitable access needs to be considered when technology use is embedded in an assignment.

- The instructor must be prepared for added emphasis on the concept of learner and educator learning together. Learner frequently suggests technology options, modifications, or shortcuts, and there is typically at least one learner in the class who is more skilled and confident with technology than the instructor.

Based on these guidelines, Woodbridge (2004:1) views technology as an instructional tool for delivering subject matter in the curriculum already in place. In this respect, educators need to understand technology integration more completely.

In addition, Ali (2005:132) states that the role of a technology educator is to open the door of knowledge and invite the learner inside. Therefore, educators must create an environment conducive for effective learning and extend effective transmission of knowledge. He further states that a teaching pedagogy the educator adopts must look at how to teach, what to teach and what aids to use in the process. Many educators have already integrated technology into subject-specific instruction, and have seen the benefits technology integration can bring to the learning experience.

Integrating technology effectively into the curriculum requires planning, time, dedication, and resources (Shelly et al 2006:413). Several researchers (Shelly et al 2008; Heinich et al 1996; Alessi & Trollip 1991; Ken & Anderson 1990) highlight several programmes such as Spreadsheet, Word Processors, PowerPoint and Databases that could enhance the integration of technology into teaching and learning activities. These packages are described hereunder.

- *Spreadsheet software*

Spreadsheet software allows one to organise numeric data in rows and columns. These rows and columns collectively are called a spreadsheet, or worksheet (Shelly et al 2008:147). Similarly, Heinich et al (1996:237) define a spreadsheet as a page of rows and columns that displays word, numeric, and formula entries. According to them, a spreadsheet can be used to record, average and manipulate data. They point out that spreadsheet programmes are easy to use tools that should be exploited by educators and learners to create graphics from numerical data.

At the same time, Alessi and Trollip (2001:249) add that a spreadsheet can also help educators to budget and to carry out evaluation of learners' examination results. In this connection, Ken and Anderson (1990:83) report that "an educator may use a spreadsheet that enables her to enter marks for test throughout the year and automatically calculate class average for each test as well as maintaining an ongoing average for each student."

In simple terms Ken and Anderson (1990:83) also means that learners may use a spreadsheet to compare the return on funds invested at various rates of interest, and work out income when different taxes are applied to the interest earned.

- *Word processor*

A word processor is a writing tool just like a pen or a pencil. It is one of the more widely used application software used to create, edit, and format documents that consist primarily of text (Shelly et al 2008:144). In addition, a word processor allows learner to easily revise and edit their composition, thereby avoiding too much recopying of the work. The exercise enables learner to demonstrate pride in producing legible, neat and attractive pieces of work as they practice word processing skills. At the same time, word processing helps to eliminate the physical barriers that learner experience as they struggle to make letters. When the learners are working, educators are also able to view learners' work on the monitors without interfering with the exercise. Therefore, Heinich et al (1996:226) stress the need for every learner to be familiar with word processing skills because it helps to improve their writing skills, reading and composing stories.

- *PowerPoint*

Microsoft PowerPoint is a presentation graphics programme that allows educators and learners to create multimedia presentations that can incorporate text, graphics, animation, audio, video, links, and most importantly interactivity (Shelly et al 2008:296). Using presentation graphic software, educators and learners can create documents called presentations, which they will then use to communicate ideas, messages, and other information to a group, such as a class or auditorium of people. The presentation can be viewed as slides that are displayed on a large monitor or projected onto a screen.

- *Database*

A database is a computer program intended to keep information in an ordered form like a filing system. It is simply a collection of related information organised for quick access to specific items of information. Shelly et al (2008:145) describe a database as a collection of data organized in a manner that allows access, retrieval, and use of that data. Shelly et al (2008:145) add that database software allow users to create a computerized database; add, change, and delete data; sort and retrieve data from the database; and create forms and reports using the data in the database.

Schools use databases to organise data and information about learners, staff members, school policies, equipment inventories, book inventories, purchases, and more. Heinich et al (1996:408) feel learners in schools need to learn how to manage information, to retrieve information, to sort resources, to organise information and to evaluate their findings. Heinich et al (1996:408) add that a database is a versatile and easy to learn computer tool. He believes that learners can access databases for inquiry and research studies and at the same time, they can create their own databases. For example, he says that learners can design information sheets and questionnaires to collect data, put in relevant facts, and then retrieve the data in different ways. Heinich et al (1996:232) believe that once the learners complete constructing databases as part of their learning exercise, they are able to engage in higher-level thinking skills as they analyse and interpret the data.

These discussions indicate that computers are important and multifaceted tools for classroom instruction. Shelly et al (2008:21) argue that when used appropriately, technology has the potential to enhance learners' achievement and assist them in meeting learning objectives. Additionally, Roblyer (2006:15-17) explains four uses of technology in education:

- Using technology in the classroom can motivate learners by gaining their attention, supporting manual operations during high-level learning, illustrating real-world relevance through highly visual presentations, engaging them through production work and connecting them with audiences for their writing.

- Technology can enhance instructional methods by supplying interaction and immediate feedback to support skill practice, helping learners visualise underlying concepts in unfamiliar or abstract topics, illustrating connections between skills and real-life applications, letting learners study systems in unique ways, giving access to unique information sources and populations, supplying self-paced learning for capable learners, allowing access to learning opportunities and providing opportunities and support for cooperative learning.

- Technology makes educators and learners work more productively by saving time on production tasks, grading and tracking learners work, providing faster access to information sources; and saving money on consumable materials.

- Technology can help learners learn and sharpen Information Age skills in technological literacy, information literacy and visual literacy.

As demonstrated by these examples, technology, when placed in the hands of educators and learners, can provide unique, effective, and powerful opportunities for many different types of instruction and learning.

2.5 National policies and practices on Information and Communication Technologies in developed and developing countries

The teaching of technology was introduced to schools for various reasons provided by parents, employers and society.

These reasons are highlighted by the ISTE (1998a) as follows: parents demand it, in order for their children to be prepared for the world of work or for tertiary education; employers demand it, because they prefer employees who are technologically literate; and society demands it, because technologically literate citizens can make an effective contribution towards society.

Based on the given reasons, teaching at school level and the training of educators are aspects of critical importance when looking at the introduction of technology in schools. In the same vein, Dooling (1999:65) supports this view and also recommends that educators consider involving other learners, parents or members of the community when teaching technology; educators strive towards the more effective integration of computer technology into the whole school curriculum; and that the continued training of educators receives urgent attention.

From these recommendations, it has been discovered that ICT as a global phenomenon is rapidly growing and this growth is observed mostly in education. Countries in both the developed and developing worlds have expressed visions of participating in and shaping the global information society. Invariably these visions emphasise education as a primary way for ICTs to produce competent learners, suitably qualified and skilled to contribute to economic growth.

Various governments have produced policy statements that address the use of ICTs in schools. According to Odera (2005:31), most of these policy statements are written documents and others are not documented for circulation to schools but are contained in existing educational policies. However, the integration of technology into teaching and learning is a critical issue that requires well planned policies that will assist schools to implement technology education into the curriculum. Policies that emanate from developed countries are generally more established and related to strategic actions with sufficient funding.

Countries in the developing world have forged partnerships that enable the implementation of such policy but they often face the challenge of having to finance multiple components of their policies in environments where partnerships with industry and the private sector are embryonic (Howell & Lundall 2000:1).

2.5.1 ICT policies in the developed countries - United States of America (USA)

In rich industrialised nations, like the United States of America (USA), computers and the Internet are abundant in schools and classrooms (Vrasidas & McIsaac 2001:127). According to the 'Educators' tools for the 21st century survey', in 1999 almost all public school educators (99%) reported having computers available somewhere in their schools and 84% reported having computers available in their classrooms (US Department of Education 2000a). Furthermore, there is a rapid increase in the proportion of schools that are connected to the Internet.

Pearson (2001:279-290) reports on various government policies on the use of computers and noted that the American government formulated a computer policy in 1996 entitled: "Getting America's learner ready for the 21st century." The policy document included the provision of technology and during the last decade, the number of microcomputers in schools was in the ratio of 1 computer to each 10 learner.

Other reports indicated: "Every classroom will be connected to the Internet by the year 2000 and all learners will be technologically literate" (The Seven Priorities of the USA Department of Education July 1997).

The USA is continuing to use ICTs in schools as a strategy to improve quality of education. Furthermore, the USA has the greatest level of connectivity of all countries in the world and the highest levels of Internet use. According to the International Data Corporation, the USA is ranked number one as the nation most prepared for the Information Age.

The government's plan to convert this technological infrastructure to social and economic development resides in its Educational Policy released by the Secretary of Education in 1997. Similar to the British strategy, the USA policy framework outlines areas of focus over a five-year period until 2001 (USA Working Document, 1997):

- Connecting to schools especially in poorer areas.
- Improving student access to ICTs.
- Effective software development.
- Co-ordinating the schools effort through management of the process.
- Professional development of educators.

The USA has also used legislation to establish a culture and practice of ICTs in Education. Among these are 'Goals 2000: Educate America Act' which provides financial support for use of ICTs to promote school reform, and the 'Improving America's Schools Act' which emphasises professional educator development. To date, it is the most explicit and comprehensive American legislation aimed at promoting educational technology (USA Congress, Office of Technology Assessment 1995:6).

Based on the above description, USA is selected amongst other developing countries due to its major role in the integrating of technology in its curriculum. These features are significant and will therefore inform the study of technology integration in the South African education context.

2.5.2 National policies on Information and Communication Technologies in developing countries

In Africa, a decade ago, the use of Internet in schools was a novelty, but today it is a reality in general. However, it is not widely spread and where it exists it has not been implemented effectively. The reasons for this range from the high cost of start-up equipment, maintenance costs and shortage of those with specialist knowledge to make appropriate decisions on what should be prioritized or what is most relevant (Isaacs, Broekman & Mogale 2000:23).

For the purpose of this study, ICT education in Mozambique and Uganda will be reviewed and compared with the situation in South African education.

2.5.2.1 National Information and Communication Technology Policy in Uganda

Various researchers (Kamya 2007; Eremu 2005) explain that Uganda is the first of the twenty-seven World Links countries in Africa, Latin America, the Middle East and Asia to pilot the use of the Very Small Aperture Terminal (VSAT) technology for school connectivity. This represents an incredible success toward achieving relevancy of ICT in education. This success in turn led Uganda to become the first country in Africa to use Microsoft Partners in learning to develop localized digital content that maps directly to the national curriculum.

According to Farrell (2007:4), Uganda developed its initial ICT policy in 2003. This policy framework document recognised that Uganda would need to embrace the goal of lifelong education for all with strategies that include:

- Integrating ICT into mainstream educational curricula as well as other literacy programmes to provide for equitable access for all learners regardless of level.

- Developing and managing ICT centres of excellence to provide basic and advanced ICT training.

- Setting up mechanisms that promote collaboration between industry and training institutions to build appropriate human resources capacity.

- Promoting the twinning of training institutions in Uganda with those elsewhere to enhance skills transfer.

Moreover, Kamya (2007:15) points out that the Ministry of Education on recognition of the value of integrating computer-based learning into its classrooms has ensured that its schools and children would be a part of the global dynamism of ICT in the classroom. The Ministry of Education in partnership with the Partners in Learning therefore, launched a pilot programme with eight different Uganda schools.

This was not the only initiative for ICT education in Uganda. Several other initiatives made ICT available to schools. Eremu (2005:20) described two initiatives, namely; Uganda-connectivity (Uconnect) and SchoolNet Uganda.

The Uconnect incorporated in Uganda as a nongovernmental organisation (NGO) in 1996, provides computers, training and Internet services to schools in urban settings. SchoolNet Uganda was incorporated as an NGO in December 2003 and supports Uganda educators and learners by providing pedagogical and technical expertise and advice, infrastructure and human resource, coordination, training and capacity building and developing local and international partnerships in the areas of Internet connectivity, content and curriculum development.

Like other African countries (such as Kenya and South Africa), Uganda faces challenges, such as a poorly developed ICT infrastructure, high bandwidth costs, an unreliable supply of electricity, and a general lack of resources (such as computers, Internet access and relevant digital content or educators who could facilitate ICT in education) to meet a broad spectrum of needs (Farrell 2007:2; Kamya 2007:15). According to Mutonyi and Norton (2007:264), access to ICT remains a major challenge in Uganda in which less than 1% of the population has access to the Internet.

One of the drawbacks in Uganda is the disparity in the academic performance between rural and urban schools. One of the requirements for a school to be connected is a telephone line in the computer lab. This is a nightmare in Ugandan rural schools. Eremu (2005:20) notes that a very poor and dilapidated network denied many rural schools the chance to get Internet services. Due to these challenges, a growing digital divide has arisen between urban and rural schools in Uganda.

Although there are several challenges in Uganda, a national ICT policy is in place and an education sector ICT policy is before the cabinet (Farrell 2007:2). According to Uganda's Working Document for the Second Preparatory meeting for the World Summit on the Information Society (WSIS), the Uganda government has formulated an ICT policy framework so as to meet the challenges and harness underlying potential and opportunities (WSIS 2003).

The Ministry of Education and Sports in Uganda have sought diverse means of incorporating the new technologies into the education system (Mutonyi & Norton 2007:265). These in turn have led to an increase in ICT provision in education. For example, Nawanguna (2005:4) shows that Makerere and Kyambogo Universities have become centres for training educators to use the Internet as a resource in the classrooms. Finally, over 160 rural schools, both primary and secondary, have benefited.

It is from the above mentioned technology practices that Uganda is selected and part of its literature is reviewed for the contribution of this study.

2.5.2.2 National Policies and practices on Information and Communication Technology in education for Kenya

Various researchers (Farrell 2007; Odera 2002; Inyega & Mbugua 2008), report on Kenyan Information and Communication Technology (ICT) policies and implementation. According to Farrell (2007:4), the Ministry of Education introduced the National ICT Strategy for Education and Training in June 2006. This document, referred to as the ICT policy for the education sector, consists of objectives and expected outcomes, such as: ICT in education policy; digital equipment; connectivity and network infrastructure; access and equity; technical support and maintenance; harnessing emerging technologies; digital content; integration of ICT in education; training (capacity-building and professional development); and research and development.

Additionally, Odera (2002:320) points out that the government of Kenya has formulated a policy for the use of computers in secondary schools, but a written policy document and guidelines have not been circulated to schools for the implementation of computer education. Therefore, the policy is not clear neither realistic. There is also no government policy for educator training in the use of computers in teaching and learning; however, the main thrust of the government policy is that secondary schools should use computers to teach computer literacy.

The education system of Kenya is divided into three components described by Farrell (2007:6) as follows. The first component, Kenya ICT Trust Fund, facilitates mobilisation of resources to provide ICT to schools and communities. The second component, the Kenya Institute of Education has a mandate to: prepare syllabi, publish, and print materials; develop digital curriculum content; provide educator in-service training; develop and transmit programmes via mass media to support educational development; prepare distance learning materials; and conduct research on educational matters. The third component is the Non-Government Organisations Network Initiatives for Computers in Education (NICE) which is involved in the introduction and use of ICTs in schools.

Although computers have been integrated and used in public secondary schools in Kenya, the Ministry's policy framework faced various challenges. For example, Farrell (2007:6) maintains that most secondary schools have some computer equipment that may consist of one computer in the office of the school head; very few secondary schools have sufficient ICT tools for educators and learners; and most of the schools with ICT infrastructure have acquired it through initiatives supported by parents, the government, NGO's, or other development agencies and the private sectors, including the NEPAD e-Schools programme.

In addition to these challenges, Odera (2002:151) identified barriers to the effective implementation of computer policy, which range from lack of computer training to disparities amongst the areas. To be specific, these barriers are described as follows: lack of suitable training and technical and administrative support with computer literacy skills among employed educators. In terms of finance, computers are expensive to purchase and maintain, therefore, it is a heavy budget commitment for the government to supply all institutions with training for secondary school educators in computers and to re-train others. Highly important was the lack of a reliable source of electricity in most of the schools in rural areas. There were also disparities in resource allocations, for example, advantaged schools managed to use computers in their instructions, whereas disadvantaged schools conducted theory classes which had a negative effect. This increased educational inequalities in secondary education and created imbalances such as the limitation of access to computing to very few learners.

Despite the challenges experienced by Kenya, this study preferably selected Kenya for its framework of study. This is based on the efforts and contributions that Kenya made in formulating and implementing a policy for the use of computers in secondary schools.

2.5.2.3 National policies and practices on Information and Communication Technology in education for South Africa

Since 1994 the South African education landscape has undergone major transformation. At the core of this transformation is the National Qualification Framework (NQF) and the new curriculum framework for schools based on the concept of outcomes-based education (OBE). According to Isaacs (2007:2), OBE is a learner-centred approach which considers learning as an interactive process between educators and learners, where the educator serves as both educator and facilitator. This system is preferred for its learner-centred quality; it also promotes technology-enhanced learning environments, valued for their capacity to afford the individual learner a wider choice of manipulation of data in the quest to construct his/her own meaning.

South Africa has 12.3 million learners, some 366 600 educators and 26 292 schools, including 1 098 registered independent or private schools. Of all schools, roughly 6 000 are high schools (grade 8 to grade 12) and the rest primary (grade 0 to grade 7). In government-funded public schools, the average ratio of scholars to educators is 32.6 to 1 (one), while independent or private schools generally have 1 (one) educator for every 17.5 scholars (http://www.southafrica.info/about/education/education.htm). In addition to this, the national Department of Education is responsible for education across the country as a whole, while each of the nine provinces has its own education department.

The central government provides a national framework for school policy, but administrative responsibility lies with the provinces. As stipulated in the South African Schools Act (SASA), Act 108 of 1996, the NQF recognises three broad bands of education: General Education and Training (GET) which includes Adult Basic Education and Training (ABET), Further Education and Training (FET) and Higher Education and Training (HE). General Education and Training runs from grade 0 to grade 9 whereas, Further Education and Training runs from grade 10 to 12 (See Table 2.1 for the educational levels in South Africa). Therefore, the school life span in South Africa is thirteen years. This Act further stipulates compulsory education for all in South Africa from the age of seven to age fifteen, or the completion of grade 9.

Table 2.1: Levels of education in South Africa

Band	School grades	NQF Level	Qualifications
HIGHER		8	Doctor's degree
		7	Master's degree
			Honours degree
			Postgraduate diploma
		6	General first degree
			Professional first degree postgraduate
			Bachelor's degree
		5	First diploma
			Higher certificate
			Certificate
FURTHER	12	4	Diplomas
	11	3	Certificates
	10	2	
GENERAL	9	1	Grade 9/Adult Basic Education and Training level 4
	8		
	7		
	6		
	5		
	4		
	3		
	2		
	1		
	R		

Adapted from DoE (2003)

According to Mentz and Mentz (2003:4), in 1997 South Africa was the fourteenth most wired country in the world, yet less than 1% of its schools have Internet access. In the same vein, the Department of Education of South Africa (1998) reported that 82% of all schools in the country do not have any educational media at all. Therefore, a large number of learners in the country do not receive any training in basic computer technology. The worse part is that more than 85% of educators in the country are regarded as unqualified or under qualified (ETDP, 2000). Without any shadow of doubt, qualified educators are the catalysts in the introduction of technology in any school. From this viewpoint, 80% of learners in South Africa leave school without once being exposed to a computer (Haupt & Mintoor 1997:2).

In 1998 the new curriculum was introduced in schools in South Africa, Curriculum 2005. The latter implied a move towards the instructional method known as outcomes-based education. Eight learning areas were introduced into schools, including Technology. As early as 1992, Einsenberg (1992) developed a curriculum framework for a Technology education project in South Africa. He referred to Information Technology (including the computer) as part of technology. This

framework was used to an extent in developing the outcomes for technology for Curriculum 2005. The emphasis, however, is largely on systems and control, communication, and structures and processes not directly linked to computer technology (Department of Education, 1998).

Based on the given views, education transformation in South Africa led to the development of an Information and Communication Technology policy. It is evident that South Africa has a well-designed policy framework for schools and the Further Education and Training (FET) college sectors (Isaacs 2007:224). However, the majority of educators in South African schools have not been prepared during their college years for integrating technology in their teaching. Therefore, buying computers and software for schools and connecting them to the Internet does not automatically imply effective uses of technology.

Similarly in 2002, the Ministers of Education and Communication announced in a joint statement that the question is not whether computer technology should be fully introduced in teaching and learning, but how it should be introduced (DoE 2002).

As a short-term strategy all schools would be provided with at least one computer for administration and support services. Satellite technology and solar power would be used where schools do not have electricity.

Emanating from this announcement, educator education programs have addressed the challenge of producing computer literate educators in various ways and at different rates across the nation. The government, the private sector, parastatals, and non-government organisations have responded positively to the challenge of bridging the digital divide over the last five years (See pages 46 and 47 for examples and descriptions). Efforts include the following (DoE 2003:4):

- *ICT Professional Development*

SCOPE, SchoolNet SA and the South African Institute for Distance Education have developed 11 Educator Development modules for introducing ICTs into schools. SchoolNet SA provides online, mentor-based in-service training for educators on introducing ICTs into the curriculum and management; and INTEL “Teach to the Future” Educator Development Programme provides educator training in ICT integration into teaching and learning (DoE 2003:4).

- *Electronic Content Resources*

Mindset develops content resources and makes it available via satellite television, Internet multimedia and print supplements, and an Educational Portal initiated by the Department of Education provides digital content resources (DoE 2003:4).

- ***I**nfrastructure and connectivity*

The Telecommunications Act 103 of 1996, amended in 2001, called for the development of an Educational Network and the implementation of an e-rate (a discounted connectivity rate) for GET and FET institutions. Microsoft has donated software and provides educator development and support. The Digital Partnership Programme provided 188 000 refurbished computers and 20 000 laptops. SENTEC is obliged to provide 500 schools with computer labs and educator development, through licensing obligations. The 1800 MHz/3g Frequency Spectrum available to mobile operators obliges them to provide universal services to schools.

Telkom Foundation has established Supercentres in more than 1 300 schools, providing computers, software applications, Internet connection, monthly subscription and a rent-free telephone line. Telkom Foundation, together with Telkom's strategic partner Thintana, has committed over R200m to support education and training in the areas of ICT, Mathematics and Science (DoE 2003:4).

- *Parastatal organisations*

Telkom is involved in a number of initiatives to provide appropriate networks for computer-based and interactive education projects. It has also launched the InfoSpace project based on SpaceStream, Telkom's VerySmall Aperture Terminal (VSAT) satellite networking capabilities, and 66 Degrees East, which offers training and support services to communication technologies and distance learning. The Thousand Schools Project is another Telkom – sponsored initiative to introduce and support ICT in one thousand schools around the country.

The National Research Foundation (NRF) is responsible for operating the UNINET, a computer-based information highway, linking Universities, Technikons (currently called University of Technologies) and some school. The NRF also facilitated the EDUNET initiative, an interest group promoting interactive distance education.

The Development Bank of Southern Africa (DBSA) is investigating innovative ways of producing remote centres for distance learning, containing video facilities.

The Council for Scientific and Industrial Research (CSIR) initiated and co-ordinated the telematics for Africa Development Consortium of organizations in technology and education, which offers technological support to users, and is involved in the development of new technologies.

The South African Broadcasting Corporations (SABC) has a number of initiatives using existing national television channels with varying degrees of interactivity, as well as programmes using satellite transmission.

- *Industry and non-governmental organizations (NGOs)*

Numerous initiatives in private sector companies and internal institutions offer educational training and information programmes via the Internet. These fall across all disciplines and levels of education, and tend to involve large amounts of money as funding. Industry is also collaborating with parastatal organisations in sponsoring some new initiatives such as the Telkom Centers of Excellence and the Soweto Technology Project.

- *Higher education institutions*

A number of higher education institutions have projects or programmes in various stages of development. These include: the University of Pretoria, UNISA, the then Technikon South Africa and Potchefstroom University.

