THE INFORMATION AND COMMUNICATION TECHNOLOGY INFRASTRUCTURES IN PUBLIC SCHOOLS IN THE WESTERN CAPE: A CASE STUDY

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A mini-thesis submitted in partial fulfilment of the requirements for the Degree of

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DECLARATION

I declare that *The Information and Communication Technology (ICT) infrastructures in public schools in the Western Cape: A Case Study* is my own work, that it has not been submitted for any degree or examination in any other university and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Lyndwill Clarke **January 2010**

Signed :……

KEY WORDS

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ABSTRACT

This mini-thesis attempts to explain the Information and Communications Technology (ICT) infrastructure in public schools in the Western Cape. The mini-thesis uses the case study as research design to explore aspects such as the motivation for using ICT, funding models, infrastructure models, ICT curriculum integration and teacher development. In order to gather data on the above, interviews and observations are used as research tools. The study begins with the exploration of the history of ICT infrastructure in South African schools and subsequently an international perspective is added through the literature review. Officials and teachers of the Western Cape Education Department (WCED) were interviewed to obtain their perspectives and a school was visited to observe procured ICT infrastructure. The results revealed that the WCED is using the Khanya project to deliver an ICT infrastructure to schools and to provide facilitation in the integration of ICT into the curriculum. It further showed that due to the rapid change in technology, Khanya had to adapt the hardware configuration on a regular basis and that this put considerable strain on and already small budget for ICT. The challenge that emerged is the lack of adequate ICT training for teachers. This could potentially hamper the integration of ICT and if not addressed, could serious hamper the WCED in its quest to deliver a technology based curriculum. The study concludes with conclusions drawn for the data as well as recommendations for effective ICT integration.

LIST OF ABBREVIATIONS

CD-ROM	Compact disk –Read Only Memory
DfES	Department for Development and Educational Skills
DoE	Department of Education
ERS	Education Renewal Strategy
GB	Giga Byte
ICT	Information and Communication Technology
LAN	Local Area Network
LTSMs	Learner and teacher support materials
MB	Mega Byte
NASA	National Aeronautics Space Association
NCS	National Curriculum Statement
NEPI	National Education Policy Investigation
OBE	Outcomes-Based Education
PC	Personal Computer
RAM	Random Acess Memory
TELI	Technology Enhanced Learning Investigation
WAN	Wide Area Network
WCED	Western Cape Education Department

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CHAPTER 1

INTRODUCTION TO THE STUDY

1.1 Introduction

The Western Cape Education Department (WCED) is one of the leading provincial education departments in South Africa when it comes to the implementation of Information and Communication Technology (ICT). This chapter elucidates the reasons, background and rationale for the study of the ICT infrastructure in public schools in the Western Cape. A framework of the literature review, research methodology, as well as the aims of the research, research questions, significance of the study, ethical considerations and overview of the chapters are also discussed.

1.2 Background

The election of the first democratic South African (SA) government in 1994, brought about the initiation of processes to restructure the SA education system to address apartheid inequities. The foundation for these educational changes was based on the development of a new curriculum framework called Outcomes-Based Education (OBE). The framework was to be implemented through Curriculum 2005 that was later revised to be called the National Curriculum Statement (NCS) (DoE, 2002). Broadly speaking, the new curriculum aims to equip learners with the knowledge, skills and values necessary for self-fulfillment and meaningful participation in society, irrespective of their socio-economic background, culture, race, gender, physical ability or intellectual ability. During this time the Department of Education (DoE) realized that the implementation of this curriculum would take place in the context of the 21st Century and a globalised world and became engaged in various programmes to reap the practical benefits of digital technology.

One of the attempts to utilise the benefits of technology was to align with international technological developments. The Education Renewal Strategy (ERS) of 1990 and the National Education Policy Investigation (NEPI) done in 1993 supported this effort. The ERS and NEPI reports confirmed the need for teachers to be educated in the use of ICTs in schools as it

highlighted technology as a tool for educational reform. The DoE however realized that a coherent comprehensive policy was needed on the use of technology in education. In February 1996, the Ministry of Education commissioned a group of experts to develop a national framework and strategic plan for technology-enhanced education. In July 1996, the commission presented a report called "Technology Enhanced Learning Investigation in South Africa" (TELI). The main thread of TELI was that technology on its own would not contribute to the quality of education, but that it should be integrated in the whole educational system, which realistically meant that changes would have to take place at all levels of the system.

> A technology-enhanced system generates and derives knowledge from schools, universities, corporations, public and private organizations, and individuals. It provides for the planning of instructional programs, and produces and delivers them through a variety of communications media. The work of centrally located course designers and media experts is integrated with local activities of learner groups and the activities of individual learners who are supported by experts in interpersonal interaction and learning, located in schools, colleges, workplaces, homes, and elsewhere (DoE, 1996b: 17).

Although, the Ministry and the ICT sector welcomed the TELI-report, the DoE opted not to develop it into a concrete policy document as it did not see ICT as a priority above other educational components. It instead established the National Centre for Educational Technology and Distance Education in 1997. This structure would commission a second TELI-report that contained a more detailed plan for concrete implementation and action.

The TELI-report provided provinces with some guidance for implementation. However provincial budgets were over extended with teacher salaries, provision of classrooms and supply of learner and teacher support materials (LTSMs) which were the top priorities for provincial education authorities. Because of the lack of budget, no coherent implementation of ICTs could take place and each province was implementing its own programmes based on available funding and personnel. The use of ICTs in schools was a personal preference and only schools with a strong bank balance could afford to purchase hardware and software. The schools that could not afford had to depend on donations of second hand computers from the private sector. The computers were “dumped” in schools, usually with great media coverage for the donating company, with no technical or other support for teachers. It then became the pet-project of an interested teacher or gathered dust in the principal’s office or a storeroom. However, in this

time, three provinces initiated specific ICT programmes to provide hardware and software to the schools under their control. The Western Cape through its Khanya project, Gauteng through Gauteng On-Line and the Northern Cape through its Connectivity Project, made significant progress in the implementation of ICTs. To a certain extend, this prompted government to initiate the writing of a White Paper that would ultimately govern the implementation of e-Education in the country.

The Minister of Education, Naledi pandor, declared White Paper on e-Education in August 2004. It mandates the DoE to oversee the provision of ICT infrastructure and the implementation of curriculum related programmes in schools in South Africa.

The policy goal of the White Paper is that:

> Every South African learner in the general and further education and training bands will be ICT capable (that is, use ICTs 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 (DoE, 2004:5).

Although the DoE is responsible for education across the country and provides a national framework for school policy, each of the South Africa's nine provinces has its own education department and is responsible to administer and implement policies as promulgated by the DoE. Where necessary and with the permission of the Minister of Education, policies can be amended according to the needs of the province. Thus, budget permitting, each province sets about implementing the White Paper. However, budgets and the aforementioned priorities still stood in the way of implementation as each province has its own dynamics. Each province is also now at different levels of ICT integration in education as some provinces have started earlier with ICT provision than others.

This mini-thesis intends to determine what ICT infrastructures are available in public schools in the Western Cape, and what are the issues of best practices that have emerged during the implementation of ICT programmes in schools. In the context of this study, infrastructure is viewed as everything that supports the flow and processing of information. This includes the facilities housing the technology, the computer hardware and software as well as other related components, such as security, electricity, worktops and cabling. The research is based on the

province's motivation for using ICTs in schools, the infrastructure and funding models of the province, technical and curriculum integration support offered, teacher development programmes, future plans and constraints. This research could provide an insight into structural support and could therefore potentially provide other provinces with an example and an analysis of how to deal with the areas above.

1.3 Rationale

Globalization and technological change have created a new global economy, strongly supported by technology, fueled by information and driven by knowledge. This technological change, which accelerated in the last twenty years, has implications for the nature and purpose of educational institutions as it introduced different forms of teaching and learning such as on-line learning. As a result schools have to change from being mere sites for the transmission of prescribed sets of information from the teacher to the learner.

Transmission of information can lead to the change in perspective and alter a learners learning methodology and thought processes. According to the futurist Toffler, et al (1998), "… the illiterates of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn and relearn". ICTs, are potentially powerful enabling tools for educational change and reform and can among others:

- Help expand access to education through the internet;
- Strengthen the relevance of education to the increasingly digital work place through exposure to new technologies;
- Raise educational quality by encouraging teachers to be critical about and research their own teaching practices; and
- Make teaching and learning, an engaging and active process connected to real life at work place.

Toffler's assertion and the use of ICTs in education illustrate a reflective process in teaching and learning where all participants must be enabled to move seamlessly between teaching methodologies.

Change however, is not a natural process and issues such as curriculum and pedagogy, institutional readiness, teacher competencies, and long term financing, to mention but a few, have to be considered. These issues play a crucial role in effectively and efficient curriculum delivery. Also, like any other educational tool or mode of educational delivery, ICTs do not work for everyone, everywhere in the same way. It is however clear that the use of computers and internet for teaching and learning offers exciting possibilities for teaching the curriculum. These possibilities include individualised learner-paced learning, repetition and a mechanism for dealing with individual barriers to learning in a world of large classes. The use of computers also allows for the sharing of work and experiences of other teachers. This sharing of work could lead to teachers' time being utilised more effectively and their time becoming more flexible. More specifically, the processes of:

- Learning *about* computers and internet , where technological literacy is the goal;
- Learning *with* computers and internet, where technology facilitates learning; and
- Learning *through* computers and the internet which integrates technological skills development with curriculum applications,

could provide the methodological background to effective ICT implementation.

Despite numerous studies into the use of ICTs in schools there is very little evidence that supports the view that an ICT infrastructure in a school will improve the educational capabilities of that school. A research into the issues around the provisioning and utilisation of ICTs in public schools will provide a clearer picture of how ICT infrastructures should be deployed to improve teaching and learning.

1.4 Theoretical framework

1.4.1 Introduction

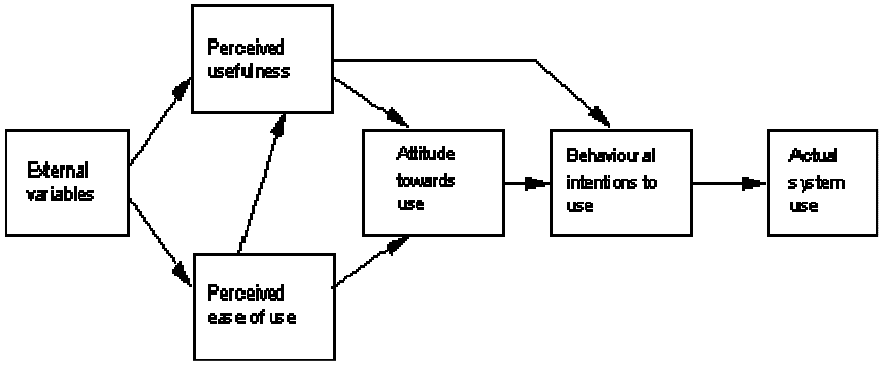
The theoretical framework as set out below includes the motivation for using ICTs in schools, teacher development in ICT, and technical and curriculum integration support. It further includes ICT infrastructure and model as well as the funding for it.

The power of educational technology to act as an instrument for educational transformation and reconstruction has been identified by many governments, especially in the United Kingdom, that hold the view that the introduction of computers into schools will change learners and society for the better (Mooij and Smeets, 2001). South African communities and educational authorities have embraced this phenomenon and school communities are increasingly demanding an educational system that will prepare and equip learners to adapt and participate in globalisation. Like almost every other component of society, education is experiencing immense change due to increasingly more powerful information technology. Hardware with faster processing capabilities and more user friendly software allows for faster methods of evaluation and content development. This increase in technology power means that teachers are confronted with opportunities and challenges at both administrative and curriculum levels. Opportunities to improve their own understanding of technology and to do ICT related training, but also challenging to come to grips with the new technologies and how to integrate it into their daily teaching. The field of technology and more specifically ICT is changing so rapidly that it overwhelms the ability of most teachers to keep up.

1.4.2 Motivation and infrastructure

What would motivate teachers to use ICTs in their daily teaching? Davis, Bagozzi and Warshaw (1989) developed a theory of 'action relating to reasons', a so-called "Technology acceptance model" to investigate the reasons why some people use computers. Their model, shown below, links the perceived usefulness and ease of use with attitude towards using ICT and actual use. They found that people's computer use was predicted by their intentions to use it and that perceived usefulness was also strongly linked to these intentions.

Diagram 1: Technology Acceptance Model (Davis, Bagozzi and Warshaw, 1989)



In the above model, the external variables represent the many factors beyond the teachers' control. The model relates perceived usefulness and perceived ease of use to the external variables. It then illustrates that a person's attitude and behavior towards ICT use is based on these perceptions which is then eventually translated into mannerisms when actually using technology. External variables might include:

- The requirements of a national curriculum or national guidelines;
- School policies on using ICT;
- Opinions of colleagues;
- Responsibilities of the teacher;
- Pressure from parents and pupils; and
- The influence of the district and provincial education authority.

There are a number of factors which have been identified which relate to the perceived ease of use of ICT, which in our case is for experienced practicing ICT users. A wide range of skills and competencies which teachers felt they needed in order to find ICT easy to use can be identified. These include:

- Regular use and experience of ICT outside the classroom as opposed to difficulties in using software/hardware;
- Ownership of a computer instead of always needing/looking for more technical support. This leads to confidence in using ICT; and
- Easy to think of new lesson ideas as opposed to insufficient access to the resources and too expensive to use regularly.

The above-mentioned factors imply that teacher will have to be re-skilled which could mean that they will have to change the way they teach. If teachers see no need to question or change their professional practice then they are unlikely to adopt the use of ICT. If, however, they perceive that acquiring ICT skills are useful to them in their teaching and their pupils' learning, they are more likely to have a positive attitude to the use of ICT in the classroom.

1.4.3 Teacher development

One of the guiding principles of OBE is lifelong learning for all (DoE, 1995:10). I believe that lifelong learning relates to education as a continuing aspect of everyday life and that it should not be bound by time, age or a set curriculum. Thus as South Africa embraces OBE, so should educational authorities shift toward a model that treats the lifelong education of teachers with the same importance as the education of learners. If teachers are life long learners too, they will become reflective practitioners who will constantly strive to find new ways to improve or add on to their practice. If teachers accept that lifelong self-learning leads to continuous professional and personal development, they can become the drive agent for school-based reform and development in teaching and learning, as well as leadership in local education reforms. By accepting that they are learners too, teachers can network and collaborate with professional peers across borders and have an active contribution to their peers' professional development (Mok, 2004). It thus stands to reason that teachers must be offered opportunities for coursework in information technology (Kearsly, Hunter & Furlong, 1992:3) and the opportunity to collaborate with peers in the use of ICT as an effective tool to improve teaching and learning.

If more significance is attached to lifelong learning and teachers are granted opportunities to improve their practice, then in-service training and staff development will form an integral part of capacity building amongst teachers. All too often, education authorities apply traditional models of training to areas, like technology, that require a more progressive and modern approach. Newer models of training are especially needed in the areas where teachers have to reflect on their classroom practice. The rapid change in technology has necessitated this need for newer and updated models of training for ICT integration. Govender (1999:79) asserts that failure to empower teachers with adequate and appropriate technological skills could lead to negative attitudes towards technology. As mentioned before, teachers could perceive themselves as being incompetent or they could rationalise that technology is not needed to "get ahead", but more importantly, teachers could feel de-skilled by technology (Msila, 2008). Teachers might feel that they are losing their authority over learners, which might have more ICT knowledge than they do. This stems from the fact that people anticipate that the change-over to a technology based system might lead to loss of status or power, isolation, failure or even job displacement (George, Sleeth & Pearce, 1996).