The University of Pretoria has an interactive tele-teaching project and expertise on hardware and software infrastructure.

The University of South Africa (UNISA) has wide-ranging experience in distance teaching and has established the Centre for Education Design and Technology which will make contributions to the design, development and evaluation of courseware.

Technikon South Africa has established a Centre for Media Technology and Centre for Courseware Design and Development. These form the central component of their interactive distance education.

Potchefstroom University offered programmes such as MBAs through the Telematic Learning Initiative.

In addition, consortiums have been formed to collaborate on initiatives. These include the then COLISA (UNISA, Technikon South Africa, and Vista) and the Foundation of Tertiary Institutions in the Northern Metropolis (FOTIM), which involves all universities and technical universities in the greater Gauteng area.

- *Technologies*

The scope of technologies used in education in South Africa is vast and ranges from first generation technologies to sophisticated fourth-generation technologies. These include: Open way radio; Audio tape; Audio visual aids; television broadcast; video-cassettes and video–recorders; interactive radio; computer networks linked by modem to terrestrial and satellite tele-communications; CD-ROM; computer based education; expert systems; geographic information systems; packet radio (radio with modem, antenna and computer); compact disc-interactive; tele CD-interactive; CD-recording and CD erasable; wireless communications; new generation PABX; IT/Lightsat satellites; and mobile telephony.

In a developing country like South Africa, advances in ICTs have created a magnitude of opportunities for the country but also pose many challenges. One of the most important challenges is addressing the frightening gap between the information “haves” and the information “have-nots”, commonly known as the “digital divide” (Fürstenburg 2005:22).

2.6 Addressing the challenge of the digital divide in South Africa

Digital divide can be described as: “Some people have the most powerful computers, the best telephone services and fastest Internet service, as well as wealth of content and training relevant to their lives. [An] other group of people do not have access to the newest and best computers, the most reliable telephone service or the fastest or most convenient Internet services” (U.S. Department of Commerce 2000, cited in Noll, Older-Aguilar, Ross and Rosston (n.d.).

The digital divide can also be described as the differing imbalances that exist between countries that are in the fortunate position to reap the advantages of the information age and those countries that are not in the same position. The

digital divide does not only exist between developed and developing countries in the world, but also between those countries who have access to technology and those who do not have access to technology within the borders of a country, and among other things, in gender, physically disability, race and age (http://www.southafrica.info/about/education/education.htm).

In respect to the above description, South Africa as a country is also affected by the digital divide in relation to ICT resources. This has also been observed by the Department of Education (2003:1). Africa is regarded as a developing continent and according to the Department of Education (2003:2) a lack of infrastructure for Information and Communication Technologies is widening the gap between Africa and the developed world. Fürstenburg (2005:18) describes this knowledge gap as the gap that exists between the resource-advantaged (RA) learners and the resource-deprived (RD) learners.

This is in line with Costello's (in Herselman and Britton 2002:270) view that the current Information Age, which he calls the current "Golden Age Technology", is being constructed on a "foundation of knowledge". He further explains:

> As such, the fuel for the engine of expansion will be an increasingly better-educated populous. And the fruits of this Golden Age will go to those who have the knowledge in our society, the haves and the have-nots, more than ever before will be the educated and the uneducated.

From the above discussion, it is evident that in South Africa a number of disparities have found expression in ICT integration into education. Although the number of schools with computers for teaching and learning increased from 12.3% in 1999 to 26.5% in 2002, there are still more than 19 000 schools without computers for teaching and learning.

2.7 Schools with computers in South Africa

Based on data from the Education Management Information System (Department of Education 2003:5) and information received from provinces, Table 2.2 reflects the distributions of ICTs in schools across the provinces.

Table 2.2: Schools with computers, by provinces

Provinces	Schools with computers	Schools with computers for teaching and learning
Eastern Cape	8.8%	4.5%
Free State	25.6%	12.6%
Gauteng	88.5%	45.4%
KwaZulu-Natal	16.6%	10.4%
Mpumalanga	22.9%	12.4%
Northern Cape	76.3%	43.3%
Limpopo	13.3%	4.9%
North West	30.5%	22.9%
Western Cape	82.4%	55.8%
National	**39.2%**	**26.5%**

Adapted from DoE (2002)

From the above table, schools with computers mean schools that have computers and use them for other purposes such as administration. On the other hand, schools with computers for teaching and learning refer to schools that use technology (computers) for their daily activities, which is using technology for teaching and learning by both educators and learner.

The Draft White Paper (Department of Education, 2003) has also highlighted certain important aspects of the ICTs in South Africa.

These are:

- The growth rate of schools that acquired computers between 2000 and 2002 averaged 59% and were higher among secondary schools than primary schools. If the same growth rate was maintained from 2003, only 9 278 schools was estimated to have computers by the end of 2004.

- Despite some extreme variations, schools in Gauteng, Northern Cape and Western Cape have, on average, better ICT infrastructures than schools in Eastern Cape and Limpopo. Schools in the Free States, KwaZulu-Natal, Mpumalanga and the North West hold the middle position.

- E-mail facilities are beginning to be used more extensively in many schools as a management and administrative resource, and also in some cases, as a teaching and learning resource.

- Internet access is becoming more common, but the use of Internet for teaching and learning purposes is very limited, due to high connectivity and tele-communication costs, lack of local content and examples, and inadequate technical and pedagogical support at local level.

- In both primary and secondary schools, the teaching of basic computer principles and word processing skills forms the most important component in the teaching of computer literacy. Limited integration into teaching and learning is also evident.

- There is a gap in the ability of learners and educators to use these technologies effectively, to access high-quality and diverse content, to create content of their own, and to communicate, collaborate and integrate ICTs into teaching and learning.

- In order to address the digital divide, the South African education and training system has to respond to the pressure and challenges posed by the Information Revolution. It is for this reason that the government has expressed strong commitment to the use of ICTs in education.

2.8 An overview of education in the Gauteng Province with special reference to e-Education

The Gauteng Provincial Government is one of the nine provincial governments in South Africa. Gauteng means a place of gold. The Province has a string of industrial towns to the east and west of Johannesburg. The backbone of the Province is called the Witwatersrand. Gauteng is the richest in engineering, metal and manufacturing industries developed from mines. According to The Pretoria News Supplement (1997:4), Gauteng stretches just over 110 kilometres from Springs in the east to beyond Randfontein in the west, and from the engineering heartland of the Vaal, through Johannesburg, to Pretoria in the north. Gauteng Province is home to more than 7 million people.

The Gauteng Department of Education (GDE) set up eighteen district offices of which were later condensed into twelve districts. The responsibility of these districts, as they are closer to the people, is to serve the needs of the local communities. Each district has five units, namely (GDE: Progress Report, 1995-1997:6):

- An Administration Unit responsible for administrative systems in the district.

- The Teaching and Learning Unit, which is responsible for curriculum development processes, educator support and in-service educator development.

- The District Education Co-ordinators/Education and Training Unit. This unit is responsible for the training of principals, regular communication with the schools, and helps to improve the effectiveness and efficiency of schools.

- The Auxiliary Unit which is responsible for educators working with learners who have special learning needs, supporting learners with special needs, career guidance, providing support to children and families in need, sport, youth and cultural activities.

- The Development Unit which is responsible for programmes aimed at groups which were previously neglected under apartheid, as well as developing strategies for providing adequate resources to disadvantaged communities.

The eighteen district offices are divided into three regional clusters, and they provide support to the district offices. These regions are divided as follows:

- Seven districts in the North Region.

- Six districts in the Central Region.

- Five districts in the South Region.

2.8.1 E-Learning as seen by the Gauteng Department of Education

The MST Strategy Formative Report (2009:1) gives the following information with regard to the view of the Gauteng Department of Education on e-Learning:

E-Learning is learning that is facilitated and supported through the use of information and communications technology. It is the convergence of electronic resources and tools, enabling learning. E-Learning covers a spectrum of activities from supported learning, through blended learning (the combination of traditional and e-learning practices), to learning that is entirely online.

This learning is done through the paradigm of transformational pedagogy. Whatever the technology, learning is the vital element. During this process the educator will never be substituted by electronic equipment but remains the pivotal point in the delivery of the curriculum. E-Learning in Gauteng Department of Education supports the curriculum in the following activities: Rubricate, Partners in learning, Thutong, Intel Teach, Web-lessons (Resources for lessons) and managing ICTs in school.

There is also a technology resource, “Gauteng Online”, used by some of the schools. The Gauteng Online, driven by the Gauteng Department of Education has been implemented since 2007 by the Gauteng Shared Services Centre (GSSC). The idea of computers in every schools is already a reality for the majority of Gauteng’s 2 200 schools. The Gauteng Online Schools’ project, which was first conceived back in 2002, is now about 80% complete, with 1493 schools having access to computers as well as through the Internet.

The Gauteng Online aims to provide every school in the province with a computer laboratory, giving every learner in the public schooling system access to the Internet and to e-mail. Furthermore, it aims to:

- Provide all learners access to quality education.

- Through e-learning, make notable advances in supplying skilled learners for further study and employment which improves South African culture, democracy, employment and the growth of the economy within the knowledge society.

- Provide and ensure that comprehensive sets of curriculum resources, tools and information across all grade levels and learning areas/subjects in multiple South African languages are freely and electronically accessible for re-use and adaptation by learners and educators.

- Ensure that the solution allows communication with peers and educators within and beyond the borders of the South African system.

- Ensure methods, tools and support systems that facilitate learning and learners who experience barriers to learning are designed, developed, deployed and made available.

Molaodi Khutsoane, CEO of GSSC (in Gibson & Daviso 2009:47) explains that the main challenges over the last seven years have included theft, dissonance, poor ICT skills and lack of institutional support from educators, school management teams and school governing bodies.

The Gauteng Online project has gone through six previous phases (Gibson & Daviso 2009:47). During phases one to five, six hardware vendors – HP, Sahara, Dell, Mustek, Pinnacle and Business Connexion - were involved in the roll-out of hardware and software. Independent contractors under the management of Gauteng Online team handled the infrastructure work. Internet connectivity in the early phases was provided by Sentech. In phase six, a different approach was taken with Pinnacle Technology undertaking the entire phase as a turnkey project, and Internet connectivity supplied by iBurst.

The current phase has been outsourced to SMMT Online, which is not only rolling out new computer laboratories to schools, but is also refreshing existing schools to keep them up to date and providing Internet access and ongoing support necessary to a project of this magnitude.

Research by Acikalin and Duru (2005:1) showed that the use of computers in education opens a new area of knowledge and offers a tool that has potential to change some of the traditional and ineffective educational methods.

It is currently considered as crucial to “modernized educational systems on the basis of information and communication technologies” as globalization and transformation to the information society “call for new literacy for the information society” (Orhun 2003:1).

Against this background, this study describes learning theories that meet the needs of the Information Age. A learning theory fundamentally describes the way we as educators teach and the way learners learn. It is important to know enough about the learning theories in order for us to understand how to integrate technology into teaching and learning in the Information Age. This study focuses on several learning theories and models that could enhance learning in the Information Age.

2.9 Theoretical framework

The world of education is coming up with new movements, frameworks and theories to explain how learning occurs or how it should be conducted. Each has passionate supporters and detractors who debate on the effectiveness and inherent appropriateness of one over the other. For example, Papert (1998:141) highlights the dramatic change that is taking place in today’s teaching and learning. He states:

> Today the situation has changed dramatically. This dramatic change led to a wide range of tools, and the Net itself, which creates a new paradigm in the delivery of learning. The new media have helped create a culture for learning where the learner enjoys enhanced interactivity and connections with others. Rather than listening to some professor regurgitating facts and theories, learner discuss and learn from each other with educator as a participant. They construct narratives that make sense out of their own experiences.

Based on this description, one noticed that the fellow human beings we know and associate with became the way they are, largely because of learning. Their habits of living have been learned and can be changed by learning, so too can their stores of knowledge, their skills, and the human qualities that characterise them as individuals.

In view of this statement, learning is not simply an event that happens naturally, it is also an event that happens under certain observable conditions. Thus, one can make inferences about what has been learned. Also scientific models and theories can be constructed to account for the changes observed.

2.9.1 Theories of learning in the digital classroom

Historically the field of education has been oriented towards models of learning which focus on instruction, what is called broadcast learning. According to Tapscott (1998:129), the lecture, textbook, homework, assignment and school are all analogies for the broadcast media. This approach has been the foundation of authoritarian, top-down, educator-centred approaches to education which go back centuries.

The educator is primarily a transmitter; curricula are designed by experts who presumably know the best sequencing of material. Since the birth of the digital age, there is a paradigm shift in learning where the roles of both educators and learners have changed. In essence, constructivist educators become facilitators in their classrooms where learner become actively engaged in exploration, invention and discovery. This view is also supported by the Gauteng Department of Education (DoE 2003: ii) when stating:

> Information and communication technologies are central to the changes taking place throughout the world. Digital media has revolutionised the information society and advances in ICTs have dramatically changed the learning and teaching process. This has opened up new learning opportunities and provided access to educational resources well beyond those traditionally available.

Based on the given information, this study is informed by the learning theory of constructivism.

2.9.1.1 Constructivism

Constructivism is a fundamental departure in thought about the nature of knowing, hence of learning and thus of teaching. The constructivist perspective describes learning as a change in meaning constructed from experience (Tam 2000:2). Constructivists believe that knowledge and truth are constructed by people and do not exist outside the human mind (Dufay & Jonassen 1991:9). In an instruction, learners are told about the world and are expected to replicate its content and structure in their thinking (Jonassen 1991:6).

Bruner (1996:1) proposed that learning is an active process in which the learners construct new ideas or concepts based on their current or past knowledge. Bruner (1996) believes that constructivist learners are active learners; this means that they select and transform information, construct hypotheses, and make decisions relying on a cognitive structure. Bruner (1996:1) further highlighted that the instructor should try and encourage learner to discover principles by themselves. In this view, the instructor and learner should engage in an active dialog (Socratic learning).

In the same vein is Vygotsky (1978) who believes that learning was influenced significantly by social development. Vygotsky (1978:57) states that every function in the child's cultural development appears twice: first on the social level, and later, on the individual level; first between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals.

Vygotsky therefore, theorised that learning takes place within the context of a child's social development and culture. Vygotsky believed that a child's social environment could positively or negatively affect the child's cognitive development.

He then proposed that children have a zone of proximal development, which is the difference between the problem-solving ability that a child has learned and the potential that the child can achieve from collaboration with a more advanced peer or expert, such as an educator.

Vygotsky theorized that if a nine-year old child worked on a problem with an adult or another child who was advanced, the nine-year old would be able to learn concepts or ideas that were more complex than what a nine-year old could understand on his/her own; this is known as collaborative learning. Vygotsky felt learner should work collaboratively to share their different perspectives with each other so that they could negotiate a solution and come to a much deeper understanding of a problem or tasks.

Furthermore, Vygotsky proposed that educators should discover the level of each child's cognitive/social development, and build or construct their learning experiences from that point. He referred to this process as scaffolding. In education, a scaffold is the altering of the schemata, which is an organized way of creating or providing a cognitive mental framework for understanding and remembering information. As educators and other learner provide information and different perspectives for each other, these resources can become a scaffold, that is, a temporary source of knowledge. Thereafter, learners assimilate this knowledge and build their own, thus removing the need for a scaffold.

In addition to Bruner and Vygotsky's views, Jonassen et al (1999) describe four principles of constructivist learning, namely: the principle of knowledge construction; the principle of active learning; the principle of social interaction and cooperative learning; and the principle of situated learning.

- *Principle of knowledge construction*

According to this principle, knowledge is not simply transmitted to learners, but learners construct their own knowledge or phenomena from their own interactions and experiences with those phenomena in meaningful learning environments. Teaching is not seen as a process of transmitting, imparting or mapping the educator's knowledge onto the learner, but as helping learners to construct their own knowledge and to reflect on it by guiding them in the meaning-making process. Knowledge building also includes opportunities for learners to articulate, express and represent what they have learned in a verbal, written, visual or auditory format (Jonassen et al, 1999:3-5).

- *Principle of active learning*

Knowledge construction results from activity; in other words knowledge is embedded in activity. Constructivists believe that we cannot separate our knowledge of phenomena from our experiences and interactions with those phenomena. We can only interpret knowledge in the context of our own experiences (interactions), which implies that the meaning we construct of phenomena emerges from our interactions with it. Learners can certainly memorise facts that they have not experienced, but they probably do not make much meaning of those facts (Jonassen et al 1999:3).

- *Principle of social interaction and cooperative learning*

Social interaction among individuals plays an integral part in how people learn. Learner-learner and learner-educator interactions are important ingredients of learning from a constructivist perspective. According to Piaget's (1970) cognitive development theory, peer interaction is a source of experience that evokes cognitive conflict (disequilibrium) in children, and human beings all have a tendency to reduce this conflict and re-establish equilibrium at a higher level.

For Vygotsky (1978:57), the cognitive development begins with an interaction between the child and a more knowledgeable other, and the social processes are then transformed into the child's internal mental processes. The role of 'scaffolding' provided in guiding social interaction thus becomes central to the Vygotskian view. Based on Vygotsky theory, one important step in designing instruction to develop complex mental function is the analysis of the 'zone of proximal development' – the distance between the actual developmental level that is reflected in the child's independent problem-solving process and the problem-solving level that is accomplished with guidance. Most importantly, the zone of proximal development is created in the interaction between learner and the instructor or in the cooperative problem-solving with peers.

In addition, Jonassen et al (1999:5) points out that meaning can be shared with others. In this regard, meaning making can also result from discussions and conversations with others. Humans are social creatures who rely on interactions with fellow humans to determine their own identity and the viability of their personal beliefs. Constructivists believe that meaning-making includes a process of social negotiation in which members of a culture share experiences, understandings and meanings, and reach consensus through dialogue and conversation.

- *Principle of situated learning*

Constructivists believe that part of the meaning of a phenomenon is embedded in its context. Learning and cognition of phenomena should, therefore, be situated in the social and physical context from which the phenomena originate. The knowledge of phenomena that learners construct and the associated skills they develop include information about the context in which they experience those phenomena. So, the more directly and interactively learners experience phenomena in a meaningful context, the more meaning they are likely to construct.

The implication is that teaching and learning a new concept should always take place in its real-life context that is in the context in which the concept is embedded and from which it originates. In contrast, a concept that is taught divorced from its context has little meaning for learners, and results in inert knowledge that learners are unable to use outside the classroom (Jonassen et al 1999: 3-4).

2.9.1.2 ARCS motivational model

The ARCS motivational Model was developed by John, M. Keller in 1983 and is applicable to learning in the digital age. Keller (1983:4-6) highlights the importance of motivation in teaching and learning environments and stresses that even the best designed instructional strategy will fail if learner are not motivated to learn. He developed a model that would attribute differences in learners' learning to the amount of effort they were willing to put forth. In his model, he catalogued four specific areas that could account for the differences in student efforts, namely: Attention, Relevance, Challenge or Confidence, and Satisfaction or Success (ARCS). These four areas are clearly indicated on table 2.3; for clarity, they are further discussed.

Table 2.3: The ARCS motivational model and digital learner

Attention	Lessons are designed to gain learners' attention using alternative techniques, such as stories, sensory stimuli, thought-provoking questions, and variability in exercises, and using media.
Relevance	Learner sees relevance in the lesson, which, in turn, leads to increased learning. The lesson must be relevant not only to the learner, but also to previously taught lessons.
Challenge/ Confidence	Learners are challenged to achieve, and they gain confidence as they meet the challenge. Learners need to feel that if they put in a good faith effort, they are capable of achieving the objectives. The challenge should properly match the learners' abilities.
Satisfaction /Success	Learners gain success in achieving their objective, which promotes self-satisfaction from the learning experience. The most powerful reward is that the learner finds that the learning experience is relevant and useful to their own world or the one they aspire to live and work in.

Adapted from Shelly et al (2008)

- *Attention*

According to Keller (1983:4), effective learning techniques seek to capture learners' attention to eliminate boredom and arouse natural curiosity. Keller (1983:4) emphasises that learning should increase learners' focus by using novel, surprising, out of the ordinary, and uncertain events. From this emphasis, he therefore, argues that effective techniques should stimulate the sense of wonder and maintain interest.

- *Relevance*

To Keller (1983:4), learners will become motivated to learn when they feel that learning is relevant or important to their lives. Keller also points that by using digital media to develop lesson concepts, educators bring familiar technology into the classroom, and these concepts utilise technologies that learner value.

- *Challenge/Confidence*

Keller (1983:5) echoes that learners who believe they can achieve often do. From this angle, he argues that lessons created with digital media allow learners to develop confidence by enabling them to succeed. He further states that lessons created with digital media present a degree of challenge that allows for meaningful success through both learning and performance conditions. Based on the above, Keller (1983:5) highlights that lesson content created with digital media can be levelled to challenge multiple skill levels, to generate positive expectations, to provide feedback, and to support internal attributions for success.

- *Satisfaction*

Keller (1983:6) points that, by using digital media, learner can showcase their achievements, allowing them to share their successes with others, which increases their desire for positive peer evaluation.

2.9.1.3 Interactive model of learning

According to Tapscott (1998:134), it is important to adopt a new model of teaching and learning, the interactive model. Tapscott (1998:134) emphasises that in adopting the new interactive model of learning, learners are already assimilating the learning goals; they are not just discussing such goals – they are achieving them; they rely on each other for learning; they debate everything online; they are critics; and they are tolerant of diversity in their worlds.

Tapscott (1998:139-147) further explains that by exploiting the digital media, educators and learners can shift to a new, more powerful and more effective learning paradigm. He therefore, points out eight shifts of interactive learning:

- *From linear to hypermedia learning*

Tapscott (1998:142) explains that traditional approaches to learning are linear, and these date back to the approaches relating to books which are usually read from the beginning to the end, as a learning tool; television shows and instructional videos which are designed to be watched from beginning to end. He further emphasises that the Net-Generation (N-Gens) access to information is more interactive and non-sequential, that is, when surfing some new material, they hyper-link to servers and information sources all over. Oblinger (2005:1) describes the Net Generation as children born around the time that the personal computer was introduced.

- *From instruction to construction and discovery*

This learning focuses itself around the theory of constructivism that states that learners construct knowledge anew, rather than assimilating the knowledge broadcast by an instructor. This is in line with Tapscott (1998:144) when saying that people learn best by doing rather than being told. Learners are found to be enthusiastic, and through enthusiasm learners self-discover meaningful fact or concepts which are retained more than the same concepts written out on the educator's blackboard. In support of this view, Papert (1996 cf. Tapscott, 1998:144) states:

> The scandal of education is that every time you teach something, you deprive a child of the pleasure and benefit of discovery. The school can become a place to learn rather than a place to teach.

- *From teacher-centered to learner-centered education*

According to Tapscott (1998:145), the new media enables centering of the learning experience on the individual rather than on the transmitter. He further points out that learner-centered education improves the child's motivation to learn. In this respect, the educator is equally critical and valued in the learner-centered context, and is essential for creating and structuring the learning experience.

- *From absorbing material to learning how to navigate and how to learn*

Brown (in Tapscott, 1998:147) compares the previous generations' learning to the N-Genes learning. He therefore states that in our generation, we reach for the manuals, if we don't know how to do something, we ask; we do not engage and synthesise. However, our new generation is good at the analysis of things, as opposed to the synthesis of things; they assess and analyse facts; they synthesise; they engage with information sources and other people on the Net and build or construct higher-level structures and mental images.

- *From school to lifelong learning*

The knowledge explosion of humanity is now doubling annually, and some people still think that once they have graduated from university, they are good for the next decade, when they are really good for the next ten seconds (Tapscott 1998:146).

- *From one size fits all to customised learning*

Tapscott (1998:147) sees the computer as a medium in which what one makes, lends itself to be modified and shared. He further states that when children get together on a project, there is abundant discussion; they show it to others and others want to see it. In essence, children learn to share knowledge with other people much more than in the classroom.