McKenzie (1991) sees traditional staff development as taking place once a year, for one day, in a crowded room, with no opportunity to practice new skills and with no compensation to teachers for investing their own time. Successful staff development requires ongoing, sustainable programmes with proper funding where ample opportunity is given to practice newly acquired skills in a "safe and controlled" environment and time is allowed to adjust to new strategies (Locatis & Atkinson, 1984:3). This will allow teachers to explore evolving teaching practises (Enola, 1997:46) and the power of technology to effect change or reform teaching practice. Staff development should thus not be seen as a rigid time based process, but rather as a timeous and expansive process that allows teachers to be creative as they adapt to new technologies and teaching processes.

Effective staff development in technology is that which provides for the individual needs and is capable of producing system-wide changes in teaching methods. Since successful teachers have always been inventive, developmental programmes should serve as inspiration to invent and use teachers' natural talent to build on. Furthermore, the active involvement in exploration (McKenzie, 1991) leads teachers to feel more committed to the discoveries made and encourage a greater acceptance of the changes technology brings. So its stands to reason those school systems that want to change must promote professional development of teachers with the same commitment they make to hardware and software availability and network access. Teachers must be given time to travel to meetings and share information with colleagues. They must have the authority to structure their classrooms in ways that allow them to meet high standards and simultaneously address the individual needs of their learners. Since education is one of the critical aspects of our modern society and the digital age, ICT support is a critical element in elevating the professional task of the teacher. achers As true professionals, they deserve the technological support that professionals need to do their jobs (Carter, 2000:30).

The quality of teachers is known in virtually all countries to be a key predictor of student learning. Therefore, teacher training is crucial. ICT can become a tool that on the one hand facilitates teacher training and on the other hand helps them to take full advantage of the potential of technology to enhance student learning.

1.4.4 Curriculum integration

e-Education is essentially about how ICTs can transform teaching and learning by making the process as well as the content appropriate to the 21st century. It should entail a blended, integrated, seamless process of teaching, learning, assessing and feedback from teacher to learner to textbook to computers, digital material and back to the teacher and any combination thereof.

The teacher should create a learning environment that promotes creativity, communication, collaboration and engagement, which would lead to knowledge comprehension, application, analysis, synthesis and evaluation. This order of learning follows Bloom's (1956) taxonomy of cognitive learning that prescribes a sequential order of learning, in which the preceding level must be met before the next level can be addressed, sustaining that an awareness must exist before any knowledge gain will occur. By following the above process, learners will develop information literacy and be equipped for participation in the knowledge society. As a developing nation, e-Education in South African should be more than developing computer literacy and the skills to access manage and create information. It should provide learners and teachers with platforms to transform education and engage with one another to create knowledge and knowledge systems. "e-Education will connect learners and teachers to better information, ideas and one another via effective combinations of pedagogy and technology in support of educational reform" (DoE, 2004:14) .

While the introduction of this technology into the schooling system opens new avenues for teaching and learning, the ability of teachers to effectively integrate the technology into their daily teaching (the curriculum) to improve learning and educator performance, is proving to be easier said than done (Welsh, 1997). Teachers see technology, or rather, the computer room, as an "add-on" and the relevance of the computer room, and what is taught there, to classroom practice is not always made clear during training sessions. Also, rather than exposing their lack of technology skills, they become cyber-phobic and dismiss the technology as expensive toys. Teachers have dire need for structured in-service training that is not only acknowledged in some form, but also takes place on a continuous basis. This stems from their structured pre-service teacher training and not enough in-service training.

Various education support staff such as curriculum advisers, technology advisers and district managers, to name but a few, with different technology agendas visit and provide support to schools on a daily basis. Each one of the support staff provides a function, which sometimes overlaps. For example, some curriculum advisers have embraced technology and try to integrate it into their support. While some technology advisers have some knowledge of a specific subject and try to provide support in this regard. It is therefore natural that principals and teachers are confused about the roles that each person plays and who to turn to in their time of need. Furthermore, the introduction of OBE has developed a huge demand for resource and technology based teaching. Since OBE allows for learners to learn at their own pace, teachers now need to be resourceful and adopt different learning strategies for different learners. This approach to education allows for a variety of classroom experiences that places emphasis on critical thinking, teamwork, compromise and communication. These are the skills valued in today's workplace. Teachers are changing from being the repository of all knowledge to being guides, mentors or project leaders who help learners navigate through the information made available by technology and interactive communications. Teaching with technology requires the knowledge and skills necessary to use it as a means of analyzing and solving teaching and learning problems.

Curriculum integration depends on teacher training and a willingness of teachers use ICT as an enabling tool to change the way they have been teaching in the past. We therefore need to make the policy imperatives as set out in the South African Schools Act (DoE, 1996a) and the White Paper on e-Education (DoE, 2004:17) work for us and realise that:

- Teaching and learning is no longer confined to the teachers and learners and the four walls of the classroom;
- Visual and moving explanations, diagrams, descriptions, processes are possible. (Here the use of digital material and a data projector is invaluable.);
- Shifting from a teacher-centered, task-oriented, memory-based education to an inclusive and integrated practice can only enhances teaching and learning. This approach also allows for a shift from static knowledge to current knowledge;
- Assessment must emanate from the process of teaching and learning. Therefore there is a need to develop appropriate methods of using ICT to assess teaching and learning via ICTs;

- Feedback in assessment can be enriched by data analysis, e.g. item analysis of Senior Certificate exams; and
- Managing assessment via IT systems could reduce the workload vastly.

My research will attempt to establish whether the WCED addresses the above mentioned issues and how ICT infrastructure enhances or hampers it.

1.4.5 e-Challenges

Integrating ICTs with the curriculum is not without challenges. One should be careful to ensure that the curriculum is taught and not ICT and that a conflict between classroom teaching and computers does not arise. We need to "… reconsider what kids in our schools need to learn as a prerequisite to the consideration of where and how we insert ICT into instruction" (Bosco, 2003:1). A change management process should therefore ideally accompany the integration of ICT.

Change management should be applied sensitively as dealing with the fast-changing world of ICTs, software, hardware, sites, theories and knowledge can be a daunting experience for teachers. This is made more relevant if one realizes that success in education is about multi-dimensional systems management. There is no single solution and ICTs alone will not solve all the problems in education. It is for this very reason that ICT integration should be approached with caution. With South Africa's diverse culture the following three issues should be kept in mind when implementing ICT programmes in schools in South Africa:

Firstly, access to the internet encourages dipping, copying and pasting instead of good research, depth of analysis and good writing. In some cases, internet resources may even be unedited, un-sifted and incorrect. It is vital that teachers should not allow learners to use technology without alerting them to the pedagogical understanding of the dangers the technology present (Potter, 1996). In addition to this, the use of computers can encourage learners to be passive consumers rather than active thinkers.

Secondly, South Africa has eleven official languages and although the language of teaching and learning in schools are English, the language of ICT is predominantly English and this may be in conflict with the learners' home language. The language issue is further compounded by the fact

that Americans post most resources and there is a distinct danger that the South African curriculum can be completely lost in Americanisms or multi-national curricula.

Thirdly, learners cannot teach themselves everything through the internet, they still need to be taught face to face. Getting learners in and out computer labs also takes up contact teaching time. Technology is useful "insofar as it is handled competently by teachers and it is integrated into the teaching program as a whole" (Hoven, 1992:19). The International Society Technology in Education (ISTE) supports Hoven's assertion and defines curriculum integration as follows:

> Curriculum integration with the use of technology involves the infusion of technology as a tool to enhance the learning in a content area or multidisciplinary setting. Technology enables students to learn in ways not previously possible. Effective integration of technology is achieved when students are able to select technology tools to help them obtain information in a timely manner, analyze and synthesize the information, and present it professionally. The technology should be come an integral part of how the classroom functions, as accessible as all other classroom tools (ISTE, 2000: 6).

1.5 Research Questions

Main research question.

The main research question is "What are the issues that influence ICT infrastructure utilisation in public schools in the Western Cape?"

Subsidiary questions:

The following subsidiary question emanated from the main research question:

1. What is the motivation behind the use of ICTs in the schools?
2. What type of ICT infrastructures are being installed in the schools?
3. Who is responsible for curriculum and technology support and training in the province?
4. Who funds the ICT programme in Western Cape schools?
5. What are the challenges that the province faces in terms of technology support, especially with reference to in service training?
6. What best practices are observed in the process of ICT infrastructure supply and are the in-service technology programmes adequate to enhance curriculum delivery?

1.6 Aims

The following aims were developed to:

- Determine what motivates teachers and learners to use ICT.
- Understand the ICT infra-structure models that exist within public schools in the Western Cape
- Establish the types of support systems available to teachers and learners in respect of ICT.
- Find out how and by whom ICT programmes in schools are funded in the Western Cape.
- Determine the challenges that face the provinces in establishing and ICT infrastructure in schools and what plans are put in place to overcome them.
- Reveal best practices in the province and how they can be applied to the rest of the country .

1.7 Research methodology

My primary research methodology paradigm is a qualitative one that allows me to make knowledge claims based primarily on constructivist perspectives. This approach permits me to explore "multiple meanings of individual experiences and meanings that are socially and historically constructed" (Cresswell, 2003:18). My research design is a case study and I used the interpretative approach. My research tools are the interview process and observations. These methodologies will be further elaborated on in Chapter Three.

1.8 Significance of study

The research is significant in the sense that it exposed how the introduction of an ICT infrastructure can lead to the introduction of new approaches to teaching and learning by teachers. It is further significant as it showed the a range of beneficial impacts on learners including improved motivation, increased confidence and self-esteem, enhanced social skills, improved group-working and co-operative skills, and enhanced achievement.

The various conclusions and recommendations in Chapter 5 provide significant insight into ICT infrastructure provisioning and the issues that impact on it. This will contribute positively to the e-learning process in South Africa, as we attempt to bridge the digital divide.

1.9 Ethical statement

My conduct during the research and processing of this mini-thesis was based on the following fundamental principles:

1.9.1 Confidentiality

I treated all information provided by interviewees in confidence in order to foster a trusting relationship. This includes confidential information of the institutions they belong to as well as the format they provide the information in be it in oral, electronic or print form.

1.9.2 Accuracy

I recorded all data accurately. This included attribution and data analysis. The said analysis was done without personal prejudices or biases. I verified the reliability of sources (print, electronic, and otherwise), as well as the sources utilized by third parties to gather information on my behalf.

1.9.3 Relevance

I sought and recorded only information that was relevant to the promotion, upliftment and enlightenment of sound educational objectives with respect to the topic of this thesis.

1.9.4 Honesty

I was truthful with regard to my identity and purpose, and the identity of the institution I study with during the course of my research work. I collected all data and information in a lawful manner and respected applicable laws and institutional policies. I did not evade or avoid questions about my affiliations or purpose when requesting information in person, over the phone, electronically, or in writing

1.9.5 Objectivity

I presented information in an objective and factual manner; noted attribution and clearly identified and differentiated between information that was hearsay and analysis. Where there was conflicting information, I objectively presented the multiple versions and stated any reason for preferring one version over another.

1.10 Overview of thesis chapters

1.10.1 Introduction of the study

The first chapter provides insight into the background, rationale and theoretical framework for this research. Specific sub-sections in this chapter provides the reader with an insight into the e-education development and challenges in South Africa as well as teacher development in this area. This chapter also includes sub-sections on aims, research methodology my ethical statement and this section, namely the overview of the thesis chapters.

1.10.2 Literature review

In the second chapter I review and analyse relevant and applicable literature on e- Education and computers in schools. This chapter provides literature support for aims of this research as well as for my assertions in the various subsections namely, Motivation for using ICT, infrastructure, funding, professional development and technology, curriculum integration and ICT management. The review includes books, journals, newspaper articles as well as digital publications from websites and CD-ROMS.

1.10.3 Research methodology

Chapter Three outlines my research methodology and strategy for this research. It includes the research paradigm, approach, research design and research instruments.

1.10.4 Presentation of findings

In Chapter Four I present my research findings and situational analysis and provide an insight into particular school circumstances.

1.10.5 Recommendations and conclusions

In the fifth and final chapter, I identify constraints in the implementation of ICT in schools and make recommendations as to how to overcome them. I also draw specific conclusions for the research in terms of key factors that influence the impact of ICT in schools.

1.11 Conclusion

This chapter has provided a broad overview of the aims and objectives of my research and the background and theoretical and research methodology framework that supports it. This included and overview of e-education development and challenges in South Africa as well as teacher development in this area. I also outlined the various chapters in the thesis and what it entails. In the next chapter, I explore various literatures on ICTs in schools to provide a support and motivation for my research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Today's school children are the first generation of the "digital age." They are being raised in a society that is changing rapidly as a result of the influx of new technologies. New digital technologies are providing more pervasive and foster links with commerce, communication, and culture world wide. The methods used in business, transportation, communication and agriculture have changed dramatically from this influx of technological innovations. As a result, every child's educational, employment and cultural opportunities will be shaped by their ability to understand and manage these emerging technologies. In this chapter I review relevant literature and policies that impact on ICTs in schools in South Africa for the purposes of supporting my research into determining the ICT infrastructures in schools in the Western Cape.

2.2 Motivation for using ICTs

In his book, The Road Ahead, Gates (1995:74) made the statement, "One thing is clear. We don't have the option of turning away from the future. No one gets to vote on whether technology is going to change our lives". This statement is as true for educators as it is for the National Aeronautics Space Association (NASA) scientists who work on today's sophisticated shuttle systems. Technology is now available in our classrooms and it is changing the way educators think about teaching and the way students think about learning.

Over the past 30 years there have been numerous research studies of the uptake of ICT in education. In particular, British researchers have done studies that included the effects of teacher training (Cox, Rhodes & Hall 1988), levels of resources (Cox, 1993), teachers' pedagogies and practices (Watson, 1993) and teachers attitudes (Woodrow, 1990). Many of these studies have shown that in spite of teacher development, an increase in supply of ICT infrastructure and the fulfilling of requirements of national curriculum and policies, there has been a disappointingly slow uptake of ICT in schools by the majority of teachers. Some of the reasons for this lack of more widespread uptake of ICT, are misconception of the need for

change, doubt with regard to professional practice and pedagogical practice versus technical skills, lack of support from the whole school, loss of control of the learning and teaching process and inadequate supply of resources.

Fullan and Stiegelbauer (1991) found that one of the most fundamental dilemmas in understanding the need for education change is that teachers do not have a rational sense of the reasons for educational change, what the change is and how it is to be implemented. He maintains that teachers who resist change are not necessarily rejecting the need for change. They are, however, often the senior teachers who usually lead and coordinate projects and do not understand why change is necessary and is seldom given the opportunities to make sense of the change. Fullan further maintains that the most effective way to bring about the adoption of an innovation in schools is to democratically engage the whole school in the process of planning the change. If this is not done then any suggestion of adopting very innovative teaching techniques such as using ICT is therefore seen as threatening the orderly flow of the school and therefore deemed undesirable. This leads to a fear amongst many teachers about the change, in this case ICT, and skepticism of its value to their learners. However these challenges must be seen within the context of bridging the "digital divide", a term coined to represent the increasing technological difference between the rich and the poor, among and within countries.