- *From learning as torture to learning as fun*

The Ninth College Dictionary gives the third and fourth definitions of the verb 'to entertain' as 'to keep, hold, or maintain in the mind' and 'to receive and take into consideration.' Tapscott (1998:148) is in support of this view and explains it clearly by saying that entertainment has always been a profound part of the learning process and educators have throughout history been asked to convince their learner to entertain ideas. He further highlights that the best educators are entertainers, using the new media and by so doing they build enjoyment, motivation and responsibility for learning.

- *From the educator as transmitter to the educator as facilitator*

According to Tapscott (1998:148), learning is becoming a social activity facilitated by a new generation of educators. In this regard, the educator is not an instructional transmitter, but a facilitator of social learning whereby learners construct their own knowledge. Tapscott (1998:148) further points out that with the assistance of the educator, learners construct knowledge and their world.

2.9.1.4 The ASSURE model

The ASSURE model was developed by Heinich et al (1999:5) as a procedural guide for planning and delivering instruction that integrates technologies and media into teaching the process. The ASSURE model incorporates Robert Gagne's events of instruction to assure effective use of media in instruction. According to the ASSURE model of instructional design, the designer should follow the following important criteria:

- *Analyse learners*

Before educators begin, they must know their target audience, that is, their learners. They need to consider and write down the following characteristics about their learners: general characteristics (grade, age, ethnic group, sex, mental, emotional, physical or social problems, and socioeconomic level); specific entry competencies (prior knowledge, skills and attitude); and learning styles (verbal, logical, visual, musical, structured, etc) (Shelly et al 2008:344).

- *State objectives*

Once educators know their learners, they can begin writing the objectives of their lesson. Objectives are the learning outcomes, that is, what the learners will get out of the lesson. The lesson objectives must be clear and sound. Educators must state what the learner will achieve in the end. The ABCD's of writing objectives are summarised as follows: Audience (who are your learners?), Behaviour to be demonstrated, Conditions under which the behaviour will be observed; and Degree to which the learned skills are to be mastered.

- *Select instructional methods, media and materials*

According to Shelly et al (2008:344), once educators know their learners and have a clear idea of what they should get out of the lesson, then they are ready to select the instructional method that they feel is most appropriate to meet the objectives for these particular learners; media that would be best suited to work with their instructional method, the objectives, and their learners. Media could be text, still images, video, audio, and computer multimedia; materials that provide learners with

the help they need in mastering the objectives (Shelly et al 2008:83). Materials might be purchased and used as is or they might need some modifications. Educators can also design and create their own materials for the learners to use. Materials would be specific software programs, music, videotapes, images, but would also be equipment, that is, overhead projector, computer, printer, scanner, TV, laserdisc player and VCR.

- *Utilise media and materials*

The educator must use the media and materials that s/he has selected. S/he should always preview the materials before using them in a class and should also use the equipment in advance to be sure it works and know how to use it. If he uses electronic equipments for example, s/he must not assume that everything will work. There must always be a plan B. Hardware and software are created by humans and humans make mistakes. Hardware can malfunction. Therefore, educators should not get discouraged if technology lets them down, but should make sure that the instructional material are suitable and working the best they can and then use it in the classroom (Shelly et al 2008:345).

- *Require learner participation*

Learners learn best when they are actively involved in the learning. The passive learner has more trouble learning whatever is tried to be put in his brain. Whatever teaching strategy, questions and answers, discussions, group work, hands-on activities, and other ways of getting learners actively involved in the learning of the content should be incorporated. Lecturing for an entire hour should be avoided and learners should be listened to and be allowed to become aware of the content. Educators should allow learners to learn as opposed to trying to “teach” them (Shelly et al 2008:346).

- *Evaluate and revise*

Shelly et al (2008:346) views that good educators must reflect upon the lesson, the stated objectives, the instructional strategy, the instructional materials, and the assessment and determine if these elements of the lesson were effective or if one or more of them need to be changed the next time the lesson is done. Sometimes a lesson may seem like it would be great on paper, but then when the educator actually

teach the lesson with a specific set of learners, the educator might discover there were several things that did not seem to work.

The educators' expectations might be too high or too low. The materials used might not have been appropriate for the grade level or the material might not be very motivating. The instructional strategy might not have got learners interest in participation or the strategy might have been difficult for the educator to manage. The assessment used might have shown that learners did not learn what the educator tested for. This might mean that educators did not accurately test for the stated objectives and the method of assessment needs to be revised, or the lesson did not permit enough time for the learners to master the objectives.

2.9.1.5 The Technology Integration Planning (TIP) Model

According to Roblyer (2006:53), each of the model's five phases outlines a set of planning and implementation steps that help ensure technology use will be efficient and successful in meeting needs (See figure 1.2). Following are the explanations of each phase:

- *Phase 1: Why should I use a technology-based method?*

Educators look at their current teaching problems and identify technology-based methods that may offer good solutions.

- *Phase 2: How will I know learner have learned?*

Educators decide skills they want learner to learn from the technology-integrated lessons and design ways to assess how well learner have learned and how effectively the activity has been carried out.

- *Phase 3*: *What teaching strategies and activities will work best?*

Educators decide on instructional strategies and how to carry them out. When educators create an instructional design for technology integration, they consider the characteristics of their topic and the needs of their learners and decide on an instructional course of action that addresses both within the constraints of their classroom environment.

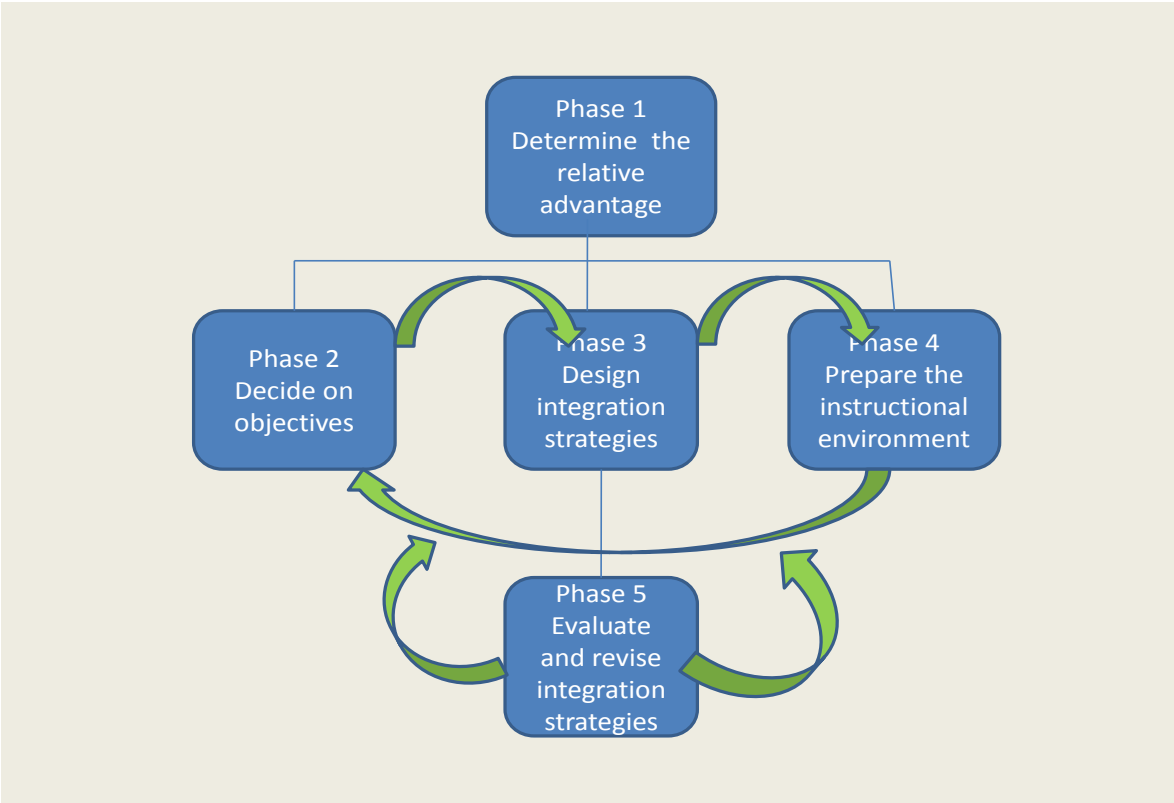
- *Phase 4: Are essential conditions in place to support technology integration?*

Educators organise the teaching environment so technology plans can be carried out effectively.

- *Phase 5*: *What worked well? What could be improved?*

Educators review outcomes data and information on technology-integrated methods and determine what should be changed to make them work better next time.

Figure 2.1: Technology Integration Planning (TIP) Model



2.9.1.6 Four-stage continuum of ICT integration

In addition to the TIP model, a report on ICT curriculum and educator development for schools suggests a four-stage continuum of ICT integration (UNESCO 2002:15-16). These are:

- *Emerging*

Schools in the beginning stages of ICT development demonstrate the emerging approach. Such schools begin to purchase, or have donated, some computing equipment and software. In this initial phase, educators are just starting to explore the possibilities and consequences of using ICT and adding it to the curriculum. Schools at this emerging phase are still firmly grounded in traditional, educator-centred practice.

- *Applying*

Those schools in which a new understanding of the contribution of ICT to learning has developed exemplify the applying approach. In this second phase, educators use ICT for tasks already carried out in the curriculum.

- *Infusing*

The infusing approach involves integrating or embedding ICT across the curriculum, and is seen in those schools that employ a range of computer-based technologies in laboratories and classrooms. Educators explore new ways in which ICT changes their personal productivity and professional practice.

- *Transforming*

Schools that use ICT to rethink and renew school organisation in creative ways have adopted the transforming approach. ICT becomes an integral though invisible part of daily personal productivity and professional practice. ICT is taught as a separate subject at the professional level and is incorporated into all vocational areas. Schools have become centres of learning for their communities.

2.10 Conclusion

ICT does not exist in isolation; it is interwoven with the rest of the tools and participants in the learning environment. This is in line with Lim (2003:411) when stating that a sociocultural approach towards the study of ICT in education rejects the view that ICT can be studied in isolation; it must be studied within the broader context in which it is situated.

After examining all the literature reviewed, it is important to point out that technology offers the potential to greatly enhanced teaching and learning in the classroom. But due to its complex technical nature, this potential has not always been realised to the full. This has been as a result of the slow pace of integrating technology into curriculum instruction in various countries. This chapter briefly explained the concepts covered in this study, outlined the various ICT policies of developed and developing countries, explored ICT activities taking place in South Africa, and lastly indicated the theory wherein the study is located. The next chapter (Chapter 3) looks into the research methodology employed in this study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter discusses the research design and methodology followed in undertaking the necessary qualitative research to explore and describe the barriers to effective technology integration in teaching and learning. The chapter begins by describing qualitative research as the approach of choice and then moves on to discuss the research design; data collection techniques and procedure for data analysis; ethical considerations during qualitative research; credibility and trustworthiness and finally, triangulation and crystallisation.

3.2 Knowledge claim

Epistemologically the interpretive paradigm denies the existence of a hard, objective and tangible knowledge (Cohen et al 2000:6). The results of the interviews and the theoretical propositions support my epistemological assumptions, namely that knowledge is a social construct: something that is constructed by people, acquired by people and communicated to people (Cohen et al 2000:6; Henning et al 2004:20). These propositions also dovetail neatly with the interpretivist theoretical framework in that they support its basic premise, which is that because knowledge is constructed by people, research participants should therefore not be regarded as passive sources of knowledge but as co-creators of shared meaning and experiences.

The findings that emerged from my data (see Chapter Four) also reflect my ontological assumption that people construct meaning not only for purposes of interaction but also to make sense of their own and others' realities.

The results of my inquiry, therefore, validates Henning et al's (2004:21-22) contention that the interpretive framework allows for the discovery of multiple realities, of varied interpretations and ways of experiencing the same event.

3.3 Research paradigm

A paradigm may be viewed as a set of basic beliefs or metaphysics that deals with ultimate or first principles. It represents a worldview that defines, for its holder, the nature of the world, the individual's place in it, and the range of possible relationships to that world and its parts. According to Lincoln and Guba (1985:107), the beliefs are basic in the sense that they must be accepted simply on faith. Lincoln and Guba (1985:105) further propose four paradigms that inform and guide an inquiry especially qualitative inquiry as: positivism, post positivism, critical theory and related ideological positions, and constructivism.

As indicated in Chapter One, the reasons I chose to conduct my inquiry in a qualitative rather than a quantitative research paradigm were primarily epistemological and ontological: the key philosophical assumptions upon which qualitative research rests, namely that individuals interacting with their social worlds construct reality from a variety of perspectives (Merriam 1998:6), was also the main premise on which my inquiry rested. Moreover, because inductive analysis, typical of qualitative research allows for the construction of such multiple realities, it allowed me to select participants who would reflect such different realities.

From the discussion above, this study falls into the fourth column, that is, the constructivist paradigm. This is based on the ideas that realities are apprehensible in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature, and dependent for their form and content on the individual persons or groups holding the constructions (Lincoln & Guba 1985:110).

3.4 Research methodology

There are various kinds of research methods such as qualitative and quantitative. The distinction between quantitative and qualitative research methods is generally perceived as being that while the quantitative approach is objective and relies heavily on statistics and figures, the qualitative approach is subjective and utilises language and description (Lee & Roth 2001:88).

3.4.1 Quantitative approach

Quantitative research is defined as research that is aimed at testing theories, determining facts, statistical analysis, demonstrating relationships between variables and prediction (Garbers 1996:282). According to Lee et al (2003:87), the quantitative research method is derived from the natural sciences that emphasise objectivity, measurement, reliability and validity. Standardised methods and techniques like experiments, surveys, structured observation and interviews are used to realise these ideals of diagnosis, treatment, control and prediction (Garbers 1996:282).

According to Garbers (1996:283), a researcher involved in quantitative research typically stays in the background and does not become involved in the events or 'objects' of inquiry, for example, the research subject. Garbers (1996:283) further explains that quantitative research methodology lends itself to the description of opinions and attitudes and gauging the effect of one event or variable on another. In view of the above statement, Garbers (1996:283) stresses that in quantitative research, clearly formulated hypotheses are usually stated beforehand while operationalisation techniques feature prominently. He added that these techniques result in the structuring of data categories beforehand; in other words, the researcher knows in advance, in the light of a theory, what type of data to collect and what eventual data or information will look like.

The strength of the quantitative method is that it produces quantifiable data that enables the researcher to generalise the situation to certain larger population. Quantitative measures are usually most appropriate for conducting needs assessment or evaluations and comparison of outcomes with baseline data. However, it fails when the phenomenon under study is difficult to quantify (Mutai 2001:119).

3.4.2 Qualitative approach

The word qualitative implies an emphasis on processes and meanings that are not rigorously examined or measured (Denzin & Lincoln 1994:4). Research studies that investigate the quality of relationships, activities and situations are referred to as qualitative (Wallen & Fraenkel 2001:432).

A qualitative method is designed to provide the researcher with the perspective of a specific target audience through immersion in a culture or situation and direct interaction with the behaviour under study. The common techniques of the qualitative method are observations, interviews, and focus group discussions (Giddens 1993:63; Nunan 1992:7). This method helps researchers understand the meanings people attach to social phenomena and to illuminate the mental processes underlying behaviours (Novak, 2002:80). In such a method, ideas generated during data collection and analysis and measurement tend to be subjective. In the qualitative method, the researcher becomes the instrument of data collection, and results may vary depending upon who conducts the research (Patton, 1990:59).

In the pure sense, qualitative research method is not interested in numbers or quantities (Strauss and Corbin 1990:17). The advantage of using qualitative methods is that they generate rich, detailed data that leave the participants' perspectives intact and provide a context for human behaviour. This particular study is both descriptive and evaluative and hence involved the gathering of largely qualitative data.

According to Ritchie and Levis (2003:28) descriptive research concerns itself with '…identifying what exists in the social world…' The study further aims at interpreting the phenomenon under study in terms of the meanings that the participants brought to it (Greenhalgh & Taylor 1990:740). In addition, Strauss and Corbin (1998:11) indicate that the qualitative approach is usually used to explore areas about which little is known and to gain information about phenomena such as attitudes and thought processes, that are difficult to extract through mere conventional research methods.

Several authors (Merriam 1998; Woods et al 2002; Miller & Dingwall 1997; Maykut & Morehouse 1997) highlighted the philosophic assumptions of qualitative research. Following are philosophic assumptions of qualitative research and are based on:

- Individuals interacting with the reality of their social world's construct. What is important in qualitative research is that the participants give to the phenomenon from their world, as well as their experiences. The insider's perspective, also known as *emic*, is emphasised (Merriam 1998:6).

- The researcher is the primary instrument for data collection and analysis and goes where people are, collects data and later analyses this data (Merriam 1998:6).

- Qualitative research involves fieldwork. The researcher is expected to physically go to the people, natural settings, site or institution (Merriam 1998:6; Woods et al 2002:2). In this study, the researcher went to a setting. (where the participants gathered) to conduct interviews. These interviews served as a way of determining the participants' perceptions of technology integration into teaching and learning.

- Qualitative research primarily employs an inductive research strategy. This means that the findings are in the form of themes, categories, typologies, concepts, tentative hypotheses, even theory, which have been inductively derived from the data (Merriam 1998:7; Woods et al 2002:2).

- Qualitative research product is descriptive. The participants describe their experiences of the phenomenon under study. In this study, participants describe their knowledge, understanding and experience of technology integration (Merriam 1998:8; Miller & Dingwall 1997:6).

- Maykut and Morehouse (1997:44) see the outcome of qualitative research not as the generalisation of results, but a deeper understanding of experience from the perspectives of the participants selected for the study.

From the above mentioned assumptions, one notices that qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret phenomena in terms of the meanings people bring to them. Thus, a qualitative researcher should focus on a natural setting.

Johnson and Turner (2003:5); Scott and Usher (2000:3) explicitly enunciate that the choice of what type of research to carry out will depend on the purpose of research, the research questions being explored and the kind of data required. It is from this view that I selected a qualitative approach as a method of research.

Based on the description of quantitative and qualitative research approaches, Lee et al (2003:87) concurs that these are two different approaches based on different paradigms and different assumptions about ontology and epistemology, that is, two human phenomena rather than two different sets of research techniques. It is from this stance that the nature of paradigm is discussed hereunder.

3.5 Research design

A research design is a plan or strategy which moves from the underlying philosophical assumptions to specifying the selection of participants, the data gathering techniques to be used and the data analysis to be done (Maree 2007:70; Terre Blanche & Durrheim 2002:29). This means that a researcher uses a design to look for, explore and to obtain answers to research questions such as: *What are the barriers to effective technology integration in teaching and learning?*

Moreover, Mouton (1996:107) and Denzin and Lincoln (1998:28) define a research design as a set of guidelines and instructions to reach the goal that the researcher has set for himself/herself. Guidelines direct what should be done how to do it and to whom it has to be done. The aim of this study as described in chapter 1, paragraph 1.4 is to explore and describe barriers to effective technology integration in teaching and learning. A research design in this study, therefore, is a set of guidelines that seeks and discovers answers to the research questions.

In respect of the above information, Creswell (1994:3) divides qualitative research into five main types and identifies the key challenges of each mode of inquiry as follows: the biography, phenomenology, grounded theory, ethnography and case study. Based on this view, the case study design is adopted for this study. In addition, De Vos et al, (2002:269) state those terms such as *strategies, methods, traditions of inquiry and approaches* are used interchangeably with design.

3.5.1 A case study design

A case study is a specific instance that is frequently designed to illustrate a more general principle (Nisbet & Watt 1984:72); it is the study of an instance in action (Cohen et al 2000:181). Furthermore, Cohen et al (2000:181) add that a single instance is of a bounded system, therefore, the cases studied in this research focus mainly on senior secondary schools.

Cohen et al (2000:181) also note that a case study provides a unique example of real people in real situations, enabling readers to understand ideas more clearly than simply by presenting them with abstract theories or principles. Based on this

information, Cohen et al (2000:181) explain that in case studies, contexts are unique and dynamic, hence case studies investigate and report the complex dynamic and unfolding interactions of events, human relationships and other factors in a unique instance.

In respect of the above views, Hitchcock and Hughes (1995:322) suggest that the case study approach is particularly valuable when the researcher has little control over events. Hitchcock and Hughes (1995:317) further consider that a case study has several hallmarks:

- It is concerned with a rich and vivid description of events relevant to the case.
- It provides a chronological narrative of events relevant to the case.
- It blends a description of events with the analysis of them.
- It focuses on individual actors or groups of actors, and seeks to understand their perceptions of events.
- It highlights specific events that are relevant to the case.
- The researcher is integrally involved in the case.
- An attempt is made to portray the richness of the case in writing up the report.

Qualitative research uses a case study design, meaning that the data analysis focuses on one phenomenon, which the researcher selects to understand in-depth regardless of the number of sites or participants for the study (McMillan & Schumacher 2001:398). A case study is a “systematic inquiry into an event or a set of related events which aims to describe and explain the phenomenon of interest”.

Bromley (1991:302) point out that a case study provides a unique example of real people in real situations, enabling readers to understand ideas more clearly than simply by presenting them with abstract theories or principles. From an interpretivist perspective, the typical characteristics of case studies are that they:

- Strive towards a comprehensive understanding of how participants relate and interact with each other in a specific situation and how they make meaning of a phenomenon under study.
- Offer a multi-perspective analysis in which the researcher considers not just the voice and perspective of one or two participants in a situation, but also the views of other relevant groups of actors and the interaction between them.
- Open the possibility of giving a voice to the powerless and voiceless, like children or marginalised groups.
- Often focus on a system of action rather than an individual or group of individuals (Maree 2007:75).

Based on the given explanation, a case study is used in this study for learning more about a little known and poorly understood situation (Leedy & Omrod 2005:135). In the same tone, Drever (1995:7) adds that the focus is often on a number of people who work together but have different roles, and the aim is to understand them as a group, with their different but interdependent functions and ways of thinking. In a case study, the researcher does not aim to cover the whole population and extract common factors, but to provide an in-depth picture of a particular area of the educational world. Therefore, the researcher's focus is on the experiences of different groups of educators (those who are regarded as office-based and those who are referred to as school-based) and learners.

3.5.2 Data gathering techniques

Data collection is a detailed description of the data gathering procedures for the planned investigation. This description covers the specific techniques to be employed and the specific measuring instruments to be constructed in making the measurements (De Vos 1998:100). Qualitative research is interactive face-to-face research, which requires relatively extensive time to systematically observe, interview, and record processes as they occur naturally (McMillan & Schumacher 2001:428).

In collecting data, I spent some days doing field work. It was during this time, that I interacted regularly with the people who are being studied. Based on Leedy and Omrod (2005:135), I also recorded details about the context surrounding the case. This information includes information about the physical environment and any historical, economic, and social factors that had a bearing on the situation. These records are named field notes. In support of the above statement, Gay and Airasian (1992:223) write that “field notes describe what the observer heard, experienced and thought about during observation”. Clandinin (2000:93) adds that “field notes, in an important sense, also say much about what is not said and not noticed”, which indicates that not only what was observed during observation and heard during interviews was recorded. During any interaction with participants, I had my memo-pad on hand to compile my field notes. In the field notes I described what I had heard and seen from the lesson observation and captured the essence of the evidence from the participants. Recorded field notes also served as data collected and were used to support data collected through the use of the instruments mentioned below.

According to Creswell (1994) peoples’ words and actions represent the data of qualitative inquiry and this requires methods that allow the researcher to capture language and behaviour.

Creswell (1994) further highlight the key ways of capturing data as: observations (both participant and direct), in-depth interviews, group interviews, the collection of relevant documents and photographs and video tapes. On the basis of the general objectives set out for this study and the findings from the review of literature, the collection of data combined four methods: in-depth interviews (semi-structured), observation (participant observations), document studies and group interviews (focus group).