The policy framework of the White Paper on e-Education in South Africa (DoE, 2004:14) was an attempt to ally teachers fears to change and to encourage the "… use of ICTs in teaching and learning without the constraining the teachers, learners and learning organizations in creativity, problem-solving and innovation." (DoE, 2004:12).

2.3 Infrastructure

As mentioned in Chapter One, even before the declaration of the White Paper (2004), many schools have spent vast amounts of money to purchase computers or to upgrade their instructional computing capacity with the hope that the mere presence of these technologies will promote positive educational changes. However, McClure (2007) writes that:

> As schools face the challenge of bridging the "digital divide," the goal is typically complicated by the costs of computers and then support once they have been

> acquired. Many districts are therefore turning to refurbished computers as a possible solution.

The assertion by McClure illuminates the debate of new versus donated second-hand or purchase of refurbished computers. Donations of second hand computers and pre-owned computers are often seen as a cheap way for companies to dump their rubbish on developing countries without any support. In contrast, the older computers, which were refurbished, reconditioned and restored to working order, could potentially save schools money. It could also be argued that because of the maintenance cost and shorter lifespan of refurbished computers, the total cost of ownership of a refurbished Personal Computer (PC) could be higher than that of a new PC. However, a SchoolNet Africa (2004) research report asserts that it has not been proven that the total cost of ownership of a new PC is less than that of a refurbished one. The report concludes that most schools, because of cost, are committed to continuing to use refurbished computers until the cost of new computers is more affordable.

Schools, however, quickly discovered that technology alone does little to support changes in the way teachers think about teaching and the way learners think about learning. It also further opens the debate on whether to use open source or propriety software on the refurbished computers,. According to open source on-line encyclopedia, Wikipedia, open source software is software which the human-readable source code is made available under a copyright license that permits users to use, change, and improve the software, and to redistribute it in modified or unmodified form. It is very often developed in a public, collaborative manner. In contrast, propriety software is software on which the producer or developer has set restrictions on the use, private modification, copying, or republishing of the software. The restrictions effectively does not allow for any changes to the software. The main arguments revolve around the fact that open source software is more cost effective, while promoters of propriety software claim that propriety software is more reliable since it has been tested in a closed environment and is not open to tampering. Irrespective of whichever side holds true, schools do not have the luxury to experiment and appropriate solutions need to be researched and provided to schools as a completely packaged reliable hardware and software.

From the above, it has become abundantly clear that the provision of an ICT infrastructure, which includes the rush to connect classrooms to wide area networks (WANs), Intranets and the

Internet, has to be done within an educational context which clarifies educational purpose and intent. School administrators must realize that introduction of new technology into the school environment represent a modification in a teacher's pedagogical belief system and not simply a change in the tools that are used to facilitate this process. In fact, the data that exist on the effectiveness of computers and related technologies to increase student learning is equivocal in nature. The ambivalent nature of the data could be because different people in schools use computers for different reasons. Some studies have reported that computer technologies produce positive learner outcomes when used for teaching and learning (Hasselbring & Williams Glaser, 2000). Others report that studies found evidence of only moderate, minimal and sometimes non-effectiveness when it comes to the academic performance of learners using computers (Kirkpatrick & Cuban, 1998). Consequently, parents, teachers and school administrators are often uncertain about the real benefit of these technologies as instructional tools. Interestingly, in cases where technology-based instruction has been successful, the research suggests that it is most often the result of using the computer to deliver well designed and well managed classroom programmes. Thus, the focus is once again placed on the teacher's actions in the classroom rather than on the technologies that were utilized in that setting. The teacher's perspectives of classrooms are often overlooked and most education innovations, more often than not, are initiated by outsiders and not by teachers. The failure of ICT to be successfully integrated into classrooms may be because of the inability or failure of its advocates to address the most important perceptions and needs of teachers.

Furthermore, studies have found that uses of technology are limited by both the quantity and quality of the hardware and software available in the schools. While the number of computers in the schools has increased in recent years, the inequitable distribution of hardware and software is a problem, often referred to as the "digital device." For example, Technology Counts 98 reported that the groups most likely to lack technology access include Hispanic students, students in large schools, and students who attend schools populated entirely by minority students. Affluent schools that are not eligible for federally subsidized lunches are much more likely to be technology rich, as are schools with low minority enrollments (United States Department of Education, 1999).

As far back 1989, private schools in South Africa have introduced technology into their school environment. During the 1990 more schools, especially the Model C schools in the country, opened computer laboratories for learners and included computer studies as a subject into their curriculum. School in poorer communities had no access to ICT since the Education Department's budget, on which these schools were dependent, did not include technology provisioning. For most part, schools in poorer communities had to depend on computer donations, which in most cases were not further supported or maintained by the donor.

In America, low-income and minority-serving schools that do have technology, however, tend not to integrate it productively. More than 50% of African American students have teachers who use computers mostly for drill and practice, as compared to only 30% of white students (Educational Testing Services, 1996). In a South African context the provision of computers was initially used just for administrative purposes and schools were given one computer for the secretary to do the schools administration. As more and more educators and administrators realised the value of computers, the provision changed to include teaching and learning.

Table 1 below shows statistics of the percentage of schools with computers and schools with computers for teaching and learning. Currently 39,2% of South African schools have either one or more computers at school, while 26,5% of the schools are using it for teaching and learning (DoE, 2004:12). The table also shows that the Western Cape (82.4%) has the second largest number of computers in schools, behind Gauteng (88.5), but is the province whose schools use computers for teaching and learning (56.8%) the most since they developed an effective ICT integration process. My research attempts to bear out this statistics and shows how the ICT infrastructure provisioning in the Western Cape has led to the increase of ICT usage for teaching and learning. The ratio of schools with computers versus that of schools that actually use computers for teaching and learning clearly indicates that there is a concerted effort to provide infrastructure to benefit the teachers and learners in the curriculum environment. The table further shows that provinces with the highest provision of computers to schools are those that use computers for e-learning the most.

Table 1: Computers in South African schools

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%	56.8%
National	39.2%	26.5%

(DoE, 2004:12)

Thus it is clear that access to an ICT infrastructure will impact vastly on the success of e-learning and effectiveness of implementation (DoE, 2004:22). The aforementioned is particularly true as schools in the Western Cape and Gauteng have consistently been the top academic performers in the country.

2.4. Funding

Access to an ICT infrastructure is of course vastly dependent on the funding for it. Schools as well as provincial education departments are reliant on sustainable funding to provide and maintain ICT infrastructure. In realistic terms, the establishment of an ICT infrastructure at schools depends on the available school budget. Many school managers make the mistake of thinking that once the initial layout for hardware and software has been done and computers have been bought and installed, there are no further costs to cover. Schools do not take into account that there are further running costs such as insurance, maintenance and repairs. During the ***S***outh African - Finnish ***Co***-operation ***P***rogramme in the ***E***ducation Sector (SCOPE) project, a government-to-government partnership between the South Africa and Finnish governments, a *Toolkit for beginners* (SchoolNet SA-SCOPE, 2002) was developed. The toolkit suggests that schools should breakdown their budgets in the following manner: hardware (45%), software (20%), teacher training (15%), repairs and maintenance (5%), replacement (10%) and Internet access and insurance (5%). The initial purchase price of a computer is hardly ever more than half of the total cost of ownership, which means that fifty percent or more of the cost is taken up by 'running costs' as mentioned above (SAIDE, 2005). This cost split places more emphasis on

mechanical infrastructure and less on teacher development in the use of ICT. Although this should be the case initially, because you need to have infrastructure first before you can use it, this split could also lead to a situation where computers become "white elephants" in schools. The lack of investment in the very people that must integrate this equipment with the stated curriculum will lead to the under utilization of hardware. Thus, it is vital to plan the implementation process and have a balance between spending on infrastructure and teacher skills as this will ensure optimal utilization of the hardware.