3.5.2.1 Semi-structured interviews

Semi-structured interviews allowed participants to have their voice heard. I used semi-structured interviews to glean information that I could not observe directly, and to gain a detailed picture of a participant's beliefs about, or perceptions or accounts of a particular topic (Smith, Harre & van Langenhowen 1995:9).

The relationship enjoyed with the participants made my task an easy one. The maintenance of cordial relationship between researcher and participants is recommended by Czarniawska (2004:49) when he defines interviews as "an observation of an interaction between two people". In the same vein, Cohen et al (2000:260) state that an interview involves the gathering of data through direct verbal interaction between individuals.

In this study, I interacted with eight participants on an individual basis. All participants were asked the same set of questions of a probing nature and questions were also asked in the same sequence on each occasion. A set of basic rules was observed during interviews. I avoided long explanations of the study and was careful not to deviate from its main purpose. I did not allow telephone or other interruptions that could sidetrack the participant. All interviews were conducted on a one-to-one basis as this eliminated the risk that others could suggest an answer on behalf of another participant, or agree or disagree with the answers that were provided. Interview questions were kept simple and straightforward and I did not offer interpretations of the meaning of the questions.

This general pattern followed was that recommended by Denzin and Lincoln (1994:364). The structure of the sessions minimised the chances of giving any hints to educators about what I was looking for and thus reduced the risk of bias.

Participants permitted me to use an audio tape recorder during the interviews. This enabled me to return to the data at a later stage. All the interview data were transcribed and submitted to close analysis. While audio-recording and making notes, care was taken not to influence or disturb the participants in their responses.

3.5.2.2 Focus group interviews

A focus group interview is a carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment (De Vos et al 2002:385; Krueger & Casey 2000:6; Litosseliti 2003:1). Patton (2002:385) defines a focus group as a small group of people discussing a specific topic. This means that a focus group is a type of group interview in which a researcher leads a discussion with a small group of individuals to examine, in detail, how the group members think and feel about a topic (Johnson & Christensen 2000:145).

According to Stewart and Shamdasani (1990:9), focus group interviews are among the most widely used research tools and are often used for exploratory research. Focus groups occur when groups of people focus on a particular topic. These individuals have certain characteristics that give them an advantage as a group (Anderson 1993:224).

For the purpose of this study, four focus groups comprised of eight learners respectively were used. It is felt that this number was sufficient to achieve synergy and to facilitate group dynamics on the one hand while at the same time ensuring that every member had sufficient time to have a say in the deliberations.

Similarly, Crabtree and Miller (1999:118) state that a minimum of four to five focus groups are required to reach saturation. I used focus groups interviews to obtain large and rich amounts of information in the participants' own words, because focus groups help participants to exchange views among themselves and to clarify their individual opinions or behaviour (Morgan 1993:18). Focus group interviews enable participants to be comfortable and to enjoy the discussion, while sharing their ideas and perceptions. According to De Vos et al (2002:310) and Litosseliti (2003:2), in focus group interviews, participants feel comfortable in sharing their experiences and perceptions of a topic in group activity. Focus group participants have similar levels of understanding and can influence each other by responding to ideas and comments in the discussion (Krueger & Casey 2000:6; Litosseliti 2003:32).

Various authors (Stewart & Shamdasani 1990; Litosseliti 2003; Barbour & Kitzinger 1999; Krueger et al 2000; De Vos et al 2002; Bless & Higson-Smith 1995) highlight the importance of focus group interviews as follows:

- To obtain general background information about a topic of interest (Stewart & Shamdasani 1990:15).

- To generate new stimulating ideas and creative concepts (Stewart & Shamdasani 1990:15).

- To learn how participants talk about the phenomenon of interest (Stewart & Shamdasani 1990:15).

- To provide useful information and offer the researcher a number of advantages (Stewart & Shamdasani 1990:15).

- To explore people's experiences, opinions, wishes and concerns, which is not possible when using other methods (Litosseliti 2003:16)?

- To enable the researcher to work with pre-existing groups, that is, people who are already acquainted through living, working and socialising together (Barbour & Kitzinger 1999:8).

- The focus group is fundamentally a way of listening to people and to create lines of communication (De Vos et al 2002:306).

- The focus group is a powerful means of exposing reality and to investigate complex behaviour and motivation (De Vos et al 2002:307).

- The focus group enables the researcher to interview several people at the same time (Bless & Higson-Smith 1995:113).

To administer focus group interviews, I used the interview schedule which is a list of questions a researcher has prepared in advanced and intends to ask. The questions were framed as:

- Why did you enrol for computer as a subject?

- How much have you learned from this subject?

- Which programmes are used for teaching and learning?

- What problems have you encountered with this subject?

- How do you find technology usage?

3.5.2.3 Documents

Documents such as policy documents, learning schedules and lesson plans (See examples of documents in appendix K) were used in this study to collect data.

Maree (2007:82) maintains that when using documents as data collection technique, you have to focus on all types of written communications that may shed light on the phenomenon that you are investigating.

3.5.2.4 Observations

Observation is the systematic process noting and recording of events, behavioural patterns of participants, objects and occurrences without necessarily questioning or communicating with them (Maree, 2007:84; Marshall & Rossman 1999:107). It can further be defined as "the process by means of which researchers establish a link between reality and their theoretical assumptions" (Mouton & Marais 1991:156-157). I used observation in the study, a technique which McMillan and Schumacher (1997:516) describe as one conducted to "obtain and corroborate salient observation of different perspectives recorded in field notes and summary observation".

According to Lee et al (2003:92), qualitative researchers claim forcefully to know relatively little about a given piece of observed behaviour until they have developed a description of the context in which the behaviour takes place and attempted to see that behaviour from the position of its originator. It is from this explanation that the qualitative researcher recognises and believes that the research process itself is a form of social interaction in which the researcher converses with, and learns about the phenomenon being studied, especially when the object on inquiry is another human being (respondent).

Gummensson (2000:29-30) agrees with Johnson and Christensen (2000:147) that observation aims to reveal behavioural patterns of research participants that will enable the researcher to collect additional information about the participant. Margaret and Preissle (1993:195), add that observers live as much as possible with the individuals they are investigating, trying to blend in and taking part in their daily activities, they watch what people do, listen to what people say, and interact with participants.

For the purpose of this study, I observed three lessons in each of the schools whereby technology educators used technology in teaching.

During my first visit to the schools, participants were informed that I would also observe the lessons offered with technology. I requested the school manager to provide me with the time table so as to see the number of periods and time allocated to the technology integrated lessons per week. An appointment was set with the educators concerned for the lesson observation, that is, the day and time when the instruction would take place. The template appearing in the appendix J was used. In the case study the researcher typically observes the characteristics of an individual unit – a child, a class. The purpose of such observation is to probe deeply and to analyse intensively the multifarious phenomena that constitute the life cycle of the unit with a view to establishing generalisations about the wider population to which that unit belongs.

In summarising the above mentioned points, Sharp and Howard (1998:317) suggest that researchers should use a checklist to ensure that data collected will be of an appropriately high standard so that the data actually measures what they purport to measure; proper attention is paid to measurement error and the reduction of its effects; a suitable sample is used, in particular one that provides a basis for generalisation, and is large enough for the effects of interests to be detected; and data are properly recorded.

Considering the above points, I ensured that the conditions under which data were gathered were properly identified and that suitable data recording methods used and efforts made to detect errors and eliminate them during recording (See table 3.1 below). To record data, an audio visual instrument was used. Field notes were also written during observation of participants. The recorded semi-structured interviews, observations, focus group and document review data were then transcribed and analysed. Before data can be analysed, it must be documented and edited.

Data was documented in accordance with the three steps outlined by Flick (1998:169): recording, transcribing and constructing.

Table 3.1: Data planning matrix

What do I need to know?	**What do I need to know this?**	**What kind of data will answer the questions?**	**Where can I find the data?**
To what extent do educators and learners have access to technology?	To find out if technology is used for teaching and learning at schools.	Classroom observation Individual interview	Educators HOD's Principals
What is the frequency of technology usage in school?	To discover the amount of time allocated for technology.	Document review Interviews Observation	Educators Learners HOD's Classroom
What is the degree of training and professional development of educators?	To find out the level of computer literacy.	Interviews	HOD's Educators
Which teaching strategies are applied in integrating technology in school subjects?	To evaluate the integration process.	Observation Interview	Classroom Educators
What are educators' perceptions regarding the integration process?	To hear different views of educators with regard to integration process.	Individual interviews Focus group interviews	Principals HOD's Educators Learners

3.5.3 Data analysis

Data analysis is defined by Burns and Grove (1997:521) as “a method to reduce, organise, and give meaning to data gathered and constructed into a meaningful whole.” Additionally, De Vos (1998:100) and Maykut and Morehouse (1994:127) view data analysis as the process through which one understands more about the phenomenon under investigation and describes what one has learnt with a minimum of interpretation. It simply explains the procedure that one will use to analyse data. Jorgenson (1989:107) puts it clearly when he states “analysis of data is the breaking-up, separating, or disassembling of research materials into pieces, parts, elements or units”. He further states that when facts are broken down into manageable pieces, the researcher is able to sort and sift them, searching for types, classes, sequences, processes, patterns or wholes. Based on the above descriptions, Lee (2003:92) states that the qualitative approach uses the interpretative techniques that seek to describe, decode, translate, and come to terms with the meaning in the world.

Qualitative research examines the patterns of meaning which emerge from the data and these are often presented in the participants’ own words. The task of the qualitative researcher in this activity is to find patterns within those words (and actions) and to present those patterns for others to inspect while at the same time staying as close to the construction of the worlds as the participants originally experienced it (http://www.computing.dcu.ie~hruskin/RM2.htm). Based on this information, Marshall and Rossman (1999:152) therefore, identify the six phases of data analysis that were used in this study. These phases are explained as follows:

3.5.3.1 Organising data

Each participant’s response were organised separately and later compared with the other information received from other participants.

3.5.3.2 Generating categories, themes and patterns

Information received was divided into categories and groups to show similarities and differences for easy identification of pattern in the study.

3.5.3.3 Coding data

A coding strategy of analysing data is employed to identify facts, factors and other important aspects of the study easily. The coding may take several forms such as the abbreviation of key words, coloured dots, numbers or any other form chosen by the researcher. In this study, the researcher used abbreviation of key words as a coding form. This allowed for easy interpretation. This stage also requires the researcher to identify similarities and differences in the information supplied by participants.

3.5.3.4 Testing emergent understandings

This step tests the correct understanding of interpretations by the researcher. The researcher asked herself questions such as: Did the respondent understand the question, and does the researcher understand the response? This assisted the researcher to identify words that were difficult to understand.

3.5.3.5 Searching for alternative explanations

Some words or responses might not be easy to understand. In this case, the researcher must initiate alternative ways of interpreting and understanding responses.

3.5.3.6 Writing the report

After all the endeavors to try and make sense of the recorded materials, the researcher compiled and wrote the report on the findings and conclusions of the study.

3.5.4 Selecting the sample

Sampling and selection are principles and procedures used to identify, choose and gain access to relevant units that will be used for data generation by any method (Mason 1996:83). The purpose of sampling and selection is to identify the units to be studied and to gain access to schools for data generation. To be specific, sampling is defined as a representation of a population (Bless & Higson-Smith 1995:88; Mouton 1996:136; Henry 1990:136). According to Maree (2007:79), the word 'sampling' refers to the process used to select a portion of the population for the study. Also of the same idea are Miles and Huberman (1994:26), who say that sampling is crucial for later analysis.

Miles and Huberman (1994:26) further maintain that as much as one might want, one cannot research everyone, everywhere doing everything. One's choices of whom to look at or talk with, where, when, about what and why, all place limits on the conclusions one can draw and on how confident one and others feel about them. The following aspects of sampling as used in this study looked at: population; sample; and sampling criteria.

3.5.4.1 Population

According to Vockell and Asher (1995:170) the term "population" refers to the entire group from which the sample was drawn. Similarly, Polit and Beck (2006:506) describe population as an entire set of individuals having some similar characteristics.

The accessible population in this study was curriculum specialists from the Department of Education (Tshwane North Region offices), principals, deputy principals, educators and learners of the senior secondary schools.

3.5.4.2 Sample

A sample is described as a small portion of the total set of objects, events or persons that, together, comprise the subjects of the study (De Vos et al 2002:199). From this description, sample size depends on what the researcher wants to know, the purpose of the inquiry, what's at stake, what will be useful, what will have credibility, and what can be done with available time and resources. In support of this view, Patton (2002:244) stresses that there are no rules for sample size in qualitative inquiry. Although the sample is small, it should represent the larger population. Based on this description, the sample of this study therefore, consisted of two curriculum specialists responsible for e-Learning, two principals, two deputy principals, two educators and thirty-two learners of senior secondary schools.

3.5.4.3 Sampling criteria

Rubin and Babbie (1993:220) assert that if all the members of the population were identical in all respects, there would be no need for careful sampling procedures. In such a case, any sample would indeed be sufficient. This view is supported by Miles and Huberman (1994:26) when arguing that one cannot study everyone, everywhere doing everything. Similarly, LeCompte and Preissle (1993:56) add that the observation of a phenomenon in its entirety would be time consuming and would produce a massive amount of data, which would be difficult to process, analyse and interpret. Thus, for the reason stated above, I decided to use purposive sampling as the criteria for sample selection.

Purposive sampling is “selecting information-rich cases for study in-depth” (Patton 1990:169) when one wants to understand something about those cases without needing to generalize to all such cases. To put a layer on top, Garbers (1996:103) adds:” In purposive sampling, researchers handpick the cases to be included in the sample on the basis of their judgement of their typicality. In this way, they build up a sample that is satisfactory to their specific needs.” To be specific, McMillan and Schumacher (2001:400) highlighted two facts about purposive sampling as follows:

- Purposive sampling is done to increase the utility of information obtained from small samples.
- Purposive sampling requires that information be obtained about variations among the subunits before the sample is chosen.

As its name suggests, the sample has been chosen for a specific purpose, that is, participants are likely to be knowledgeable and informative about the phenomena the researcher is investigating (Maree 2007:257; Cohen, Manion & Morrison 2005:103). In light of this, I purposefully selected the given sample (see Chapter 3, paragraph 3.5.4.2) with the view that the participants were information rich cases.

3.6 Measures to ensure trustworthiness

The term “trustworthiness” refers to the way in which the inquirer is able to persuade the audience that the findings in the study are worth paying attention to and that the research is of high quality (Lincoln & Guba in Johnson & Turner, 2003). To achieve this goal, Maree (2007:113) describes procedures that can be used for assessing the trustworthiness of the data analysis: consistency check and credibility. For the purpose of this study, I adhered to the following pointers as explained by Maree (2007:113):

3.6.1 Using multiple data sources

Multiple data sources, such as semi-structured interviews, focus group interviews, observations and document studies, helped the researcher to check the research findings.

3.6.2 Verifying raw data

At the completion of all data collection strategies, the researcher submitted the transcript to the participants to correct errors and to verify whether his or her interpretation of what they have shared with is correct.

3.6.3 Stakeholder checks

To enhance the credibility of the research findings, the researcher allowed the participants to assess and comment on the research findings, interpretations and conclusions.

3.6.4 Verifying and validating the findings

For the research findings to be valid and verified, copies of a draft report were provided to the participants and asked for written comments on the report.

3.6.5 Maintaining confidentiality and anonymity

The researcher maintained confidentiality and anonymity on all occasions.

3.7 Ethical considerations

Ethics in research are the principles of right and wrong that a particular group accepts (Bogdan & Biklen 1992:49). Ethical codes are developed with the intention of serving as guidelines for practice to ensure that participants in research projects are protected from harm and are not deceived. The researcher considered all ethical measures throughout this study, which is the principles guiding the study from the beginning. These principles included deception and consent; privacy and confidentiality; and trust and betrayal. These principles are described by Rossman and Rallis (2003:73) as follows:

3.7.1 Deception and consent

It is ethical norm in social research that no one be forced to participate in any research attempt. The informed consent of participants is crucial for the ethical conduct of research. The ethical principles underlying informed consent are: participants are as fully informed as possible about the study's purpose and audience; they understand what their agreement to participate entails; they give that consent willingly; and they understand that they may withdraw from the study at any time without prejudice. For the purpose of this study, I sought consent from the school principal and asked all educators in the two schools knowledgeable about the topic to participate. Only volunteers were interviewed and had their lessons observed. Each participant in the study was informed of the purpose of the study and the time necessary for participation and was assured of anonymity and confidentiality. This manner of informing participants was done to encourage free choice of participation.

In an essence, this means that the participants are not deceived about the study and that their participation is voluntary. Informed consent also served to protect the identities and privacy of participants. In this study participants were aware that their names and/or identifying information such as specific roles would not be used in any discussions or written documents about the research.

3.7.2 Privacy and confidentiality

Qualitative research takes place in the field, with real people who live and work in the setting. If the researcher promises confidentiality to the participants, s/he must be sure that s/he can deliver confidentiality. This challenge has two elements: protecting participants' privacy and holding in confidence what they share with the researcher. It is also important to remind participants that the researcher will use their words in direct quotes in a written report. In this study I gave the assurance that participant' views, responses and opinions would be treated in the strictest confidence, which would not be violated.

3.7.3 Trust and betrayal

Qualitative research involves building and sustaining relationships with people. It is therefore important that the researcher builds trust with the participants so as to gain reliable data. In the light of this, I built a relation of trust with the participants from the first day when I visited the sites.

3.8 Crystallisation of qualitative data

Crystallisation refers to the practice of “validating” results by using multiple methods of data collection and analysis. In this study, I preferred crystallisation to triangulation, because, as Richardson (in Janesick 2000:392) opines, “the crystal combines symmetry and substance with an infinitive variety of shapes, substances, transmutations, multi-dimensionalities and angles of approach. Crystals grow, change, and alter, but are not amorphous”. Janesick (2000:392) explains that the substance of what one sees when viewing a crystal depends on the way one views it by holding it up to the light or not: “Crystallisation provides us with a deepened, complex, thoroughly partial understanding of the topic” (Richardson, in Janesick 2000:392).

3.9 Conclusion

This chapter described the design and method to be used in data collection and analysis. It further explained the strategies of data collection and described how they are going to be used in the data gathering process. Measures to ensure trustworthiness were also described. Chapter four presents the data analysis and findings of the study.

CHAPTER 4

DATA ANALYSIS, FINDINGS AND INTERPRETATION OF RESULTS

4.1 Introduction

This chapter provides the reader with a factual account in a descriptive format of the data collected at selected senior secondary schools in the Tshwane North Region. Discussion is based on the data collected through semi-structured interviews, focus group interviews, document review and lesson observations as discussed in Chapter 3, paragraph 3.5.2.

As one of the major aspects of research, data analysis and interpretation involve the assertion about the research findings. This level requires the researcher to look for patterns of generalization across multiple sources (Erickson 1986). Different writers (McLean 1995:56 & Yin 1994:135) have employed varied steps or procedures for analysis and interpretation of data. They generally agree that addressing the research question or research objective are the key issues to focus on in data analysis and interpretation.

Qualitative data analysis involves a series of steps working on the raw data and forming categories and hierarchies to arrive at a description of the meaning inherent in the data. To this effect, three major steps could be recognised in analysing and interpreting qualitative data. These are coding, interpreting and making claims (Mason 1996; Stake 1995).

In qualitative research, segmenting and coding of data enables the researcher to organise, manage and retrieve the most meaningful information. Coding is the process of condensing the data by creating categories. Coding links different segments of instances in the data that have some common properties or elements, or relates them to some particular topic or theme. Coding thus helps to link all data fragments to a particular idea or concept (Coffey & Atkinson 1996:27).

In other words, coding helps researchers to identify themes, patterns, events, and actions that are of interest to the researcher and provides a means of organising the data sets (Coffey & Atkinson 1996:32).

Qualitative data analysis has been used in this study because it allowed the researcher to examine patterns of relationships and also to create new concepts and theory by blending together empirical evidence and abstract concepts in order to come to terms with their diversity for the interpretation of data (Neuman 1998:240). This included examining, sorting, categorising, evaluating, comparing, synthesising, and contemplating the coded data and presentation of responses to different points (See the steps of data analysis in Chapter 3, paragraph 3.5.3).

4.2 Results of the semi-structured interviews

This section reports the findings of the data collected from the semi-structured interviews conducted with the e-Learning curriculum specialists, principals, deputy principals and technology educators at senior secondary schools in the Tshwane North Region. Each individual analysis is presented in a table showing themes, categories, descriptions and codes allocated to the different responses. Themes are therefore, classified into categories, descriptions and codes that are shown on different tables. Below each table a brief interpretation of data with summary of quotations obtained from the transcripts of individual interviews is presented and also supported by literature.

4.2.1 Coding of the responses of the curriculum specialists

Interviews were conducted with two e-Learning curriculum specialists responsible for the schools in the Tshwane North Region. In South Africa, the core functions of curriculum specialists are classified as follows:

- To facilitate curriculum and educator development and support initiatives of different phases.

- To ensure the enhancement and expansion of capacity of educators to be effective facilitators and mediators of learning.

- To structure and facilitate constructive relationships with various educator and curriculum development providers in the community, private, government and non-government sectors.

- To ensure the establishment and substance of appropriate structures.

Following the coding of the participants' transcribed responses in terms of the main research questions and interview questions (See Appendix I for interview questions), the following three themes were identified from the semi-structured interviews conducted with the curriculum specialists: technology integration policy, resource allocation, and the role played by the Department of Education in technology integration.

4.2.1.1 Technology integration policy

Table 4.1: Coding system regarding technology education policy, policy adoption, policy implementation and challenges met when implementing the policy at school level

Category	Description	Code
Computer education policy	Schools have to devise their own policy according to the guidelines of the White Paper.	CP1
	The only policies available are e-Education White Paper and Policy number 7.	CP2
Policy adoption	Schools adopt their own customised policy and it is not scrutinized by District office yet. If they have policies, they regulate the use of ICTs; if they do not have policies, they do not have control measures in place.	PA1
	These policies were adopted to close the digital divide gap.	PA2
Policy implementation and steps	Schools implemented their own policies. Not many schools have completed theirs. Training was given by the District office to implement this policy.	PI1
	The policy is implemented at a slow pace. ICT Infrastructure has been installed at schools and Gauteng Online labs are functional at schools.	PI2
Implementation responsibility	The schools under the guidance of the ICT coordinator implement the policy.	IR1

	The e-Learning unit is implementing this policy. Monitoring tools and support systems exist.	IR2
Challenges in implementation	Uniformity of structures or procedures within the Tshwane North Region is a major challenge. Schools do not know what is permissible and implementable due to the fact that e-Learning is a fairly new concept. It was introduced in 2007.	CI1
	The challenges include hardware failure or technical problems. The other challenges are the shortages of ICT and e-Learning materials, and the time frame for developing educators in the afternoons, which is impractical.	CI2

The findings based on the question of the availability of technology policy show that there is no uniform policy for the province. The only policies available are the national policies, namely; the White Paper on e-Education and Policy number 7.

One of the participants, Code CP1, puts it clearly by stating that there is no policy, as such each school has to design its own policy following the White Paper guidelines. As schools design their own policies, they also have to adopt and implement these policies. One of the participants mentioned that implementation is progressing very slowly as some schools have not yet started with their technology implementation processes. Schools take the initiatives in designing, adopting and implementing policies. The findings further revealed that there are guidance, monitoring and support systems from the e-Learning Unit regarding the policy implementation.

Like any another parties that encounter problems with the integration process, the District also encounters a number of challenges such as uniformity of procedures as e-Learning is still a new concept to the District and schools. One of the participants (Code CI2) further outlined the challenges encountered in the following manner:

"The challenges met include hardware failure or technical problems. The other challenges are the shortages of ICT and e-Learning materials, and the time frame for developing educators which is afternoons, and it is not practical."