On a national level funding can become more complicated. The Department for Development and Educational Skills (DfES) in the United Kingdom has a model, which funds ICT in schools from central government. This model enables schools to access funding for ICT through ring-fenced ICT budget and more recently through grants. "The Government continues to invest significantly in learning technologies for schools" (DfES, 2006). This ensures that schools always have access to funds for ICT and do not have to depend on donations or spend time on fundraising. The South African White Paper on e-Education accepts that "… bridging the digital divide and building an integrated e-Education System will require greater investment in the education sectors" (DoE, 2004:35). However, the decentralized nature of South Africa's education system meant that provincial education budgets, allocated from central government, were spent on provincial education priorities. Unfortunately, in almost all provinces, ICT lost out to priorities such as teacher salaries, more classrooms and textbooks as these components were deemed to be more important by provincial education authorities. The White Paper also promotes the sourcing of funding and resources from the private sector, Telecommunications Operators, government agencies and departments like the Universal services agency and the Department of Communication (DoE, 2004).

It is very important to note that all funding is finite and technological change is so rapid, that it is vital to concentrate on and accelerate those outputs and outcomes that address the most pressing local and national ICT issues.

2.5 Professional Development in Technology

It is significant to note that it is suggested that a large amount of a schools budget for ICT be allocated to the training of teachers. This, as stated in 2.4, is to avoid computer facilities being

under-utilised. Underwood (1997) asserts that most teachers that have completed their initial teacher training do not expect to need further training as they consider themselves fully trained as teachers and therefore do not take the initiative to improve their practice and learn new skills. Studies in the United Kingdom (UK) (Cox et al, 1988; Cox, 1993) have also shown that the majority of courses offered in the UK to train teachers in the use of ICT, have focused on the technical aspects of ICT with little training about how to incorporate ICT in the curriculum.

The question then needs to be asked: What can be done to improve the quality of teacher development to sufficiently prepare teacher to implement ICT ? According to Sivin-Kachala and Bialo (1996:5), the "… effectiveness of educational technology depends on the match between the goals of instruction, characteristics of the learners, design of the software, and the technological implementations made by teachers". This being true, the case for improved teacher professional development becomes even stronger. Well-planned in-service preparation and continued support are needed in order to increase the number of effective teachers using technology in the classroom. The White Paper (DoE, 2004:25) mandates the Department of Education in South Africa to "… develop a national framework for competencies for educators and the use of ICTs as flexible tools for teaching and learning must be integrated into pre- and in-service training". This however needs to be integrated in a holistic teacher development framework that is not only based on technology.

Several studies indicate that increased teacher support is needed to ensure that technology is appropriately applied for teaching and learning. Hadley and Sheingold (1993) reported that schools with a larger number of teachers using technology tended to have more exemplary technology users. This is particularly true since the more teachers are using technology, the more creative ideas are shared and the more teachers take up the use of ICT as integral resource for teaching and learning. A clear example of this is the increasing use of electronic mail as an additional communication tool for teaching in the classroom (Hassini, 2004). These findings suggest that districts might find educational benefits from populating schools with clusters of technology-using teachers to serve as on-site models of how best to integrate technology into teaching. This will then provide teachers with time to observe their more experienced peers and to plan collaboratively with them. This might encourage technology implementation by both experienced and non-experienced teachers (Hadley and Sheingold, 1993; Milken, 1998a). According to Gersten, Woodward, & Morvant (1992) and Hall (1997), this collaborative

planning is necessary in order to implement effectively concepts learned in staff development. In addition to increased staff development, school districts need to reassess their goals for technology for teaching and learning, decide how technology can best support the curriculum, and plan their purchases of hardware, software, infrastructure, and teacher support accordingly (Milken, Exchange on Education Technology, 1998b). Collaborative planning ensures that ICT is not an add-on to the school curriculum, but rather an integral tool that will enable curriculum delivery.

America's Office of Technology Assessment held a conference in 1995 which related some of the Department of Education's principles on professional development to the specific field of educational technology. The conference reiterated that professional development should be ongoing and intensive as opposed to the "one-shot" attempts that Ryan (1991) found to be ineffective. Singular attempts at providing professional developments stifles a teacher growth within ICT as it is normally based on only one aspect of ICT. Efforts should also be made to support the teacher's integration of the technology into their regular teaching as a tool rather than as a separate subject. This would involve not only teaching skills but also changing teachers' perceptions of how technology would benefit their classrooms. The conference participants also suggested that in-service instruction be hands-on and conducted using the hardware and software that the teachers have available to them. As to personnel, the participants recognized that teachers needed time to participate in professional development, collaborate with peers, and practice using the technology. A final recommendation was that the school community should have a long term commitment to improve their use of technology. The participants emphasized the importance of the community, school leaders, families, and learners planning together how technology can better support learner needs (U.S. Congress, 1995). The introduction of OBE in South African schools has shifted the educator's role to that of coach, mentor and facilitator. Educators now need to be tuned in to what the child brings to the classroom. The social and intellectual talents and abilities, the gaps, the inconsistencies, the fears and the joys of learners now need to be taken into account when introducing and teaching a technology based curriculum and introducing technology. It is especially in this area that staff development can help educators to understand the benefits of family and community involvement in their daily teaching. It can show them how to remove barriers to involvement and can explain techniques

for improving two-way communication between home and school, and school and the community.

Teachers' feelings of being unprepared to use instructional technologies may stem from several factors. First, when professional development is available, teachers typically receive only basic knowledge about the way they should operate the computers and software, not information on how to integrate the technology into instruction or on how to assess its benefits (Milken, Exchange on Education Technology, 1998b). Since few teachers entering the profession prior to the mid-1980s received instruction that included technological applications, school districts appear to be concentrating their efforts on training teachers to use the hardware, rather than how to integrate the technology to make positive changes in the way students think and learn. This was certainly the case in the South Africa with the introduction of computers in schools during the late 1990s and early 2000s. However after the declaration of the White Paper on e-Education (DoE, 2004) a concerted effort was made to also train teachers to integrate ICT in the curriculum. Statistics posted on the South African Government Information (2009) website shows that "By May 2008, about 53 000 teachers had been trained in basic ICT skills and some 24 000 teachers in ICT integration into the curriculum."

The content of the technology training has been shown to influence how useful it is to teachers (Kennedy, 1999). If the content of technology training is aligned to the curriculum and is relevant to what teachers do in the classroom then its is shown to be most effective. Training in the integration of technology into the curriculum is nearly always more helpful than basic technology skills training alone. The knowledge obtained through integration training assist teachers to introduce new ways of teaching and evaluating their subject field, while basic technology skills only teaches them how to operate the technology. However, a combination of both integration and skills training is reported to be most effective (Trotter, 1999). Jordan and Follman (1993) suggested that a good technology program should use cooperative learning models, incorporate higher-level thinking skills, as well as reinforce basic skills, increase communication between students and teachers, relate the skills to "real life" situations, and be flexible enough to address different learning styles.

As school districts work to improve their current professional development opportunities in the area of teaching and learning technology, they will need access to more research which focuses on the broader impact technology has in schools and in districts. Most of the work done thus far relates to specific technology initiatives with their own support systems rather than how technology is used by teachers with only district support. Researchers need to continue to explore the relationship between teaching practices and technology use as more evidence is needed to substantiate the influence that technology has on teaching practices. As Becker (1994:319) acknowledged:

> We must begin to produce systematic evidence that the kinds of teaching practices that we assume to be exemplary (i.e., the focus on writing, problem solving, and inquiry; and discovery-based learning) do result in the kind of improvements in student competencies that cognitive science research has implied is possible.