These findings are in line with Tondeur, van Keer, van Braak and Valeke (2007:214) who state that an ICT policy plan seems to be an important incentive to foster the integration of ICT use in the classroom, but only when educators are aware of its content. In other words, successful ICT integration becomes much more likely when educators share the values expressed within the school policy and understand their implications.

4.2.1.2 Technology resources

Table 4.2: Coding system with regard to resources available, annual budget allocation, software recommended by the Department of Education to schools, partnerships and sponsors available and their roles in education

Category	Description	Code
Resources available	Gauteng On Line (GOL) centers are available. From the District Office side, training for educators and the GOL mobile bus are available.	RA1
	Gauteng Online labs are functional most of the time and there is twenty-four hours per seven days Internet connection.	RA2
Annual budget allocation	No budget for computers, only a Learner Educator Support Material (LTSM) budget. This is, however, in the pipeline.	AB1
	There is no budget allocation on the part of the Department, because this computerisation project is managed by the SMMT company.	AB2
Software packages recommended by the Department of Education	Something new that was introduced this year was the assessment tool Rubricate senior.	SF1
	There is software like SA SAMS which is for management and administration, as well as Qids Service pack for ICT integration.	SF2
Partnership, sponsors or donors and their role	Schools mainly make use of their own sponsors or donors. Some of them are BMW, Telkom etc. The District also has a Policy and Planning Unit where partnerships are formed. This is then utilised by implementation of schools. These companies provide support and maintenance most of the time.	PS1
	Partnerships such as MTN, Vodacom, and Telkom	PS2

	are responsible for Internet connections. The partners provide schools with Internet and also offer ICT training for educators.	

Responding to the question on technology resources, the findings revealed that there is no budget allocated for technology education. The only budget allocated annually is for the Learner Educator Support Material (LTSM). This may be the reason that technology education is not yet recognised and fully adopted as the Department's responsibility. This idea is also indicated by one of the participants (Code AB2) who explained:

"There is no budget allocation on the part of the department, because this computerisation project is managed by the SMMT Company."

The issue of budgeting for ICTs was also highlighted by Howell and Lundall (2000:47) who explain that schools do not budget adequately for maintaining the use of computers. Moreover, the costs remain hidden unlike in the commercial sector where the capital costs of PC represent only one fifth of the yearly cost or running that PC.

At present, there is no software for schools recommended by the Department. The only available software is for management and administration (See Code SF2 for details). In Gauteng Province, Gauteng Online is the only technology resource available which claims to be functional. One of the participants (Code RA2) emphasised the availability of GOL centers by stating:

"There are Gauteng Online labs which are most of the time functional and there is twenty-four hours per seven days Internet connection."

Regarding partnership and sponsors, the Department of Education does not have such a facility. It is the responsibility of individual schools to make partnerships or look for sponsorships that would also provide training and also assist with maintenance problems. This finding is corroborated by Code PS1 who stated that:

"*Schools mainly make use of their own sponsors or donors. Some of them are BMW, Telkom etc. the District have also a policy and planning Unit where partnerships are formed. This is then utilized by implementation of schools."*

These findings corroborate the discussion about infrastructure and connectivity in South Africa as discussed in Chapter 2, paragraph 2.6.2.3.

4.2.1.3 The District's role in technology integration

Table 4.3: Coding system regarding participants view to technology, evidence of the use of technology and support by the Department of Education

Category	Description	Code
Role of technology	Technology can enhance teaching and learning but should not be viewed as the only and ultimate electronic equipment to be used.	RC1
	Technology stimulates learning, improve and promote quality education.	RC2
Evidence of the use of technology	Some schools are integrating IT into lesson planning. For example, Rubricate will be used or schools will use the labs for research and other projects or presentations.	EV1
	There are collaboration groups whereby educators participate in the use of ICT in the classroom competitions and present at conferences. There is also the use of Thutong portal by both learners and educators.	EV2

Support by the Department	We have quarterly ICT coordinators meetings where all issues are discussed. The e-Learning Unit is available for input and guidance. There is training by the e-Learning unit provided to educators and learners. There is also the creation of educator forums where educators share experiences online.	SD1 SD2

In response to the roles played by the District in technology integration, the findings show that the District is supportive as they view technology as a teaching and learning tool that will enhance learners' learning. Participants also mentioned that technology enhance and stimulate learning, improve and promote quality education. One participant (Code RC1) argued that technology should not be taken as the only and ultimate electronic equipment to be used.

In support of these findings, Clark (in Oncu et al 2008:20) argues that technology is nothing but a vehicle for delivering instruction. According to him, technology is like a truck, which delivers our groceries but does not change the value of our nutrition. Based on this argument, Clark does not accept technology as a factor that affects learning and contends that rather than technology, instructional methods affect learner's learning. This argument is also supported by Argnst and Lavy (in Greek 2002:1) who claim that the use of technology does not improve learners' achievements and could even be harmful.

In the same tone, Oncu et al (2008:20) state that focusing purely on technology would be wrong because it would give an incomplete picture of the technology-learning relation. According to Oncu et al (2008:20), learning should be the centre of interest when considering the role of technology in education. These authors stress that the purpose of incorporating technology in the classroom is to enhance learning. To be clear, they described the concept 'enhancement' in two ways. Firstly, as the reduction of time spent in specific sections of a lesson. This means that educators might spend less time introducing ideas since technology allows them to go through the items easily and quickly without having to draw or locate them in the classroom. Secondly, technology can enhance the way educators present their lessons to the learner. In simple terms, technology can be a visual aid that helps learner to picture an abstract concept they would have to understand by listening or seeing presented on the chalkboard.

The findings regarding the evidence of technology integration in schools revealed that not all the schools in the District are using technology for teaching and learning. Only a few schools have already integrated technology into their teaching and learning activities. Evidence of technology integration is provided by one of the participants in Code EV2 who explained:

"There are collaboration groups whereby educators participate in the use of ICT in the classroom competitions and present at conferences. There is also the use of Thutong portal by both learners and educators."

One of the contributory factors to the delay of technology integration might be the lack of technology resources as a budget allocation from the Department of Education for schools to purchase technology resources (See Codes AB1 and AB2).

In terms of support, the findings indicate a number of activities that the District is conducting as a means of supporting schools in the technology integration process.

For example, one of the participants mentioned meetings where technological issues are discussed and guidance is given to schools. In addition, one of the participants (SD2) explains:

"*There is training by the e-Learning unit provided to educators and learners. There is also creation of educator forums where educators share experiences online."*

This finding is in line with Tondeur et al (2007:214) who argue that mechanisms need to be put in place to ensure that educators have adequate access to support. In this respect, these authors stress the provision of ongoing support usually by the ICT coordinators. From this study, it is clear that the ICT curriculum specialist is in a good position to guide and successfully integrate ICT in schools. Tondeur et al (2007:214) further stress that cooperation between schools is an important factor for the integration of ICT. It is clear that one of the central features that underpin the process of integration are contact with colleagues who share similar interests, interaction that involves knowledge exchange, and encouragement to take risks, combined with support in analysing why things go wrong and how they can be improved.

4.2.2 Coding of the responses of the senior secondary school principals

This section presents the findings of the data collected from the interviews with the principals of senior secondary schools. The aim of the interviews was to examine the role played by principals as school managers and administrators in the integration of technology in their schools.

Matamela (1998:44) describes a principal as a professional leader of the school, the manager and a member of the School Governing Body (SGB). It is essential to bear in mind that principals, by virtue of their position, are full members of the SGB, therefore, effective governance and management of the part of the SGB and the principal is central to school effectiveness.

The core duties and responsibilities as set out in the Employment of Educators require that, amongst others, principals should be held responsible for the professional management of the school: they should give proper instructions and guidelines for time tabling, admission and placement of learners; see to the day-to-day administration and learning at the school; perform departmental responsibilities prescribed by law, and organise all the activities which support teaching and learning (Potgieter, Visser, van der Bank, Mothata & Squelch 1997:14; Menstry 2004:59).

4.2.2.1 Background characteristics

Table 4.4: Coding system regarding student enrolment, number of educators employed, educators trained for technology use, technology experience and the amount of training received

Category	Description	Code
Student enrolment	There are approximately 1 100 learners in this school.	SE1
	There are 987 learners in total.	SE2
Number of educators employed	We have 46 educators in this school. Out of these educators, 41 are employed by the state, two are provided by Dinaledi project, two provided by Eskom and one by the SGB.	NE1
	There are 52 educators.	NE2
Number of educators trained for technology use	I cannot tell how many educators were trained up to now. What I know is educators have been invited to the training.	NT1
	Educators are trained in groups. Every term there are some days scheduled for training. This takes place mostly in the afternoons. We have a specialist from outside who comes and trains the technology educator. This educator will in turn train the other educators.	NT2

Technology experience and amount of training received	I am the first one to own a computer in this school, where in 1995, I bought myself a computer and I used to do school letters. I have not undergone any training, I learned many things through trial and error. I have lot of experience I acquired because we introduced computers many years ago already.	TQ1 TQ2

In response to background characteristics, the findings regarding student enrolment show that the schools have a good number of enrolments as well as a number of educators employed to teach these learners. This evidence is indicated in Codes SE1 and SE2 respectively and further show that one school has an enrolment of approximately 1 100 learners, whereas, the other school has 987 learners. With the number of educators employed for teaching these learners, the findings revealed that in the public school there are 46 educators whereas in the private school there are 52 educators. These differences may be caused by the socio-economic status of the parents because in a private school funds are contributed by individual parent. The costs are high so that the school can afford to hire and pay the fees of a certain number of educators (See chapter 1, paragraph 1.2 for the definitions of public and private schools).

In response to the question concerning the number of educators trained for technology and the amount of training received, the findings show that educators attended some training. However, one of the participants did not undergo any training; he learned the computer through trial and error. This finding is shown in Code TQ:

"*I am the first one to own a computer in this school, where in 1995, I bought myself a computer and I use to do school letters. I have not undergone any training; I learned many things through trial and error."*

In support of these findings, Odera (2005:337) explains that training of educators in the use of computers could be a step forward in motivating them to change their beliefs about the use of computers and help them to utilise computer technology more effectively in teaching and learning. In addition, Merkley et al (2001:220) feel that educator training is key in promoting learner' successful manipulation of multiple literacies. In the same vein, Shakifa, Boekman and Mogale (2004:1) highlight that in some countries projects focus on training for the implementation and sustainability of ICT based interventions in education. Shakifa et al (2004:1) further state that some of these educators see pre-service training as essential, while others consider in-service training the appropriate response.

4.2.2.2 Personal views on technology integration

Table 4.5: Coding system regarding participants' views to donors and sponsors' vision of technology education, and the greatest challenges faced

Category	Description	Code
Donors and sponsors	Fortunately Eskom has provided some computers as well as the air conditions in the computer lab. The previous SGB somewhere in the year 2000 had a vision of establishing a computer lab. We managed to put up an infrastructure, but we did not have enough funds to buy equipments. Fortunately Telkom invited the school to write a business plan. Our school's business plan was approved. Due to the fact that we already had an infrastructure, Telkom donated thirty computers. After the SGB managed to raise funds, then twenty more computers were bought. Eskom, upon adopting our school, also provide us with twenty more computers. Right now, there is another company sponsoring us, Epoch Optimum and due to this we are conducting	DS1

	classes every Saturdays. The last contract that we did, that is with Canon, made it possible for educators to have laptops. Canon is doing a contract for all our printing work here at school. Instead of giving us printers, it gave us laptops to the educators which is part of the contract.	 DS2
Vision of technology education	Our vision is that at some stage, all educators should use computers as a teaching tool. We have a plenty of computers in the lab, therefore, no learner should leave this school without basic computer skills. I really think the Department of Education is aware of the importance of computers.	VE1 VE2
Greatest challenges faced	There are educators who are elderly and are rebellious to technology. Right now, I doubt if everybody has got an e-mail address and we have been having computers for a very long time. This would provide a stumbling block in one way or the other as we would be using technology for correspondence. Educators also get trained and at the end they do not implement. Knowing how to fix some parts of the computer is also a problem. Fortunately, I bought a new computer that took time before it could give me problems. If it jams, then I seek help from computer specialists. At the moment, our challenges are printing facilities. We have two big printers in every computer room, but the printing becomes so much that is so costly. In a classroom of 35 learners, to print whatever they have to print in one period is just not possible. The printer jams due to the printing queue. The other problem is lack of relevant computer knowledge, because if I get stuck with the computer I don't know what to do, I have to call someone to come and help.	GC1 GC2
Technical	The school has been able to replace and maintain.	TP1

problems	Fortunately, our technology educator is able to do that. We have expert educators. An educator who is very familiar with, for instance, the white board will have to assist the other educators. We also have a technician.	 TP2
Support	We don't have a facilitator for IT and CAT in our District. Such people are scarce and we don't have even one around here. Our technology educator has to attend meetings in other Districts. There is no support at all, especially in the independent schools. We have to provide our own training and pay for it ourselves. We do attend cluster meeting, but is very seldom that you will find the District representatives available.	VS1 VS2

In response to the question based on the participants' vision about technology education, they show a keen interest in the computer as a teaching and learning tool. One of the participants, in Code VE1 mentioned that his vision is to see all learners computer literate when leaving the school. Principals also have some challenges that they experience as managers of school. One of the challenges mentioned by participants is that they experience problems with the printer. One of the factors that may contribute to this challenge might be that schools do not purchase good quality printers.

For schools to overcome this type of a challenge, they have to purchase a laser printer. This view is also supported by Shelly et al (2010:226) who describe the laser printer as a high-speed, high quality nonimpact printer, which prints very high quality black-and-white text and graphics quickly.

Another problem encountered is support on the part of the Department. This emanates from insufficient qualified personnel who can assist and facilitate in the field of technology education. One of the participants (Code VS2) explained:

"*We don't have a facilitator for IT and CAT in our District. Such people are scarce and we don't have even one around here. Our technology educator has to attend meeting in other Districts.*"

4.2.3 Coding of the responses of the deputy principals of senior secondary schools

4.2.3.1 Technology integration policy

Table 4.6: Coding system regarding availability of technology policy and the integration with other subjects

Category	Description	Code
Availability of technology policy	Let me point out that the policy is there.	CP1
	For everything that happens at school, there is a policy on how it should happen. We have a subject policy which is for CAT only. This policy also shows how the computer rooms should be run. Each and every educator has his or her own subject policy which addresses the integration of the subject with computers.	CP2
Technology integration with other subjects	We got laptops that educators are already taking to classes, so I think the integration is proceeding well.	TI1
	In each and every subject, one or other time in the year you ask the learners to either do research via the Internet for your subject, or you will ask learners to make a print out task which could be a CV for an example. We make sure that each and every child will have reason in each and every subject to visit the computer centre or to use the facilities, the printer or the computer. All educators in all the subjects have to use technology in the ordinary weekly lesson plans. They also have to present how they are going to incorporate the technology in their subjects.	TI2

The findings from this data show that both schools have designed a technology integration policy to assist them in planning, controlling and managing their technological equipment. To be specific, one of the participants explained it clearly in Code CP2 when he stated:

“For everything that happens at school, there is a policy on how it should happen. We have a subject policy which is for CAT only. This policy also shows how the computer rooms should be run. Each and every educator has his or her own subject policy which addresses the integration of the subject with computers.”

This finding is supported by Tondeur et al (2007:21) when indicating that educators in schools with an explicit ICT school policy that stresses shared goals are using ICT more regularly in their classroom. They add that as a consequence, an ICT policy plan seems to be an important incentive to foster the integration of ICT use in the classroom, but only when educators are aware of its content. In other words, these authors view successful ICT integration as becoming much more likely when educators share the values expressed within the school policy and understand their implications.

It is evident from the findings that both schools are integrating technology into their daily teaching activities; however, one of the participants (Code TI1) is not quite sure of the integration procedures. To put emphasis on this finding, one of the participants (Code TI2) explained that technology is already integrated in all their school subjects, and both learners and educators are using it in their daily teaching and learning activities. This finding is verified by this statement:

"In each and every subject, one or other time in the year you ask the learners to either do research via the Internet for your subject, or you will ask learners to make a print out task which could be a CV for an example. We make sure that each and every child will have reason in each and every subject to visit the computer center or to use the facilities, the printer or the computer. All educators in all the subjects have to use technology into the ordinary weekly lesson plans. They also have to preset how they are going to incorporate the technology in their subjects."

4.2.3.2 Partners, donors and sponsors

Table 4.7: Coding system regarding donors and sponsors, technology equipment and related facilities

Category	Description	Code
Donors and sponsors	Due to the high matric pass rate in the previous year, Macro donated an amount of R50 000 to our school of which we purchased white boards. Gijima also donated an amount of R150 000 which was used to buy computers.	DS1
	In the beginning when we started with the teaching of computers, we had only a computer center with old upgraded computers which were donated by Edgars. The donors also installed different programmes that we could use.	DS2
Equipments and related facilities	There is only one computer center with 63 computers, white boards in some of the classes and a digital projector.	TE1

	There are three computer centers with 35 computers each. All in all there are 105 computers for learners in this school. Classes also have LCD projectors that show on the class screen. About five to six classes permanently have cameras inside. In all the classrooms we have computers for each educator, a laptop as well that could be carried home.	TE2

This table shows that both schools are technologically equipped and they can be classified under well resourced schools. One of the factors promoting this classification might be the relationship they have established with some top businesses in South Africa, for example, Macro and Edgars. To start teaching with computers was not an easy route to be taken. This is evident where one of the participants mentioned that they started with used computers. For further clarification, Code DS2 explained:

"In the beginning when we started with the teaching of computers, we had only a computer center with old upgraded computers which were donated by Edgars. The donors also installed different programmes that we could use."

With reference to the technology equipment and related facilities available at schools, the findings reveal availability of equipment and facilities of higher quality. Schools have at least a computer center fully equipped with technological resources. To corroborate this finding, Code TE2 stated:

"There are three computer centers with 35 computers each. All in all there are 105 computers for learners in this school. Classes also have LCD projectors that show on the class screen. About five to six classes permanently have cameras inside. In all the classrooms we have computers for each educator, a laptop as well that could be carried home."

4.2.3.3 Problems encountered in technology integration process

Table 4.8: Coding system regarding support, staff development and problems encountered

Category	Description	Code
Support	I don't know if I should say I have support, but some officials from the Department of Education do come to our school and hold workshops. They like to use our resources because we are the only school around with computers.	SS1
	We get lot of support from a certain lady. She is not involved with the Department of Education, but I don't know if she is also an educator. Apparently she wrote the textbooks. She also provided us with a wonderful scheme of work, wonderful preparations and lesson plans. Our educators are very fortunate that they get work with lot of support.	SS2
Staff development	We have made the availability of the Internet which is every Monday. Any educator can access the Internet. We also encourage educators and invite them to use the computer center regularly.	SD1
	We sent our educators on courses regularly, at least once a year. We also sit together and see how technology is implemented. I, as the deputy principal, depend heavily on the senior educator because she is a very experienced lady and has been teaching computers for many years. So we are guided by her.	SD2

Problems encountered	We don't have enough manpower on the educator part. For example, there is only one person who was trained and also has an idea in relation to IT. These people are very scarce. There are people who have a phobia of using computers. In a school like this, you would expect every educator to be having an e-mail address. However, there are many of the educators who still don't have e-mail addresses. These types of educators would only touch a computer whenever there is a demand of some kind, for example, if submission of marks is required.	PE1
	The problem we had then and that we continued to have for a number of years is maintenance. Every time we would have a computer breaking down, and it would take time for the technician who is already over burdened to come and fix that computer. So the learners could not continue. Learners will be held back while his friend in other workstation will be continuing. Sometimes computers will be out of action for a number of days depending on how serious the problem is. Security is also one of the problems. Twice we had all our computers stolen; while the second time the guard was seriously injured, almost killed. Inside stealing also is a high problem. For example, learners would steal a mouse or software.	PE2

The findings show that there is no support given by the Department of Education in terms of technology integration. It is evident that the department personnel visit the school to utilise the technological resources available as one of the participants mentioned in Code SS1. Some experts from private companies and NGO's saw it necessary to support schools with the integration processes. This is supported by the statement made by SS2:

"We get lot of support from a certain lady. She is not involved with the Department of Education, but I don't know if she is also an educator. Apparently she wrote the textbooks she also provided us with a wonderful scheme of work, wonderful preparations and lesson plans. Our educators are very fortunate that they get work with lot of support."

Data also show that the deputy principals are playing a role in developing the staff members in their departments. One of the ways used is encouragement to use the computer center and attend workshops. One of the participants (Code SD2) mentioned:

"We sent our educators on courses regularly, at least once a year. We also sit together and see how technology is implemented. I as the deputy principal depend heavily on the senior educator because she is a very experienced lady and has been teaching computers for many years. So we are guided by her."

Although the findings revealed that schools are well resourced and have a policy and other facilities, the schools still encounter problems in trying to integrate their technology effectively into teaching and learning. These problems emanate from technophobia, theft and maintenance issues. One of the participants explained these problems explicitly in Code PE2. This is stated as follows:

"The problem we had then and that we continued to have for a number of years is maintenance. Every time we would have a computer breaking down, and it would take time for the technician who is already over burdened to come and fix that computer. So the learners could not continue. Learners will be held back while his friend in other workstation will be continuing. Sometimes computers will be out of action for a number of days depending on how serious the problem is. Security is also one of the problems. Twice we had all our computers stolen; while the second time the guard was seriously injured almost killed. Inside stealing also is a high problem. For example, learners would steal a mouse or software."

The findings are in agreement with Shelly et al (2008:470) who explain that any event or action that has the potential of causing a loss of computer equipment, software, data and information, or processing capability is a computer security risk. Shelly further explains that some of these risks, such as viruses, unauthorized access and use, and information theft, are the result of deliberate acts that are against the law. Any illegal act involving a computer generally is referred to as a computer crime.

4.2.4 Coding of the responses of the technology educators

4.2.4.1 Qualifications, teaching experience and support from departments

Table 4.9: Coding system regarding participants' qualifications, teaching experience and support from the departments

Category	Description	Code
Qualifications and teaching experience	I have a Bachelor of Arts (BA) with IT as an additional course. I don't have any teaching qualification, but experience in teaching. I started teaching CAT in 2001.	QT1
	Actually I am a mini college educator, and this is my third year in the teaching of computers.	QT2
Self development	I am working on my own, whenever I discover a problem, I have to do research on my own to address it. I have been trying to go to websites, trying to get some blogs to communicate. There is neither special	SD1

	in-service training nor workshops I have attended which were arranged by the Department of Education. Last year I did lot of courses, I went for extra Excel and Access courses. But this year up to now, I did not do anything. The only thing I did was the Excel beginners' course and Microsoft basic staff. If there will be any course, I will go because I will learn a lot from it.	SD2
Support	The school itself is supportive, I have all the equipments and presently we have 40 new computers to be installed in the computer center. In terms of Department of Education, actually what I can say is I don't have enough support. There is neither special in-service training nor workshops offered by the department. There is no one coming here, I don't have a cluster leader, or a subject advisor. They are all in Johannesburg and I cannot drive there always. When I came here for the first three years, these computers were old and there were lot of problems. Sometimes learners could not log in, and the printer also stopped during printing work. Now the computers are 100% working most of the time. The syllabus is there, the CDs and the files are all right. It is a pleasure of working here and I can give more attention to the learners. For IT there is not even a subject adviser. We are coaching each other and we go to the meetings as the people there are much more experienced than us.	DS1 DS2

To answer questions concerning the relevant qualifications and technology teaching experience of educators, the findings reveal that educators are professionally qualified for teaching; however, not all have the relevant specialisation for the teaching of technology. There are two groups of qualified educators in this regard: one qualified as an educator; the other with a specialisation in technology. No matter the qualification, the emphasis is on the teaching of technology. This finding is indicated in Code QT1 who states:

"I have a Bachelor of Arts (BA) with IT as an additional course. I don't have any teaching qualification, but an experience in teaching. I started teaching CAT in 2001."

This finding is in line with Russels et al (2000:149) who explain that the identification of educators' information technology skills is a prerequisite for future professional development. Russels et al (2000:149) argue that educator preparation in the use of information technology is characterised by the provision of low-level computer skills. The authors further expound on the complexities of life in the twenty-first century. Demands for educator competencies in learning technology require a paradigm in which educators routinely use advanced computer skills and embed the use of information technology across all aspects of the school curriculum.

Thus, Wood et al (2005:201) support the notion of the level of educator experience and state: "One of the most critical features for the integration of technology is the individual educator's level of experience and comfort with technology." In addition to this, Straus and Stern (2002:2) stress that educators' knowledge, skill and philosophy are determinants of their instructional methods.

Based on the question relating to training attended, it was found that educators did not get the opportunity to be invited to any workshops or training arranged by the Department of Education.

One of the participants (Code DS2) explained that he gains experience from people with whom he shares a cluster. In this way a self-development forum is formed. The other respondent (SD1) develops himself through the use of the Internet:

"I am working on my own, whenever I discover a problem, I have to do research on my own to address it. I have been trying to go to websites, trying to get some blogs to communicate. There is neither special in-service training nor workshops which I have attended which were arranged by the Department of Education."

This finding corroborates the findings of the Department of Education (2003) regarding the challenge of producing computer literate educators across the nation (See the discussion in Chapter 2, paragraph 2.6.2.3). In support of this endeavour, Bigum (2000:14) advises schools to forget about the children and worry about educators. Today's technology standards (ISTE 2000) challenge educator education programmes to address the need for producing computer literate educators who are not just knowledgeable of the Internet, but who are also confident in their ability to incorporate instructional software and website into everyday classroom teaching. In a same tone, previous researchers (Dugdale 1994:249; Gobbo & Girardi 2001:68; Holland 2001:245) have argued that in order to use computers effectively, successfully and appropriately, all educators should be trained and need to be competent to use computer applications in teaching and learning.

In response to the question on support from the school and the Department of Education, the findings show schools providing considerable support in the shape of available equipment for teaching and learning. However, participants are not satisfied with the support from the Department of Education. Code DS2 explained:

"When I came here for the first three years, these computers were old and there were lot of problems. Sometimes learners could not log in, and the printer also stopped during printing work. But now, the computers are 100 % working in most of the times.

The syllabus is there, the CDs and the files are all right. It is therefore a pleasure of working and I can give more attention to the learners. For IT there is not even a subject adviser. The senior educator and I are coaching each other and we go to the cluster meeting because the people there are close by and also much more experienced than we are. So, I would go to people like them."

In support of these findings, Dawson and Rakes (2003:31) state that the school's principal is expected to act as the instructional leader and see that the necessary preparation and interventions are provided to educators. In this regard, the leadership in a school largely determines the outcome of technology integration. However, administrators cannot fully or effectively support technology if they do not understand it. In addition, Mecklenburger (1989:7) emphasises that administrators must understand both the capabilities and limitations of technology, only then can they plan for, budget for, purchase carefully, install properly, maintain dutifully, schedule adequately, distribute appropriately, and replace systematically the electronic technology best suited for their needs.

In the same tone, Redmann and Kotrlik (2004:2) concur that support for educators' use of technology has evolved over the last decade from minimal or non-existent support in many schools. Redmann and Kotrlik (2004:2) further state that this support comes in many different forms including public support, availability of technology for both educators and student use, educator training, release time for planning and learning, technical support, administrative support, and availability of appropriate instructional materials.

4.2.4.2 Technology use and challenges met by educators

Table 4.10: Coding system regarding networks, technology use and software available as well as allocated time and the challenges met by educators

Category	Description	Code
Networks	Not all the computers are networked in this school. I have only networked 35 computers and Gijima EST company still has to network other computers.	CN1
	Our computers are networked. We have a Local Area Network (LAN) and the server is in one of the offices.	CN2
Technology use	Actually computers are used for teaching and learning in this school. Educators are also welcomed to use the Internet for research because we have installed the card. Sometimes we load the Internet for learners to do research. Some of the educators have already integrated their subjects with the computer, for example, Mathematics, Life Sciences and others.	UC1
	Computers are used by both educators and learners. Most of the educators do their work on the computer. They also send their group of learners to the computer centre to do activities on the computer, and this takes place almost in the afternoons.	UC2
Software	The school is using software such as Windows XP as an Operating System, Windows Server 2003 for the server, Office 2003 and 2007 for programming, Delphi language in IT and Encarta for learners.	SW1
	There is lot of software programs used by learners. The IT person put on the server, and there is landscape programme that will start with Word up to Access and Excel. So, learners can log in and use either of the	SW2

	programs.	
Allocated Time	35 minutes per six day cycle is allocated for computer usage. Most of the times learners would visit the computer centre during breaks (lunch hour), after school and even during weekends. The period is 30 minutes per day.	NT1 NT2
Challenges	The challenge is the community itself, because our learners are coming from a disadvantaged community. At some stage you would ask parents to buy their children personal computers and software like Delphi to use and study at home, but parents cannot afford. There is also lack of resources such as software for teaching and learning. This is because the software that I am using right now is from the North West Department of Education. There is a new software Delphi A, which is used presently, of which I don't have and I don't know how and where to get it. There is no guidance at all; I cannot even construct an IT file. All what I can do is to rely on NCS documents. There is always a challenge in every lesson you offer and every group of learners you are teaching. You got your clever learners, you got your fast learners and your slow learners and you must accommodate them all. To start with a new lesson is a big challenge because, there are lot of people who can do things but cannot explain them. I saw it with Access program; I nearly erased the programme as I was stuck with the part of the syllabus.	TC1 TC2

In attempting to answer the question based on networks, the findings indicated that in both schools the computers are locally networked, as such, they use a Local Area Network. This finding means that learners and educators have access to the Internet.

Networks are groups of computers that are connected to each other for the purpose of passing data back and forth (Jonassen 1996:159). According to Jonassen, there are different levels of networks, that is, Local Area Networks (LANs) and Wide Area Networks (WANs). LANs are used to connect computers within an organisation or a local area. They are frequently used to connect all of the computers in a school or lab so that they can share programmes from a server, which has a large disk drive for storing programmes. WANs on the other hand connect all of the computers in a community or region. This means that educators and learners have access to the Internet. One of the participants mentioned that he has networked the computers himself, which shows an advanced knowledge and skill in terms of technology equipment. It is important for a school to have a network so as to enable both educators and learners to access the Internet as a research tool. This view is in line with Valedez and Duran (2007:33) who states:

> Having a computer and being connected to the Internet define the central characteristics of physical access. Physical access to computer is the critical factor for encouraging educators to integrate computer in their classroom instruction. Physical access can be described as a spectrum in which certain educators may have computers connected to the Internet in their own classrooms, while other may have less convenient connections or even more remote access in libraries or computer labs.

To address the question of the usage of technology for teaching and learning, the findings revealed: both educators and learners are using the computers for teaching and learning. This is indicated by Code UC1 as described:

“Actually computers are used for teaching and learning in this school. Educators are also welcomed to use the Internet for research because we have installed the card. Sometimes we load the Internet for learners to do research. Some of the educators have already integrated their subjects with the computer, for example, Mathematics, Life Sciences and others.”

Data based on the software used at school show quite number of software packages used; some of these are specifically used for teaching and learning. This software is clearly indicated by Code SW2:

“There is lot of software programmes used by learners. The IT person put on the server, and there is landscape programme that will start with Word up to Access and Excel. So, learners can log in and use either of the programmes.”

The findings indicate that both educators and learners have positive attitudes toward the use of technology in their schools. This is possible only if the users are confident and believe in themselves. Based on this statement, attitudes are usually defined as a disposition or tendency to respond positively or negatively towards a certain thing (idea, object, person, and situation). They encompass, or are closely related to our opinions and beliefs and are based upon our experiences. Since attitudes often relate in some way to interactions with others, they represent an important link between cognitive and social psychology.

These findings concur with Hovland, Janis and Kelly (1953:1) who state that changes in opinion can result in attitude change depending upon the presence or absence of rewards. Hovland et al (1953:1) further caution that learning of new attitudes is no different in nature than any other verbal or motor skill, except that opinions relate to a single proposition, whereas other skills involved a series of propositions. The acceptance of a new opinion is dependent upon the incentives that are offered in the communication

Similarly, Heider (1959:1) suggests that when beliefs are unbalanced, stress is created and there is pressure to change attitudes. He further mentions the two main factors affecting balance as the sentiment (e.g. liking, approving, admiring) and the unity (e.g. similarity, proximity, membership) qualities of beliefs. Balance exists if the sentiment or unity between beliefs about events or people is equally positive or negative; imbalance occurs when they are dissimilar in nature.

In addition, a study on educator attitudes revealed that educator confidence affects the use of technology more than other factors, such as access to equipment, administrative support and time (Levin & Wadmany 2008:237). In the same vein, Oncu et al (2008:20) point out that an educator's attitude toward using ICT in the classroom is an important factor for successful technology-classroom integration.

On the issue of allocated time, schools differ accordingly. Some schools follow a certain rule of thumb to draw their time tables. For example, some schools follow a five-day cycle whereas others would prefer a six-day cycle. This may depend on the daily hours spent at a particular school. From this view, one school scheduled its activities for 35 minutes; whereas the other school scheduled its activities for 30 minutes per period. The frequency of computer usage also plays an important role. Based on the findings, there is a high demand in the usage of computer by learners, which is reflected by Code NT1 when he states:

"35 minutes per 6 day cycle is allocated for computer usage. Most of the times learners would visit the computer center during breaks (lunch hour), after school and even during weekends."

Based on these findings, Valadez and Duran (2007:33) highlight that the use of computer expands the definition of 'accesses' by including the amount of time educators spend using computers and the Internet for instructional purposes in school and at home.

Access also includes frequency of e-mail use, creating instructional material, and keeping learners' records. From this explanation, computer use also implies the frequency educators use higher order instructional strategies in their classrooms.

To address the question concerning the challenges met by educators when trying to integrate technology into their teaching and learning, the findings show that learners are experiencing a number of challenges, such as parent involvement. One of the participants indicated parental capacity as a major barrier to technology integration due to the fact that some parents cannot afford to purchase computers and software for their children to use during study, homework or projects at home. This can be verified by Code TC1:

"The challenge is the community itself, because our learners are coming from a disadvantaged community. At some stage you would ask parents to buy their children personal computers and software like Delphi to use and study at home, but parents cannot afford. There is also lack of resources such as software for teaching and learning. This is because the software that I am using right now is from the North West Department of Education. There is a new software Delphi A, which is used presently, of which I don't have and I don't know how and where to get it. There is no guidance at all; I cannot even construct an IT file. All what I can do is to rely on NCS documents."

In support of these findings, a study by Torres (2002:8) has shown that parents play a critical role in developing a child's interest in computing. Torres (2002:8) further maintains that parents influence their children through both their own actions and the amount of encouragement they give to their children.

4.3 Results of the focus group interviews

Focus group interviews as one of my data collection methods were conducted in two senior secondary schools around Tshwane North Region to obtain as much data as possible on what learners are capable of doing on the computer and gleaning opinions about the computer as a subject taught in schools (See Chapter 3, paragraph 3.5.2.2 for the purpose of the focus group interview). The target group consisted of boys and girls aged between fifteen and eighteen years.

4.3.1 Coding of the participants who participated in the focus group interviews

Each focus group analysis is presented in a table showing categories, description and codes allocated to the different responses. Below each table a brief summary of quotations obtained from the transcripts of focus group interviews supported by literature is presented.

From the analysis of the focus group interviews, the following main categories were identified after coding learners' responses in terms of the main research questions (see Chapter 1, paragraph 1.4) and focus group interview questions (See appendices E).

- Reasons for enrolling technology as a subject.
- Programmes used for teaching and learning.
- Problems encountered in the learning of technology.
- Learners' perceptions regarding the learning of technology.

4.3.1.1 Reasons for enrolling technology as a subject

Table 4.11: Coding system regarding participants' interests, exploration, knowledge and skills

Category	Description	Code
Interest	It was presented well and I became interested.	IE1
	I am interested in working with computer programmes, because they are easy to use. You can, for example, make presentations, newspaper, and so forth.	IE2
	I think it is interesting and things are changing. Computers are becoming the biggest thing in the world.	IE3
	I found computer application technology very interesting. It gives me the opportunity to be more familiar with technology and be computer literate.	IE4
	Because I was interested in learning about computers.	IE5
	I am greatly fascinated by the computer system.	IE6
Exploration and trying new experiences	It is challenging and I prefer challenges which require a lot of hard work so that I can overcome them.	EN1
	I wanted to try something challenging and now that my school introduced IT, then I thought I would enrol for it because I thought it would be something intriguing.	EN2
	I wanted to become a chartered accountant and computer application technology as a subject will help me in the careers that I am interested in, in terms of sending e-mails and that entire stuff.	EN3
	I enrolled for computer application technology because I like experiencing new things and know more. Computer	EN4

	application technology is all about every day's technology.	
	I wanted to learn the basics of computers so that I can use computers accurately at home, and to know more about the evolving technology.	EN5
	I want to learn more about how technology work, describing how information and communication technologies affect and change our communities and society.	EN6
	I enrolled for computer application technology because I wanted to learn more about computers and the technology around us.	EN7
	Computer application technology is suggested by companies, schools and universities. It keeps me up to date with the latest uses of the programmes in the computer.	EN8
	Computer application technology is the most subject that I would like to learn a lot.	EN9
	To learn more about computer application technology.	EN10
	We are living in e-world, so I wanted to learn more about electronic things.	EN11
	To be able to create easiest technology in the future and learn more about networks.	EN12
Knowledge and skills	I wanted to learn more about computer information and be able to have an understanding on this subject. It also inspires me and I enjoy working with new technology to gain more knowledge.	KS1
	I want to acquire the knowledge and skills in this	KS2

	computer application technology.	
	To gain computer skills and be able to use different programmes without any difficulty.	KS3
	To have knowledge and be able to share more information with others around the world.	KS4
	To share information with different people and to know about how they communicate through e-mails. To study information that arrives.	KS5
	So that I can be able to get computer skills, communicate with people through e-mails.	KS6
	Because nowadays the careers that are available involve a lot of computer uses.	KS7
	I do computer application technology because I wanted to broaden my knowledge of computer. But, I would also love to do IT. It is just that our school does not offer it.	KS8

Data from this table shows that learners enrolled for computer technology as a subject due to the following reasons: Interest (IE), exploration and trying new experiences (EN) and knowledge and skills (KS).

In terms of interest, participants explained that they became interested by this subject because it was presented well to them, they find it easy to work with the programmes like presentation graphics, and it gives them the opportunities to become familiar with technology. For example, Code IE4 mentioned:

"I found computer application technology very interesting. It gives the opportunity to be more familiar with technology and be computer literate."

This finding is supported by interest theory by Renninger, Hidi and Krapp (1992:7-8) which defines interest in three ways: personal interest, situational interest and interest as a psychological state. Renninger et al (1992:7-8) propose that personal interest is considered to be an individual's predisposition to attend to certain stimulus, events, and objects. While situational interest refers to the likelihood that particular subject content or events will trigger a response in the moment, which may or may not "hold" over time. Thus, it refers to elicited attention in the sense of enjoyment, or curiosity etc. but no assumptions can be made about the level of content knowledge. Finally, interest as psychological state refers to the level of interest triggered when a specific topic is presented, and seems to have both individual and situational aspects.

The second reason mentioned by participants is exploration and trying new experiences. The findings show that many participants enrolled for the subject in order to learn more about computers and related technologies. Other participants enrolled for the subject because they experienced new things and they also wanted to be kept up to date with the latest programmes used. One of the participants mentioned that he enrolled for computer as a subject to prepare himself for a career. This can be seen in Code EN3:

"I want to become a chartered accountant and computer application technology as a subject will help me in the careers that I am interested in, in terms of sending e-mails and that entire stuff."

This finding is in line with Redmann and Kotrlik (2004:1) who indicate the rapid changes occurring in society and in technology. Redmann and Kotrlik (2004:1) state that these changes had a tremendous impact on the educational community as it prepares individuals for the workplace. These authors, further mention that an impact of rapid technological change is that employers now demand employees who not only have an understanding and an appreciation of technology, but can use it in their jobs and in their own training in innovative ways. In this respect, employees must not have a working knowledge of all types of software equipment; rather they must have a foundation that enables them to move.

The third reason mentioned is acquiring knowledge and skills so that learners can use different programmes without any difficulty; to learn about the communication tools; and to enjoy working with different programs. One of the participants Code KS5 responded:

"I want to share information with different people and to know about how they communicate through e-mails."

To support this finding, Oncu et al (2008:33) corroborate that learner need to feel comfortable using technologies that educators bring into the classroom. Oncu et al (2008:33) further mention that learner cannot be expected to know everything about a new technology. However, it is common practice to train learner before a full scale integration of technology in the classroom.

4.3.1.2 Programmes used for teaching and learning

Table 4.12: Coding system regarding Microsoft Office, Delphi, Microsoft Publisher, Encarta and Norton Antivirus

Category	Description	Code
Microsoft Office	I use multiple of programmes such as Word and Access. I am able to type assignments with Word and store data using Access.	MO1
	We also use Microsoft Office to learn how to use Databases and Spreadsheets which in turn amplify your ability to use and help people learn the basics of computers.	MO2
	I use programmes like Microsoft Database for grouping many records together, Notepad to store text that Delphi will need to make use of the information.	MO3
	We are using many programs like Spreadsheet, Access and Microsoft Word. Spreadsheet helps us with calculations.	MO4
	We are using Microsoft Word to gain more understanding and to know how to type faster, Microsoft Excel to know how to insert calculations in its columns and using signs, Microsoft PowerPoint to make presentations and to create your own magazines, and Microsoft Access to create data and queries professionally.	MO5
	I use Microsoft Excel because I want to analyze and perform calculations, Microsoft Word so that I can communicate with the world, Microsoft PowerPoint because I want to know how to present information,	MO6

	and Microsoft Access because they are essential tools for information management.	
	The programme that I am using is Microsoft Word because it is fast, colourful and has interesting features.	MO7
	We use Microsoft Excel for charts, graphs and calculations, Microsoft Word for typing exercises, Microsoft PowerPoint for producing professional presentation, and Microsoft Access for storing professional data.	MO8
	I use Excel for calculating the average, mini, max and doing school reports, Microsoft Word for writing letter, parents' letters and editing or formatting text, Microsoft PowerPoint for presentation, Microsoft Access, e.g. schedule of learners and assist on doing school reports.	MO9
	We are using Word processing for typing skills, formatting, editing documents and making tables. Excel programme for working with spreadsheet calculations, Access programme to create tables, queries, forms, report and macros.	MO10
	I use Microsoft Excel, it deals with spreadsheet calculations. Microsoft Word for typing, practicing and checking the speed. Microsoft PowerPoint deals with presentations and Access because it deals with Database.	MO11
	I am using Microsoft Word in case of typing, PowerPoint in case of making my presentations attractive, Microsoft Excel in case of calculations of columns and rows and Microsoft Access in case of	MO12

	making reports, forms.	
	We use Microsoft Word, it is a word processing program and computer application technology is more about words than text. PowerPoint presentation leads me to combine text and graphics as well as animation and sound. Microsoft Access is an important programme because it can be used to keep record of numbers and details of people.	MO13
	We are using many programmes like Spreadsheet, Excel, Access and Microsoft Word. Spreadsheet helps us with calculations.	MO14
	I am using Microsoft PowerPoint to design and use different types of word, Microsoft Word for typing and learning how fast or slow your speed is and. Microsoft Access to learn more about how Database is located.	MO15
	We are using Microsoft Excel to analyze data stored and perform calculations, Microsoft Access because you can store and organize tables that are linked, Microsoft PowerPoint so that you can be able to present proper presentations and Microsoft Word, the ability to format text.	MO16
	I am using Microsoft Word to learn about writing letters and formatting things, Microsoft Excel to learn about spreadsheet calculations, Microsoft Access for queries and tables and Microsoft PowerPoint for presentation purposes.	MO17
	We use Microsoft PowerPoint to do easy presentations, Microsoft Excel to be able to do easy calculations. Word to know more about formatting	MO18

	and other things and Microsoft Access to be able to organize any data clearly and neatly.	
	We are using Excel programmes because it works with large amounts of data and organize it quickly, examines relationships between variables and draw graphs to show the relationship, apply mathematical formulae easily, work with many variables and compare values when we change variables and interpret information.	MO19
	I am using Microsoft Word, Microsoft Excel to learn how to calculate numbers via computers, Microsoft PowerPoint to learn how to make presentations, and Microsoft Access to learn how to do Database.	MO20
	Most of the time I use Microsoft Word 2007 because its format is a great convenience. I also make use of Microsoft Excel.	MO21
	I use Microsoft Word to type letters, prepare and print all sorts of documents, Microsoft Excel to calculate other things like average, minimum and maximum.	MO22
	I am using Microsoft Word for projects and Microsoft Excel for budget.	MO23
Delphi	The main program that I use is Delphi which I use for programming as it is one of programming language such as Pascal C++.	PG1
	At school we use Delphi to design different application and to learn how different software are designed and created. Delphi is an easy way, an easy application to learn programming.	PG2

	We use Delphi programme to develop software.	PG3
Microsoft Publisher 2007	We are using Publishing programme to create Web pages, calendar, etc.	MP1
Encarta	I use Encarta for research.	PE1
Norton Antivirus	We use Norton Antivirus for checking virus on the disks.	NA1

One of the questions asked was about which programmes are used in teaching and learning. This question was asked in order to identify the various programmes that are already used by secondary schools. The information obtained emphasised the following categories:

- MS Office (MO)
- Delphi (PG)

- Microsoft Publisher (MP)
- Encarta (PE)
- Norton Antivirus (NA)

Most of the participants' answers focused on Microsoft Office (Microsoft Word, Spreadsheet, Presentation graphics, Database and Web browser). Participants indicated that they use Microsoft Word for creating documents, typing their assignments, typing letters and using editing and formatting features. Other participants use programs such as Spreadsheet for doing calculations, PowerPoint for presentations, Database or Access for capturing data, and Web browser or Internet for searching information on the Web. To verify these findings Code MO9 indicated:

"*We are using Excel for calculating the average, mini, max and doing school reports. Microsoft Word for writing letter, parents' letters and editing or formatting text. PowerPoint for presentation, and. Access, e.g. schedule of learners and assist on doing school reports."*

These findings concur with the views of several authors (Shelly et al 2008; Heinich et al 1996; Alessi & Trollip 2001; Anderson 1993) about productivity tools. These authors further highlight several programmes that could enhance the integration of technology into teaching and learning activities (See Chapter 2, paragraph 2.5 for productivity tools).

A few participants indicated that they use Delphi for programming. For example, Code PG1:

"*The main program that I use is Delphi which I use for programming as it is one of programming language such as Pascal C++."*

Based on this finding, Jonassen (1996:233) described the advantages of computer programming as follows:

- Programming languages are often bundled with computers when purchased or are otherwise available inexpensively.

- Computer programmes may be used to solve a wide range of problems.

- Programming skills are applicable to many situations and content domains.

- Programming skills are marketable, especially if the language is commonly used.

Very few participants explained that they use Microsoft Publisher 2007 to create Web pages and calendars (MP1); Encarta for research (PE1); and Norton Antivirus for cleaning a virus on the disks (NA1).

Microsoft Encarta is an educational software programme that allows learner to interact with a myriad of subjects (Shelly et al 2008:335). These applications allow learner to see and experience clearly things they could never experience by only reading a textbook. According to Shelly et al (2008:335), applications such as these also allow learner to build a cognitive scaffold, which is a mental bridge to build an understanding of complicated concepts. Another benefit is that they encourage learner to think not only in words and pictures, but also in colours, sounds, animations, and more.