In summary, reviews of research on in-service teacher professional development agreed that the components of time, sufficient hardware and software, formalized instruction, a technology plan, support, and teacher motivation and commitment play a vital role in increasing effective integration of technology into the classroom. These components can be addressed by the state and local school systems, however, a partnership between the public school system and universities would provide a more solid educational foundation for the teachers. This naturally leads to and increase in research into effective teacher development practices for ICT.

2.6 Curriculum integration

> Enriching the learning environment through the use of ICT is continuum; it's a process that takes learners and teachers through *learning about ICTs* (exploring what can be done with ICTs), *learning with ICTs* (using ICTs to supplement normal processes or resources) and *learning through the use of ICTs* (using ICTs to support new ways of teaching and learning). (DoE, 2004:19)

The above suggests a very integrated approach towards implementation of ICT in the curriculum as it covers all facets of teaching and learning as well as educational administration. It also shows the DoE's commitment to integrate ICTs with the curriculum, but more importantly, it can be interpreted that the provision of ICT infrastructure to schools are vital to ensure that integration takes place.

Given that computers are becoming ubiquitous in our classrooms, it is important for teachers to have a good understanding of ways these technologies can best be integrated into the curriculum to meet the needs of diverse student populations. Unfortunately, this is not happening quickly enough. In America, the 1999 Education Week survey of 1407 teachers revealed that only slightly more than half, namely 53%, uses software to enhance instruction in their classrooms, and only 61% use the Web for this purpose. Even more discouraging, almost 4 out of 10 teachers surveyed indicated that their students don't use classroom computers at all during a typical school week. To realize the potential of their investment, schools need teachers who are prepared to develop new learning environments that utilize technology as a flexible tool. The use of computers for various reasons is dependant on accessibility. Table 1 has shown that only 39% of schools in South Africa have at least one computer for administrative purposes. To create new learning environments, teachers need constant access to ICT to review and access new methods. The DoE has recently introduced a subsidy scheme to assist teachers to purchase their own laptops (DoE, 2009). It is hoped that this initiative will increase the use of ICT for curriculum purposes.

Today, many school systems as well as colleges of education are recognising the need to provide practicing and pre-service teachers with professional development opportunities in technology. In South Africa, as stated earlier, the DoE has embarked on various programs for ICT training. Two of them have been in partnership ICT companies, namely the Intel Teach and Microsoft partners in Learning programmes and Uninvesities have incorporated ICT training in various Advanced Certificate in Education (ACE) qualifications. A 1995 Office of Technology Assessment report stated that school computers are likely to be used ineffectively or will be underused if less than 30% of the technology budget is spent on professional development. While, efforts to provide these programs are on the rise, there is still much room for improvement. As recently as 1997, only two states reported that more than 30% of their teachers had received nine hours or more of professional development in technology (Zher, 1997). However, in the 1998 Technology Counts report (Milken, Exchange on Education Technology, 1998a), investigators found that teachers from almost all states now receive some professional development on the use of technology, and some states even require this preparation for licensure renewal. Eighty-nine percent of the teachers surveyed reported that they had received some training on how to use the computer for instruction; however, the percentages of teachers

who had training in high-end technologies such as multimedia and/or on-line activities was quite small. Even with an increase in professional development opportunities, the majority of practicing teachers still feel unprepared to use instructional technologies in their classrooms (US Department of Education, 1999). Although the majority of the educators in these settings recognise that they live in a world in which technological skills offer increased opportunities for accessing new ideas and information, few believe that they have the skills that are necessary to use these tools effectively or to teach their students to do so. It is therefore important that adequate staff development in the use of ICTs be done before the integration of ICT into the curriculum. A failure to do so will lead to untrained teachers that will get disinterested and develop a resistance to using the computers in the classroom (Anderson, 2002).

In a study that examined technology use by rural teachers (Matthews, 1998), it was reported that more than one half of the teachers surveyed perceived themselves as novices in all aspects of technological use, with approximately one third to one half of the teachers never actually using technology for instructional purposes. This study also found that fewer than 30% of the public school teachers used internet technologies in their classroom even though the number of US Schools with internet access increased by 43% between 1994 and 1997 (US Department of Education, 1999). This finding is significant in that many resources for classroom teachers are available on the Web and these data indicate that the majority of the nations' teachers do not take advantage of the opportunities to use this technology to connect their students with other individuals outside of the walls of the classroom. Similarly, the data suggest that the teachers are not likely to use these resources to increase their personal productivity or to support their own professional development.

In South Africa, only 26.5% of the 26 000 schools in the country use computers for teaching and learning, although about 40% have computers at the schools (DoE, 2004:12). This has largely been ascribed to the high costs of establishing a computer laboratory as well as internet connectivity and telecommunications costs. It could also be ascribed to the fact that most schools tend to teach computer literacy or computer operational skills, rather than subject or curriculum based computer integration (DoE, 2004:14). In addition to the White Paper, other policy frameworks such as the NCS for Grades R to 12 and the introduction of ICT related subjects such as Computer Applications Technology and Information Technology, have been

developed to facilitate the integration of ICT into teaching and learning (Hodgkinson-Williams, 2005). These subjects not allow allows for the computer literacy, but integrates ICT in everyday lives. The fact that these subjects are examinable as exit subjects for the DoE's Further Education and Training certificate, makes it more tham just "add-ons" to teachers and learners.

Wenglinsky (1998) reported that 40% of the American teaching force did not receive instruction on how to use the internet, and an additional 18% had less than eight hours of staff development on that technology. In a study on the use of the internet in secondary classrooms (Cable, 1997), only 42% of the practicing teachers reported they felt well prepared to use the internet in their instruction. That percentage may be inflated, as only 10% of principals and 9% of district administrators indicated in the study that their teachers were well prepared to incorporate the Internet into the curriculum. These findings are of particular interest when one considers that the Clinton administration has been particularly vocal about the need to provide all students with access to the World Wide Web by the turn of the century (Gore, 1994) and considerable monies have been allocated to buy the necessary hardware and software to make this a reality. This again emphasizes the need for effective teacher development in the area of ICT. However, one must be careful not to priorities the integration of ICT to a level that goes above a system wide approach viz. including uplifting of other infrastructural and social aspects such as increase of classrooms, teacher moral and a culture of teaching and learning, even without ICT.

In summary, professional development opportunities in technology are increasing, however, they are insufficient to produce the kinds of changes that teachers need to be empowered and equipped for the information age. More opportunities need to be made available and more emphasis must be placed on the integration of technology across the curriculum. Teachers that are granted theses opportunities to actively practice ICT integration will in time replace "board and chalk" and "lecture-style" teaching and create an environment in the classroom that will simulate real life work situations. This integration with ICT will provide learners and teachers with the necessary skill to be competitive in the economic arena to the benefit of the country. The time, quality and scope of technology related professional development provided to teachers clearly impact on the type and degree of technology use in their classrooms and in the future.

2.7 Technical support

The absence of teacher technical support is a potential barrier to effective use of ICTs in the classroom. With technology rapidly becoming integral to education, from keeping attendance records and designing time tables to using interactive white boards for teaching, the demands for technical support has multiplied exponentially. Teachers who do integrate the technology become frustrated if hardware breaks or there is no connectivity. This often happens if teachers and technical staff are not given time to collaboratively plan for the integration of the technology into the curriculum (Milken, Exchange on Education Technology, 1998a). Planning is vital to ensure that technical support is always available. A survey in Virginia, US, has shown that only 29% of schools have a full-time technology support coordinator (Milken, Exchange on Education Technology, 1998a), and those who do mainly employ that person to teach children computer skills instead of providing technology support for teachers (Becker, 1994). Strudler (1993) found that teachers frequently cited the need for on-site technology support. Fullen and Stiegelbauer (1991) noted that people need support in the early stages of implementation, because it is at this time that people most often have concerns and self-doubt. In South Africa, technical support is mostly left to the hardware suppliers and the turnaround time for repairs can sometimes be as long as one month. Schools in South Africa that can afford it, pay a dedicated technician to regularly service the ICT infrastructure and fix broken computers on site.