4.3.1.3 Problems encountered during the learning of technological subject

Table 4.13: Coding system regarding time, software packages, computer jargons, computer knowledge and skills, and lack of resources

Category	Description	Code
Time	The practising of IT, which is, programming in Delphi, requires more time. Therefore, other subjects are suffering.	PT1
	This subject is time consuming; you spend a lot of your time trying to understand it. You don't get enough time to concentrate on other subjects especially if you don't have a time table.	PT2
	The time allocated for the subject is not enough for me and sometimes I find it hard to get into the topic then move on to the next in one day.	PT3
	The time with Access and Excel was a little bit challenging because I didn't know how to calculate them by using formula.	PT4
Software packages	Using Microsoft Access in creating queries and reports is difficult to me.	SF1
	The problem that I really had in this subject was calculating the number of goods and service, e.g. food. It was really a big problem for me to use spreadsheet in calculating this expenses or numbers.	SF2
	The problem I had in this subject is working with Database; it is not a simple programme to use.	SF3
	The problem I had with this subject is Microsoft Access.	SF4

	The problem I had with this subject is Microsoft Excel, for me it is a bit hard.	SF5
	I had problems with practice of programming in Delphi.	SF6
Computer jargons	The terms that are used in the textbook are not understandable.	CJ1
	The understanding of some terms in this subject is too hard to get and they are very complex, and sometimes hard to get the meaning.	CJ2
	Sometimes the explanation from the textbook is not clear and understandable.	CJ3
Computer knowledge and skills	To edit and format e-mail is hard for me.	CK1
	Typing fast has given me a bit of a problem. Apart from that I am OK.	CK2
	I didn't really know what I was doing and it was a hard to learn everything especially working with the keyboard.	CK3
Lack of resources	None, except for new changes in technology every day. Our textbooks do not have much information, so we have to use the Internet regularly in order to be updated on new things.	LR1
	I have had no problems with the subject as it is user friendly and it is more practical, excerpt that computer application requires lots of information and we would use most textbook.	LR2
	Slow Internet access.	LR3

The main area of problems experienced in learning computer include time (PT), using software packages (SF), computer jargon (CJ), computer knowledge and skills (CK) and a lack of resources (LR). Participants mentioned that they lack time to practice computer. Computer is a practical subject, therefore enough time and equipment are needed for learners to manage their practice. The other contributing factor to time is the allocation of computer on the time table (See table 4.5 for time allocation). This finding would suggest that access to computer is an obstacle.

In support of this finding, a study by Odera (2005:331) shows that access to quality software is also considered to be an important factor that encourages educators to integrate technology into traditional subject teaching. An assumption made by this study states that once the technology equipment is available, educators would use it for teaching and learning. According to Odera (2005:331), access to technology equipment does not mean obtaining a computer or software, but it includes getting it and using it as required. In the same vein, Merkley et al (2001:220) denote that as classroom access to communication and information technologies increases, and as vast amounts of information become available in digital format, learner will need to be literate across a variety of communication technologies.

Using software packages is one of the problems encountered by learners. Participants explained that they experienced problems in using packages such as Access in creating queries and reports and also using spreadsheet for doing calculations. This finding is in line with Heinich et al (1996:235), who state that hardware and software are still too expensive for most schools to afford, especially in developing countries like South Africa. Heinich et al (1996:235) further mention that computers require a classroom environment free from dust and high humidity, with adequate ventilation and this might not be available in many schools. According to Heinich et al (1996:235), compatibility is a crucial issue that must be looked into before purchasing the software, because software development for one computer system may not be compatible with another. Due to differences in hardware, computer programmes are rarely accessible to many schools and this limits widespread utilization (Slabbert 1999:71).

Computer jargon is the major problem experienced by both learners and educators. Participants mentioned that they do not understand some of the terminology used in the textbooks, therefore terminology is a barrier. If educators were familiar with the jargon used, they could have explained to the learners and a flow of knowledge acquisition would result. A participant mentioned that computer skills and knowledge like editing, formatting and typing fast is his major problem.

The last problem encountered is lack of resources such as computer text books and slow Internet access. These findings are supported by Kennewell (2003:75) who claims that learning effectively with ICT requires an appropriate level of ICT capability. Moreover, Kennewell (2003:75) identifies the features of ICT that aid learning as interactivity and provisionality. To exploit interactivity, the user must know how to respond to screen prompts from the software. In order to exploit provisionality, the user must know how to save, load and edit work in progress. In conclusion, Kennewell (2003:75) mentions that if learners do not have sufficient skills in using ICT, they experience the ‘ICT interference factor’ and ICT becomes a barrier rather than an aid to learning.

4.3.1.4 Learners' perception regarding technology as a subject

Table 4.14: Coding system regarding technology usage and its advantages

Category	Description	Code
technology usage	It is easy to use. If you are familiar with the basics of the old technology, the new technology won't vary much. This enables people to get along without any problems. In conclusion, technology will remain to be basic in its sophistications.	EU1
	Technology is easy to use. You just have to learn and to practise using it then everything will just come naturally. Your mindset controls how you think, and apply different things, you will learn if you are willing.	EU2
	I find technology easy because I like working with it, and learning fast because I have passion and I love using new technology. It is not only about knowing it, but also about knowing how to use it and what to do and pressing the right buttons.	EU3
	Exchanging files from one computer to another is easy because there are fast network cables that transport information fast. Computer application technology also uses cell-phones where you can send pictures to your lap-top using Bluetooth and USB for storage devices.	EU4
	I find technology easy because every new thing involving technology has a manual for you to look at and learn about the use and operation of such technology.	EU5
	I really think it is easy to use because if you are	EU6

	committed I think you can find it easy and interesting.	
Advantages of using technology	It opens doors to a lot of opportunities in our vast world of technology. After a while you always fall in love with this subject which is a good thing.	AD1
	Nowadays, technology has a high impact on peoples' lives. It even plays a bigger role to people because we are now using technology and you have to know more about it.	AD2
	Having computer skills will help you to type your CV and you can even open your own Internet café.	AD3
	It can help you in the future, e.g. if you want part time job, you should be having a computer experience.	AD4
	It is important especially for those who will be studying for admin, office administration, etc.	AD51

The last question dealt with learners' perceptions about the technology as a subject. In interpreting these data, it was found that learners find the technology easy to use. Learners like working with technology; they have passion for the subject and love using technology throughout. One of the participants (EU6) mentioned that he finds technology easy because he is committed and is interested in what he is doing. This finding is supported by Tapscott (1998:148) who saw learning undergoing a process of change: from torture to learning as fun.

Tapscott (1998:147) further mention that entertainment has always been profound part of the learning process and educators have always been an integral part of the learning process (See Chapter 2, paragraph 2.10.1.3 for further discussion).

The second category discovered under this theme is the advantages of using technology. Several participants mentioned various advantages of using technology. For example, they mentioned that technology opens doors and there

are many opportunities in the world. Other participants see technology as having a huge impact on peoples' lives. Technology is also seen as an opportunity for the entrepreneur. For example, one respondent (AD3) indicated: "If you have computer skills, you can open your own Internet café." These findings corroborate with Gregoire, Bracewell and Laferriere (1996:18). In an analysis of the contributions of new technologies to teaching and learning process in elementary schools, Gregoire et al (1996:18) provided the following findings with respect to student learning:

- New technologies can stimulate the development of intellectual skills.
- New technologies can contribute to ways of learning knowledge, skills, and attitudes, although this is dependent on previously acquired knowledge and the type of learning activity.
- New technologies spur 'spontaneous interest' more than traditional approaches.
- Learner using new technologies concentrates more than learner in traditional settings.
- New technologies help spur a research spirit within learner.
- New technologies promote collaborative learning.

4.4 Results of the lesson observations

Observation as one of the data collection techniques was used in collecting data for this study (See Chapter 3, paragraph 3.5.2.4 for the purpose of using observations). Three lessons were observed in each school to explore the relationship between educators' beliefs and their use of various strategies to integrate technology in the curriculum.

In observations, the following data were collected and recorded as field notes:

- I stayed at the back of the classroom throughout the lesson and took notes to describe the setting, the transactions that took place as well as comments on the observations made.

- Lesson observations and daily meetings with participating educators enabled me to study the educators' practices in real life teaching and learning situations and provided indirect or implicit measures of the educators' beliefs (See observation details in Chapter 3, paragraph 3.5.2.4).

Part of the purpose of the lesson observation investigation was to establish the classroom interactions that transpired during the technology lesson. This was captured using the observation matrix (See appendices J). Observations were based on the following criteria:

4.4.1 Physical layout of the computer laboratory

- School A

The school has three computer laboratories furnished with thirty-five computers each. All computers are connected to a Local Area Network. Accessories like the printer, ceiling fan, white board and data projector are in place.

The computers are arranged in an oval shape format, that is, the computer desks are mounted on the wall sides and there are two rows of computers in the middle of the room. The educator's table is in front next to the printer and the white board. This observation findings support what was said by one of the respondents in code TE2.

There is only one computer center with 63 computers, white boards in some of the classes and a digital projector.

- School B

The school has one computer laboratory only with sixty three computers. There is an air conditioner, data projector and white boards. Neither all computers are functional, nor connected to the Internet. This will suggest that the internet is not always available to learners. These findings are supported by the respondents in codes TE1 and LR3.

There are three computer centers with 35 computers each. All in all there are 105 computers for learners in this school. Classes also have LCD projectors that show on the class screen. About five to six classes permanently have cameras inside. In all the classrooms we have computers for each educator, a laptop as well that could be carried home.

4.4.2 Sitting arrangements

- School A

Learners formed a group of four and worked together on the computer. This observation is supported by the collaborative view that learners working in groups achieve the best.

What was observed is totally an opposite because some groups kept on making noise, whereas the educator thought they were discussing the facts. This had an impact as the task could not be completed and handed over to the educator. One of the factors to this problem might result from the amount of time given for the lesson. This finding is supported by the responses of the respondents in codes MT2 and TC2 respectively.

There is always a challenge in every lesson you offer and every group of learners you are teaching. You got your clever learners, you got your fast learners and your slow learners and you must accommodate all these differences.

The period is thirty minutes per day.

- School B

Learners formed a group of six members working collaboratively towards the finalisation of a task. One of the reasons might be that there is insufficient number of computers connected to the Internet. This finding is in line with the responses of one respondent in code CN1 who stated:

Not all the computers are networked in this school. I have only networked 35 computers and Gijima EST company still has to network other computers.

Based on the above mentioned observations, one noticed that the groups varied from individual school depending on the outcomes of the lesson. In support of this finding, studies by Johnson, Johnson and Maruyama (1983:54); Johnson and Harlow (1993:4) and Slavin (1991:71) show that there has been great interest in the effects of social interaction on learner' achievements and attitudes. These studies further reported that cooperative learning has positive effects on achievement, higher-level reasoning skills, motivation, attitudes, self-esteem, collaborative skills, and other important educational outcomes in the affective domain.

Studies on cooperative learning also showed positive effects in enhancing learner' conceptual understanding (Basili & Sanford 1991:289; Smith, Hinckley & Volk 1991:410). For effective teaching and learning, it is therefore suggested that the learner be organised into cooperative teams to create a learning community.

4.4.3 Use of ICTs in class

Part of the purpose of the lesson observation investigation was to establish the classroom interactions that transpired during the technology lesson. This was captured using the observation matrix (See appendices J).

Usually the educator occupies a central position in classroom interaction in that he or she often dominates classroom talk and asks questions, while the learners sit and listen (Tanui et al 2008:282). In these observations, the opposite arose. Learners were the ones who talked a lot with the educator giving guidance to the activities.

These teaching strategies enhanced learning by enabling learner to construct their own learning using technology as an instructional tool. Woodbridge (2004:1) mentions that true technology integration is rare. It involves learner constructing their own learning while using both hardware and software tools and allows for learner-centred approaches for both educator and learner.

4.4.3.1 Lesson phases

Lesson phase is classified into introduction, development, consolidation, expanded opportunities and reflection. These categories were covered in all lessons observed. The differences were experienced in the manner of introducing the lesson to the learners.

On introducing the lesson, the educator created a rich learning environment in which learners regularly engage in activities that would have been impossible to achieve without technology. Technology was used to deliver curriculum content to learners, for example, learners were directed in the use of software programs and also encouraged to select other software programs and modify their use to accomplish the task at hand.

- Teaching methods and strategies

The teaching methods used in schools include discussion of some events, review of questions, questioning, and demonstration by the educator. In questioning activities, learners were asked questions relating to how to search for information on the Internet and the basic features, functions and facilities of a presentation graphics. Under the educator demonstrations, the following were demonstrated; concepts of a search engine and search strategy, importance of an effective search string and formulation of a search string. The educator in this regard, facilitates learning by encouraging active inquiry, guiding learners to question their tacit knowledge (http://hagar.up.ac.za/catts/learner/2001/untiedt-ish/projects/100/web-page/www.stemnet.nf.cs/%7Eelmurphy/elmurphy/cle2b.html. Furthermore, the educators facilitate learning by guiding learners, coaching them in constructing their own knowledge (providing scaffolds), then educator gradually decreasing assistance as learners construct their own meaning. This finding is further supported by Tapscott (1998) in his discussion of the changing roles of the educator in an ICT classroom with special reference to the principle: From educator as transmitter to educator as facilitator, as discussed in chapter 2, paragraph 2.10.1.3.

The findings revealed that both institutions applied cooperative learning to direct the learning process. This means that learners worked together in groups to maximize classroom learning and accomplish shared learning goals (See Chapter 2, paragraph 2.10.1.1).

- Learning activities

In terms of the learning activities, learners were given projects to complete. For example; they observe and exercise the skills of using a search string in a search engine to find information about a specific topic.

In this regard, learners play an active role in responding to the problem that should be solved (http://hagar.up.ac.za/catts/learner/2001/untiedt-ish/projects/100/web-page/www.stemnet.nf.cs/%7Eelmurphy/elmurphy/cle2b.html. They also construct their ideas to complete the given task. This finding is further supported by the constructivist theory discussed in Chapter 2, paragraph 2.10.1.1.

4.5 Results of the document review

In addition, I also collected curriculum materials related to the lesson observed. These included: lesson plans, text books, worksheets, handouts, records of learners' performance as well as some basic information about technology during the lesson (See Chapter 3, paragraph 3.5.2.3 for the discussion on document review). I also requested the following information from the school: policy related to ICT in school, ICT infrastructure, including the number and kinds of computers and peripherals, network and configurations.

In reviewing these documents, it was found that the lesson plan was explicitly written down and followed the format of the National Curriculum Statement. In one of the Schools observed, learning schedules and lesson plans were not designed by the educator herself. They were purchased as a package from one of the technology experts who also write technology textbooks (see the attached documents in appendix K). These documents are easier for the educator to follow and make the task of the educator very easy.

The observation also reveals that there are sufficient technology text books supplied by the Department of Education. Not all of these text books are used by the educators and learners. There is a great confusion of which one is most suitable to support teaching and learning.

Educators' records indicated the learners' progress in using the computer and various tasks are given as a way of continuous assessment. Learners' workbooks also correspond to the lesson outcomes and assessment standard indicated in the lesson plan. These findings correspond to Odera's (2005:330) view of the availability of curriculum study guides and texts for the use of computers. In her view, Odera (2005:330) mentions that curriculum study guides and texts such as educators' and learner' manuals, relevant software, a secondary computer syllabus and textbooks provide educators with information and the guidelines on how to integrate and use technology. The author further explains that without the necessary support materials the integration and use of technology in teaching and learning cannot be fully effective.

4.6 Conclusion

This chapter has described and presented the results of the interviews, lesson observations and document review. Interviews were held with the curriculum specialists from the Department of Education, Tshwane North Region concerning the computer technology policy in schools. The chapter also presented the results of the interviews with school principals, deputy principals, technology educators and learners at different schools concerning the use of technology for teaching and learning. Furthermore, the chapter described and presented results of the lesson observations and document used by educators and learners in the teaching and learning of technology. The next chapter (chapter 5) presents the main findings, conclusions and recommendations of the study.

CHAPTER 5

MAIN FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In this chapter the main findings, conclusions of the research and recommendations for action, improvement, integration and further research are presented. The conclusions are based on the review of literature and findings from the semi-structured and focus group interviews, as well as the findings of the lesson observations and document review. All the research instruments have been attached in Appendices A –E.

This study set out to explore the barriers to effective technology integration in teaching and learning in senior secondary schools in the Tshwane North Region, Gauteng Province. This was done by examining previous research studies on the use of technology in teaching and learning and ICT policies in both developed and developing countries; by investigating the provision of ICT education in South Africa; and by field research which explored:

- The extent to which educators and learners have access to technology as examined in Chapter 4, paragraphs 4.2.4; 4.3 and 4.4.

- The frequency of technology usage at school as examined in Chapter 4, paragraph 4.2.4.2.

- The degree of training and professional development of educators as examined in Chapter 4, paragraph 4.2.2.1 and 4.2.4.1.

- The challenges faced by both educators and learners in the integration process as examined in Chapter 4, paragraph 4.2.2.2, 4.2.3.3, 4.2.4.2 and 4.4.1.3.

This study provided evidence that technology is integrated and used in senior secondary schools in Gauteng Province. However, not all schools have already

integrated technology to their subjects. The study consists of five chapters as briefly explained in the next sections:

Chapter one set out the main research problems, aim and objectives of the study. The methods used to collect data to achieve these objectives included a review of relevant literature on the use of technology in both developed and developing countries. It also included semi-structured and focus group interviews, observations and document study. Further evidence presented in chapter one indicates that technology was introduced in senior secondary schools in the Tshwane North Region because technology gives learners skills that are needed in the 21st century. It also clarified the basic assumptions and research questions. In addition, the chapter outlined the sample of the study, data analysis and definition of concepts. The chapter ended with a summary of the organisation of the thesis.

Chapter two presented the ways to modify teaching techniques and strategies to motivate today's digital learner to learn. It discussed the development of ICTs and the Information Age. The chapter further discussed the national policies and practices on ICT in education, focusing on developed countries and developing countries. Lastly, the chapter addressed the challenges of the digital divide in South Africa, the role of the educator in an ICT learning environment and strategies for integrating technology in teaching and learning.

Chapter three explained the methods used to collect qualitative data. The empirical research for this study was conducted using semi-structured and focus group interviews. The semi-structured interviews were used to elicit information on departmental and school policies on the use of technology education from e-Learning specialists, principals, deputy principals and technology educators. Focus group interviews were used to collect data from learners in the sampled schools. Chapter three also discussed the data collection procedures and data analysis.

Chapter four provided a detailed analysis of interviews, observations and document study. It explained the research findings on the use of technology for teaching and learning and the frequency of technology usage by both learners and educators. The findings revealed evidence of the professional development of educators as well as the challenges met by the curriculum specialists, principals, deputy principals, educators and learners in using technology for teaching and learning.

Lastly, **Chapter five** provides a review of the thesis, discussion of the main research findings, limitations of the study, implications of the findings for effective technology integration in teaching and learning, recommendations for improvement, suggestions for further research and conclusions.

The field research was conducted both at District level to interview the e-Learning curriculum specialists about the policy and practice of technology education in schools as well as at the local level through interviews, observations and document review in two information and communication technology-enriched senior secondary schools. The results of the study are presented in the following sections.

5.2 Summary of the results of the field investigations

The aim of this summary is to highlight important research findings regarding the barriers to effective technology integration in teaching and learning in senior secondary schools that participated in the investigation. Firstly, it was established that:

- There is no written technology education policy document circulated to schools. Schools have to develop, adopt and implement their own policies following the guidelines of the White Paper on e-Education.

- There are neither funds allocated for the purchase and maintenance of technology equipments, nor partnerships built with donors and sponsors who will supply such services to schools. Instead, schools have to look for sponsors themselves and also raise funds to furnish their computer centres with technology equipments.

Secondly, it was evident from data obtained that:

- Few educators were trained and qualified in the use of technology for teaching and learning.

- The majority of educators had several problems that hindered effective integration of technology to teaching and learning, such as, lack of support from the Department of Education, lack of community support specifically from parents of learners, insufficient learner support materials such as software and lack of adequate time for both educators and learners to use technology for teaching and learning.

Thirdly, with regard to educators' and learners' use of technology for teaching and learning, the results indicated that:

- Technology is already integrated with subjects like mathematics, science and life sciences.

- Learners use technology tools to search information as a means of completing their homework, projects and assignments.

- Educators confirmed that learners are not at the same level of computer literacy, therefore, the findings show that learners share computers in groups.

- The majority of learners reported that they have and use Microsoft Office packages. In addition, some of the learners use Encarta, Publisher and Delphi.

The above findings are discussed in detail in the following section (5.3).

5.3 Discussion of the main research findings

The research study was designed to achieve the four objectives that were listed in Chapter one (See paragraph 1.5).

5.3.1 The extent to which educators and learners access technology

The first objective was to describe the extent to which educators and learners access technology. With regard to this objective, the findings seemed to be successful. The results indicate that educators are already using technology to plan and present their lessons**.** The findings also revealed that learners use technology to learn certain skills. This could be interpreted that technology is integrated into teaching and learning. There is ample evidence in the literature that when integrated effectively, technology can enhance and improve learner' learning.

Odera (2005:334) claims that the potential for technology to improve learning cannot be realised unless two important things are in place. First the educators must be skilful in teaching in traditional ways so that they know how to motivate learners, how to explain things clearly, how to assess learning in appropriate ways. Second, the educators must be very knowledgeable about the subjects they are teaching so that they can recognise when it is most appropriate to use technology as a teaching tool.

In light of this claim, these findings fit well into the four-stage continuum of ICT integration (UNESCO 2002:15-16) discussed in Chapter 2, paragraph 2.9.1.6. The findings reveal that the investigated schools are in the emerging phase.

Based on this finding, it would mean that when creating an instructional design for technology integration, educators should plan their lessons to meet the learning outcomes. This is informed by the Technology Planning Model (Roblyer 2006:53) and the ASSURE model (Heinich et al, 1996:20) discussed in Chapter 2, paragraph 2.9.1.4.

5.3.2 The frequency of technology usage at school

The second objective of the study was to explore the frequency of technology usage at school. The findings from this study show that technology is frequently used for teaching and learning. As indicated in Chapter 4, paragraph 4.2.4.2, learners extensively use technology by frequently visiting the computer centres during breaks, after school and even during the weekend. This could be interpreted to mean that the learners' interest is aroused by technology and they are therefore motivated to learn and work with technology. These findings are informed by ARCS Model (Keller 1983:4-6) discussed in Chapter 2.9.1.2.

5.3.3 The degree of technological training and professional development of educators

The third objective of the study was to identify the degree of technological training and professional development of educators. The findings revealed that the majority of principals and deputy principals who participated in the study had no training in the use of technology. However, most educators interviewed in the study have some relevant teaching qualifications, adequate teaching experience as well as some experience of teaching with technology.

This could be interpreted to mean that educators lack in-service training to develop technology skills necessary to equip learners effectively to operate in the twenty-first century. This would also suggest that educators have to move away from the old method of teaching to a new approach of teaching in the digital age.

For this reason, these findings are well informed by the interactive model of learning (Tapscott 1998:134) as discussed in Chapter 2, paragraph 2.9.1.3.

5.3.4 The challenges faced by both educators and learners in the integration process

The fourth objective of the study was to provide evidence on the challenges met by educators and learners when integrating technology to teaching and learning. As with adoption of any curriculum innovation, the use of technology in teaching and learning presents educators and learners with many problems and challenges. The findings revealed major challenges such as lack of common technology policy, unqualified technology educators, lack of time and insufficient resources. These challenges are further discussed hereunder:

- *Lack of common technology policy*

The findings show that there are no well structured procedures to be followed to guide schools on the implementation process. This raises a concern as e-Learning is a new concept in the Tshwane North Region introduced only in 2007.

- *Unqualified technology educators*

Many schools lack qualified technology educators who can drive the technology 'wagon' and assist other educators in integrating technology effectively into their teaching and learning activities. Educators who are presently teaching technology as a subject are not qualified educators according to the Employment of Educators Act. Educators who are deemed qualified have a problem with using technology. Some are afraid of using technology and claim that they are too old to master new technology. This raises the concern of technophobia.

- *Time*

The findings show that there is limited time which is a contributory barrier to teaching and learning with technology. This finding is evident in the training of educators whereby educators are sometimes trained in the afternoon (after school hours). This finding raises the issue of fatigue as educators have already spent half their work day involved in the classroom activities before attending training. Moreover, educators are reliant on different types of transport after school as most commute from different areas. Finally, there is the possible conflict of interest between work and family related issues in the afternoons. Some of the educators are parents with young children who need care and attention and assistance with homework.

Learners also experience time as a challenge whereby they cannot access the technology especially the Internet fully as required. The observations revealed that the time to technology allocated is too little; as a result learners cannot complete their given activities and submit their work at a given time. This problem also affects the educator, as she or he cannot proceed according to plan. Instead of making progress, educators had to give learners a chance to complete previous work before proceeding with new content. The question of time correlates with the learners' level of understanding. If learners do not understand some concepts, time is wasted on a particular activity that requires that understanding. Moreover, learners had problems with concept understanding, especially in terms of the terminology or computer jargon used in some textbooks.

- *Insufficient resources*

According to observation, both schools have technology equipments. However, the interviews revealed a problem of insufficient resources experienced by both schools. Resources such as poor printing facilities play a major role. This results from the large student enrolment; two or three printers cannot accommodate all the school's printing.

Consequently, long queues are experienced and learners cannot print their work within a given time. Printers do not produce quality work and often jam.

- *Maintenance and theft*

Maintenance and theft are challenges experienced by schools. In the case of maintenance, the findings revealed no qualified technicians on the school premises to solve maintenance problems. Schools have to employ outside technicians who must travel from Pretoria, which is costly for schools. A major problem is theft and vandalism. Computer equipment like hardware is stolen by outsiders; some learners also steal software. This can leave the school without any equipment as most equipment is donated by companies.

5.4 Limitations of the study

This study comprised a comprehensive investigation on the barriers to effective technology integration into teaching and learning to make a contribution to technology integration in senior secondary schools in the Tshwane North Region, Gauteng Province. However, various limitations prevailed during the course of field research.

Firstly, this study was limited to e-Learning curriculum specialists responsible for schools in the Tshwane North Region.

Secondly, the research was limited to senior secondary schools that had technology for teaching and learning. Since many schools in the Tshwane North Region are not using technology for teaching and learning, these had to be excluded from the study.

Thirdly, the study did not consider all stakeholders in the investigated schools. Data were collected from selected principals, deputy principals, technology educator and learners who were considered knowledgeable and would be able to shed light on the topic.

Nevertheless, the above limitations do not imply that this study is not valid. Exposing the limitations can assist in suggesting a direction for the implementation of the

findings and suggestions for future research. The data obtained are considered useful and the objectives of the study were achieved.

5.5 Suggestions for further research

On the basis of the findings and in the light of the limitations identified in this study, the following issues need further investigation:

- Since a well structured written policy for technology education on the part of the District is lacking, the District's role in assisting schools with the integration processes should be examined.

- The study concentrated on principals, deputy principals and technology educators. Further research could involve all the stakeholders to get their perceptions on technology integration.

- The study focused on two senior secondary schools that are claimed to be technology rich. Further research is necessary to investigate what other schools are doing and what inhibits their use of technology for teaching and learning.

5.6 Recommendations

Based on the research findings and suggestions for further research, a national strategy for designing and implementing technology policy should be developed in the Tshwane North Region to integrate technology effectively into teaching and learning. This will help educators to plan and teach with technology and assist learners to become technologically compliant with 21st century demands.

To this effect, the following recommendations are formulated to serve as a guideline for drafting a clear policy for the practice of technology education in schools:

- The Department of Education should design, develop and help schools to implement a common policy regarding technology education.

- The Department of Education should identify skilled facilitators who can provide training and support to educators at school levels.

- Sufficient numbers of educators in the field of technology should be trained and equally distributed to schools.

- Schools should allocate enough time for technology education as it is a new subject at all schools.

- Each school should be equipped with technology tools, for example, the Internet, so that both educators and learners can do research. Availability of technology will reduce educators' tasks, such as marking. It is, therefore, a requirement that each educator be provided with technology.

- Schools must have at least one technician in full time employment to deal with maintenance and user problems. This person should be appointed by the Department and be paid an appropriate salary to maintain the centre.

- Security systems should be in order to minimise theft and vandalism of technological assets.

5.7 Reflection on the research

This study provided me with a valuable experience through my interaction with the school management team (principals, deputy principals), technology educators and learners, while sharing their experiences, perceptions, beliefs and attitudes on the challenges encountered in integrating technology into the teaching and learning activities. I developed a better understanding of the barriers that affect schools and how teaching staff and learners endeavour to integrate technology into their teaching and learning activities. The following quotation sums up my experience and presents a challenge to other researchers and readers:

> Both educators and computers have strength that serve as logical solutions to educational problems. Neither can fully replace the other, nor can either be rejected categorically as ineffective or undesirable. Several heuristics can be followed that capitalize on the strengths, well minimizing the limitations of educators and computers (Hannafin & Peck 1988:35).

5.8 Conclusions

In presenting the research findings and using them to answer the initial research questions, the participants' experiences were discovered through the lens of those theorists who work in an interpretive theoretical paradigm. In summary, the following emerged from the findings:

Literature on computer usage in schools according to provinces as discussed in Chapter 2, paragraph 2.7 indicates that Gauteng Province has more schools with computers compared with other provinces, but it has fewer schools with computers dedicated to teaching and learning. According to tabulated statistics in Chapter 2, Gauteng Province is rated the second according to schools with computers for teaching and learning; Western Cape is first. This clearly indicates that there are schools around Gauteng Province with computers that are not used for teaching and learning. This may be the result of challenges experienced by participants at their different schools as mentioned in the main findings above.

The findings indicate that technology is integrated in teaching and learning in some schools around Tshwane North Region; however, some schools have not yet integrated technology into their teaching activities. One of the inhibiting factors may

be a lack of training and professional development of teaching staff. This factor is corroborated by Muirhead (2001) of the University of Phoenix. Muirhead (2001:1) comments as follows:

> Today, integrating technology into the curriculum is failing because educator training is the missing ingredients in educational reform efforts. I have observed how metro Atlanta, Georgia public school districts have created a flowered educational system. Sadly, the current administrative structure fails to adequately prepare educators to effectively use their computers and computer labs. Often the technology staff devotes most of their time to repairing computers. In fact my school system has state of the art equipment: all buildings are wired for computers and cable televisions, a network system that continues to add more sophisticated software packages and financial resources to provide live television shows between schools. Yet, the absence of consistent technology instruction for educators has created an unnecessary barrier to creating relevant technology applications. Unfortunately, learners are given the illusion of computer-mediated instruction. I have noticed that educators are trying to compensate for the lack of professional instruction by helping one another learn new software programs. Ultimately, school districts are going to have to invest more money and personnel into training their educators. The American public has high expectations for their educators. Yet, they are often not willing to provide the basic resources for them to effectively do their jobs.

In the sampled schools, technology is used for teaching and learning, therefore, social interaction between the educator and the learners took place. This suggests that a constructivist learning strategy is used in the typical classroom. The role of the educator had changed from educator-centred to learner centeredness. In a nutshell, learners discover new concepts themselves by using the Internet as a research tool. To Levin and Wadmany (2008:235), educators must be involved in at least two radical changes: learning to use technology and fundamentally changing how they teach.

It is clear that we as educators cannot continue teaching as was done in Industrial Age when knowledge was limited and controllable. In the Information Age, it has exploded and became uncontrollable. Moreover, in the Industrial Age work was primarily manual, using manual tools, whereas in the information age information and communication technology tools enable us to perform much more powerful tasks and be much more productive.

To be more precise, educators in the sampled schools are integrating technology into subject-specific instruction and have seen the benefits of technology integration in the learning experience. According to Levin and Wadmany (2008:234), ICT can change teaching and learning by being a source of knowledge, a medium for transmitting content, and an interactive resource furthering dialogue and creative exploration. ICT is thus considered to be both the cause of change and a major means of achieving it. To support this finding, Shelly et al (2006:413) stress that integrating technology effectively into the curriculum requires planning, time, dedication, and resources.

South African has transformed its education curriculum based on social needs as part of a globalised world. A characteristic of modern society is that it is driven and shaped by technology which brought with it the need for new knowledge, skills and values (Gauteng Department of Education 2005:3). Every day, computers help many individuals accomplish job-related tasks more efficiently and effectively. For educators, computers and other technologies serve as the tools needed to implement new and evolving teaching strategies. Educator involvement with technology is a trend that has shifted from learning how to use technologies to seeking ways to support learning with technologies. Educators appear to guide their learner towards engaging in activities of technology. Despite this trend, technology has not yet effectively been integrated into classroom practices. While there is more technology in classrooms, there is little evidence that these technologies are integrated into the teaching instruction. Though technology is increasingly available at schools, this does not necessarily mean it is being used effectively for teaching and learning.

It is therefore important for schools and educators to have computer technology policies wherein the process of technology can be effectively integrated into teaching and learning. In this respect, Tondeur, van Braak and Valcke (2006:13) add that the

responsibilities of local schools to develop a school-based ICT curriculum that translates the national ICT-related curriculum at school level into an ICT plan as part of the overall school policy is necessary. They further stress that an ICT plan makes ICT competencies visible for all parties involved, and stimulates the dialogue among school managers, educators and parents about ICT use in the local curriculum. This is also in line with the recommendation of Olson (2000:1) who states that ICT integration depends on the understanding and the commitment of educators: "What they find may challenge their educational philosophy and practice in expected ways – some good and some not so."

Although technologies have been used in some schools in Africa for up to a decade, the integration of technology into all subject areas in the classroom practice has became a new way to transform pedagogy. Shifts in pedagogy include a move to problem based, or investigative learning, which not only requires learners to assume increasing responsibility in the learning process, but also requires educators to surrender the type of control over the learning process that they have in conventional pedagogy. In this context, learning becomes more open ended, with the educator's role changing to that of a 'facilitator' from being that of a 'provider'. I believe that the integration of technology into teaching and learning makes both implications applicable to this study. When technology is incorporated into curriculum, it should be built into the whole education system. Therefore, integrating technology in the school curriculum means introducing a new pedagogy in the classroom.

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APPENDIX A: REQUEST TO CONDUCT RESEARCH

GAUTENG DEPARTMENT OF EDUCATION

RESEARCH REQUEST FORM

REQUEST TO CONDUCT RESEARCH IN INSTITUTIONS AND/OR OFFICES OF THE GAUTENG DEPARTMENT OF EDUCATION

1. PARTICULARS OF THE RESEARCHER

1.1	**Details of the Researcher**
Surname and Initials:	
First Name/s:	
Title (Prof / Dr / Mr / Mrs / Ms):	
Student Number (if relevant):	
ID Number:	

1.2	**Private Contact Details**
Home Address	***Postal Address (if different)***

Postal Code:	***Postal Code:*** 0134
Tel:	
Cell:	
Fax:	
E-mail:	

PURPOSE & DETAILS OF THE PROPOSED RESEARCH

2.1	**Purpose of the Research (Place cross where appropriate)**
Undergraduate Study - Self	
Postgraduate Study - Self	
Private Company/Agency – Commissioned by Provincial Government or Department	
Private Research by Independent Researcher	
Non-Governmental Organisation	
National Department of Education	
Commissions and Committees	
Independent Research Agencies	
Statutory Research Agencies	
Higher Education Institutions	

2.2	**Full title of Thesis / Dissertation / Research Project**
.	

2.3	**Value of the Research to Education (Attach Research Proposal)**

2.5	**Student and Postgraduate Enrolment Particulars (if applicable)**
Name of institution where enrolled:	
Degree / Qualification:	
Faculty and Discipline / Area of Study:	
Name of Supervisor / Promoter:	

2.6	**Employer (where applicable)**
Name of Organisation:	
Position in Organisation:	
Head of Organisation:	
Street Address:	
Postal Code:	
Telephone Number (Code + Ext):	
Fax Number:	
E-mail:	

2.7	**PERSAL Number (where applicable)**

2. PROPOSED RESEARCH METHOD/S

(Please indicate by placing a cross in the appropriate block whether the following modes would be adopted)

2.1 ***Questionnaire/s (If Yes, supply copies of each to be used)***

YES		**NO**	

2.2 ***Interview/s (If Yes, provide copies of each schedule)***

YES		**NO**	

2.3 ***Use of official documents***

YES		**NO**	
If Yes, please specify the document/s:			

2.4 ***Workshop/s / Group Discussions (If Yes, Supply details)***

YES		**NO**	

2.5 ***Standardised Tests (e.g. Psychometric Tests)***

YES		**NO**	
If Yes, please specify the test/s to be used and provide a copy/ies			

3. INSTITUTIONS TO BE INVOLVED IN THE RESEARCH

3.1 ***Type of Institutions (Please indicate by placing a cross alongside all types of institutions to be researched)***

INSTITUTIONS	Mark with X here
Primary Schools	
Secondary Schools	
ABET Centres	
ECD Sites	
LSEN Schools	
Further Education & Training Institutions	

Other	

3.2 ***Number of institution/s involved in the study (Kindly place a sum and the total in the spaces provided)***

Type of Institution	Total
Primary Schools	
Secondary Schools	
ABET Centres	
ECD Sites	
LSEN Schools	
Further Education & Training Institutions	
Other	
GRAND TOTAL	

3.3 ***Name/s of institutions to be researched (Please complete on a separate sheet if space is found to be insufficient)***

Name/s of Institution/s

3.4 District/s where the study is to be conducted. ***(Please indicate by placing a cross alongside the relevant district/s)***

District	
Ekhuruleni North	
Ekhuruleni South	
Gauteng East	
Gauteng North	
Gauteng West	
Johannesburg Central	
Johannesburg East	
Johannesburg North	
Johannesburg South	
Johannesburg West	
Sedibeng East	
Sedibeng West	
Tshwane North	
Tshwane South	
Tshwane West	

If Head Office/s (Please indicate Directorate/s)

NOTE:

If you have not as yet identified your sample/s, a list of the names and addresses of all the institutions and districts under the jurisdiction of the GDE is available from the department at a small fee.

3.5 *Number of learners to be involved per school (Please indicate the number by gender)*

Grade	1		2		3		4		5		6	
Gender	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*
Number												

Grade	7		8		9		10		11		12	
Gender	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*
Number												

3.6 *Number of educators/officials involved in the study (Please indicate the number in the relevant column)*

Type of staff	*Educators*	*HODs*	*Deputy Principals*	*Principal*	*Lecturers*	*Office Based Officials*
Number	*10*					

3.7 Are the participants to be involved in groups or individually?

Participation	
Groups	
Individually	

3.8 Average period of time each participant will be involved in the test or other research activities (Please indicate time in minutes)

Participant/s	Activity	Time

3.9 Time of day that you propose to conduct your research.

School Hours	*During Break*	*After School Hours*

3.10 School term/s during which the research would be undertaken

First Term	*Second Term*	*Third Term*

DECLARATION BY THE RESEARCHER	
1. I declare that all statements made by myself in this application are true and accurate.	
2. I have taken note of all the conditions associated with the granting of approval to conduct research and undertake to abide by them.	
Signature:	
Date:	

DECLARATION BY SUPERVISOR / PROMOTER / LECTURER	
I declare that:	
1. The applicant is enrolled at the institution / employed by the organisation to which the undersigned is attached.	
2. The questionnaires / structured interviews / tests meet the criteria of: • Educational Accountability • Proper Research Design • Sensitivity towards Participants • Correct Content and Terminology • Acceptable Grammar • Absence of Non-essential / Superfluous items	
Surname:	
First Name/s:	
Institution / Organisation:	
Faculty / Department (where relevant):	
Telephone:	
Fax:	
E-mail:	
Signature:	
Date:	

N.B. This form (and all other relevant documentation where available) may be completed and forwarded electronically to Shadrack Phele (shadrackp@gpg.gov.za) or Nomvula Ubisi (nomvulau@gpg.gov.za). The last 2 pages of this document must however contain the original signatures of both

the researcher and his/her supervisor or promoter. These pages may therefore be faxed or hand delivered. Please mark fax - For Attention: Shadrack 0866 400 908 (fax to e-mail) or hand deliver (in closed envelope) to Nomvula Ubisi (Room 525), 111 Commissioner Street, Johannesburg.

APPENDIX B: PERMISSION TO VISIT SCHOOLS

APPENDIX C: REQUEST FOR CONDUCTING INTERVIEWS

P O Box 2868
Renstown
Hammanskraal
0400
4 May 2009

The Headmaster

Sir/Madam

Re: Application for conducting research

I hereby wish to apply for permission to conduct research at the above-mentioned institution. The purpose of my research is to investigate the possible barriers to effective integration of Information Technology into teaching and learning. This research requires interviewing School Management Team, the responsible educator for the subject and observing the lesson presentation in the class.

All the participants' responses will be treated confidential. The completed research will be submitted as part of my doctoral thesis. The interviews may be conducted after the school hours. Only observations will be conducted during the lessons.

Thank you for your attention

Yours sincerely
Mmankoko Ziphorah Ramorola

APPENDIX D: PERMISSION TO CONDUCT INTERVIEWS

APPENDIX E: LETTER OF CONSENT

P. O BOX 2868
HAMMANSKRAAL
0400

Barriers to effective integration of Information and Communication Technology in teaching and learning

Dear prospective research participant

You are invited to take part in a research study. The aim of this study is to explore and describe barriers to effective integration of information and communication technology in the classroom. By doing so, I wish to learn more about your experiences and challenges you are faced with in your department. You have specifically been selected for participating in the research study based on your privileged knowledge as a technology (computer) facilitator.

Your participation in this research project is voluntary and confidential. You will not be asked to reveal any information that will allow your identity to be established. Should you declare yourself willing to participate in this interview, confidentiality will be guaranteed.
Please sign this letter as a declaration of your consent to indicate that you participate in this project willingly.

Participant's signature Date

Researcher's signature Date……

Yours Sincerely

Ramorola Mmankoko Ziphorah

APPENDIX F: INTERVIEW QUESTIONS FOR PRINCIPALS OF SENIOR SECONDARY SCHOOLS

1. Do you have experience with the use of computers?
2. What is your level of proficiency in relation to computer technology?
3. What is the student population of this school?
4. How many educators are in this school?
5. Does your school have a policy on computer education?
6. What is the essence of this policy?
7. Is the policy implemented?
8. What steps have been taken to implement this policy?
9. What do you see as the main obstacles of implementing this policy?
10. Do you have any budget for computer equipments?
11. How many computers do you have in this school?
12. How did you manage to obtain them?
13. Are your educators currently using computers for teaching and learning?
14. Which subjects are already incorporated with the computer education?
15. How many periods are allocated for computer education per week?
16. How many educators are trained with the use of computers for teaching and learning in your school?
17. Who offered this training?
18. What priority is given to the use of computers in teaching and learning in your school?

19. What role does the Department of education play in support of the computer education in your school?

20. Do you have a technology coordinator?

21. What role does he/she play?

22. What is your overall view about computer education programme in teaching and learning?

23. What suggestions would you make for the effective integration of computers in teaching and learning?

APPENDIX G: INTERVIEW QUESTIONS FOR COMPUTER TECHNOLOGY HEAD OF DEPARTMENT OR DEPUTY PRINCIPALS

1. Do you have experience with the use of computers?
2. What is your level of proficiency in relation to computer technology?
3. Have you had any kind of training in computer use for teaching and learning?
4. How did the training help you?
5. Does your department have a policy regarding the use of computers?
6. What priority is given to the implementation of this policy?
7. How are educators in your department implementing this policy?
8. How many computers are there for teaching and learning?
9. How accessible are computers to your educators for use in the classroom?
10. What other facilities are available for your educators to use computer in teaching and learning?
11. What means of funding is in place for the purchasing of technology resources?
12. Which software programmes are used for teaching and learning?
13. What do you see as the benefit of computers in classroom instruction?
14. What steps have you taken in assisting educators to integrate computer to teaching and learning?
15. Is there any time given for computer education in your time table?
16. How many periods are allocated weekly for the computer education?
17. What evidence do you have of learners using computers for learning?
18. What support do you receive from the department and the principal?

19. What do you see as the factors inhibiting the effective integration of computers in teaching and learning in your school?

20. What is your overall view about the integration of computers in teaching and learning?

21. What recommendations would you make for the effective integration of computers in teaching and learning?

APPENDIX H: INTERVIEW QUESTIONS FOR COMPUTER TECHNOLOGY EDUCATOR

1. How long have you been teaching?
2. What subject do you currently teach?
3. Do you have any experience with the use of computers?
4. What is you level of proficiency in relation to computer technology?
5. How long have you been teaching computer education in this school?
6. Is there any kind of in-service training that you received?
7. How often do you receive in-service training?
8. What kind of support do you receive from the department of education and your school management?
9. How many computers do you have in your lab/classroom?
10. Do your learners use computers?
11. What do learners use computers for?
12. Why do you as a educator use the computer?
13. What is the learner-computer ratio used?
14. Which software programmes are used by learners?
15. How much time is given to learners to interact with the computer?
16. Is there any computer lesson plan in operation?
17. As the computer educator, what do you see as your greatest challenge in integrating computers into teaching and learning in your school?
18. What improvements would you suggest for the effective integration of computer in teaching and learning?

APPENDIX I: INTERVIEW QUESTIONS FOR LEANERS

1. Why did you enrol for CAT/IT?
2. How long have you been doing this subject?
3. What is your overall opinion of the subject?
4. How much do you feel you are learning in this subject?
5. Did you learn what wanted to?
6. How do you feel about the ways in which technology is used in this subject?
7. Do you find technology easy to use? If not, why?
8. Did you have computer skills before starting this subject, or did you learn them while doing the subject?
9. Which programs are you using and why?
10. Which program interest you the most, and why?
11. What problems have you had with the subject?
12. Which measures can be taken to solve these problems?
13. Would you recommend this subject to others, if yes/no, why?
14. What do you think is important to successfully pass this subject?

APPENDIX J: INTERVIEW QUESTIONS FOR CURRICULUM DESIGNERS, DCES AND SCES

1. What is your level of proficiency in relation to computer technology?
2. Is there any policy on the use of computers in schools? If yes, what is this policy?
3. Why was this policy adopted?
4. Is the policy implemented in schools? If not, why?
5. What steps have been taken in implementing this policy?
6. Who is implementing this policy?
7. How is implementation being monitored?
8. What are the successes and or failures of implementation?
9. What major challenges are faced with the implementation of this policy?
10. What resources have been allocated to computer education in secondary schools in Tshwane North Region?
11. Do you have annual budget allocation for school computers? If yes, how is it allocated?
12. Are there any partnerships with donors or funders taking place? If yes, who are they?
13. What roles do these partners play in terms of infrastructure, training, support and maintenance?
14. What types of software packages are recommended by the Department of Education used in secondary schools?
15. What do you see as the role of computers in secondary education?
16. What evidence is available on the use of computers in secondary schools in your district?
17. What support does the department give to schools with regard to the use of computers?

APPENDIX K: OBSERVATION CHECKLIST

1. Physical features

1.1 How big is the computer lab?

1.2 How is lighting in the lab?

1.3 How are computers positioned in the lab?

1.4 How is ventilation in the lab?

1.5 What are the learners' sitting arrangements?

1.6 Number of operational computers.

1.7 Number of computers connected to a printer and internet.

2. Use of ICTs in class

2.1 Does the educator:

- Use media and technology that are specific to the content area?
- Provide opportunities for learners to use the internet and other tools?
- Allow learners to discover, share and create things using computers/