Evans-Andris' (1995) conducted a longitudinal study in twelve elementary schools in America where technology-coordinators were employed. Her findings revealed that in order for a technology coordinator to provide effective support to classroom teachers, it is imperative for the coordinator to be in the school on a full-time basis. Evans-Andris (1995) also noted that technology coordinators should work with teachers rather than working for teachers if they are to be effective in helping teachers use technology in meaningful ways. Working with teachers will ensure that teacher become empowered and do not stay dependant on the coordinator. The data in the above-mentioned study confirmed this, as it clearly indicated that the coordinators felt that they were seriously hampered in their attempts to promote the integration of technology because they believed the classroom teachers wanted to have someone else "worry" about using technology rather than trying to learn to integrate it themselves. In addition, the coordinators

often felt that their responsibility was little more than provide the teachers with some additional planning time and consequently they felt their role was diminished.

Several coordinators noted that their tasks were often harder in schools in which the principal also held this belief. The data clearly indicated that although these schools did have technology-coordinators, there was little communication between teachers and coordinators around curricular topics and this resulted in very little integration. Evans-Andris (1995) concluded by saying that the findings of her study suggest that it may be more appropriate to hire technology coordinators as resource facilitators in order to work with teachers to identify ways that the technology can best fit into the curriculum rather than doing the identifying for them. I do believe that by hiring "outside help" teachers will avoid their responsibility of becoming technology enablers and will stay bystanders in the integration process. Evans-Andris' research indicates that professional jealously, and an ambiguous understanding of the job responsibilities are factors that can cause friction between support personnel and classroom teachers, thus eliminating any opportunities for these people to work together to integrate technology into the existing curriculum.

In contrast to the previously mentioned studies, Coburn (2000) found that employing a full time technology coordinator offered unique opportunities for teachers to collaborate with one another and the coordinator about the ways technology could change their teaching and create learner-centered classrooms. This two year qualitative study was designed to evaluate the impact of the infusion of technology on teaching and learning in a private girls' preparatory school. Coburn, who was employed as the technology coordinator for the school acted as a participant researcher. In addition, a network supervisor was hired to maintain the network, computer hardware, system software and provide limited technical support to teachers. In contrast, Coburn served as the curriculum specialist. This role evolved from the original position of the technology coordinator who was initially hired to operate the school's computer laboratory. Interestingly, the new title did not include the word "technology", thus, clearly indicating that the school had made a commitment to focus on ways the technology could support the curriculum rather than being seen as an entity unto itself. The role was described as a consultant who would work with teachers to help them determine the most appropriate way to integrate technology into the curriculum. A technology support team, which included the curriculum specialist, the librarians,

and the network supervisor worked together to support teachers, to trouble shoot, to consult with teachers, to review proposals for purchases of technology, and to problem solve.

Findings from the study clearly showed that the training opportunities that were offered were highly valued. Week-long training sessions were offered on a schedule during the school day and during the summers, thus offering multiple opportunities for teachers to think about and experiment with technological tools, applications, and concepts of the ways these might enhance their instruction. Teachers also valued the opportunity to consult with the curriculum specialist and reflect on their instructional practices. They felt that this method of infusion did not force them to "sacrifice" their teaching to the "Great God" of technology and that their instructional goals were valued. The consultant model also placed the responsibility for infusing technology squarely in the teachers' hands, yet, at the same time, offered support on multiple levels. Most significantly, this model resulted in teachers wanting to be technologically "independent" and self sufficient in technology use and problem solving. The teachers wanted to know how to "fix things" and to make decisions because they did not want to "miss a step" or "lose time." The curriculum specialist and teachers had a collaborative relationship that supported the teachers as they refined their instructional strategies and uses of technology. They noted that this process resulted in benefits for both students and teachers. Many teachers stated that while they did not set out to change their instruction, "it just happened." The procurement and provision of an ICT infrastructure to a school implies that it must be used within the context of the curriculum and school administration. If, however, specific attention is not given to teacher training and then subsequent technical support, the technology provided will amount to a fruitless expenditure.

Interestingly, although several reports cite equipment, software, time, and training as the most common barriers to the integration of technology, the elimination of these barriers does not necessarily facilitate a smooth transition to technology use by classroom teachers (Hall, 1997). In a study which was designed to train and support school-based teams of teachers and administrators to use technology, researchers found that even when they eliminated all the "known" barriers to the integration of technology in five elementary schools, they were still faced with significant obstacles to the integration of technology into the schools' classrooms. In this situation, the project coordinators placed a great emphasis on helping the school-based teams

use technology to create constructivist environments which supported higher level thinking skills. This model, which included a mentoring relationship between the university and the schools, was well received by all the school-based teams. Unfortunately, during the third year of the project, the school system chose to institute a system wide "core" curriculum which focused on the development of basic skills. Consequently, teachers and administrators felt they were under significant instructional constraints and eventually, many of the schools chose to "go back" to using technology for drill and practice activities.

This particular study was conducted in schools around Nashville, Tennessee in the United States. The principal of a school had agreed to be an active participant in the workshops and classroom activities and to provide the necessary administrative support for teachers to successfully integrate the technology into their classrooms. The administrator's role in this process was crucial to the success of the project during the first two years. Additionally, the principal also made many of the executive decisions regarding the role that the technology would play once the "core" curriculum was mandated system wide. The study by Bloemen et al., (1999) constantly shows that the commitment and interest of the principal is the most critical factor for successful implementation of any school innovation, especially technology. Similarly, the lack of administrative support to provide planning time and support for new teaching constructs severely hamper the integration of technology. In South Africa, principals are often to busy with administrative tasks such as budgeting and day to day issues of running the school, that the task of administrative ICT support is often handed to a teacher at a lower post level or even the school secretary. The assigned person often has little curriculum knowledge and slows down ICT integration.

Similar results were obtained in a survey of 298 elementary and secondary teachers who had participated in a state-mandated technology training program associated with the funding of Tennessee's 21st Century Classrooms (Lewis, 1997). The results of this study noted that teachers felt that there was (a) insufficient time for experimenting with technology; (b) problems with the quality and timing of the training; (c) the length of time that elapsed between training and the acquisition of technology; and (d) problems of malfunctioning technology. Prominently mentioned were issues related to a lack of time to use the technology effectively due to the

imposition of a state-mandated curriculum which focused on the breadth of material rather than an in-depth look at the subject matter.

As might be expected, time is another barrier to effective technology use and professional development. On average, teachers spend between one and eight hours per year of professional development time on technology training and typically receive more time on basic skills training than curriculum integration training (Milken, Exchange on Education Technology, 1998a). Teachers who receive more than eight hours of training tend to feel more prepared to integrate technology into their curriculum than those teachers who receive less. Of those who received more than eight hours of technology integration training, 33% felt "very well prepared" to integrate educational technology into the grade of subject they taught, compared to 17% who received up to eight hours (Milken, Exchange on Education Technology, 1998a).

2.8 ICT management

One of the strategic objectives of the White Paper (DoE, 2004:25), is to introduce ICTs professional development for school management, teaching and learning. This implies that for South Africa to realize the e-Education objective:

> … educational management needs to go beyond the initial stages of planning end experimentation … Educational leaders at all levels (national, provincial, district and institutional) must leverage ICTs as a tool for improved educational performance and reorganize educational institutions accordingly (DoE, 2004:26).

Support and training for principals and senior management is integral to the management of the ICT integration process, as the senior staff will be managing the process of translating the technology process into teaching and learning activities in their schools. To this effect, Don Passey (2002) believes that there are two key assertions that are important in the Management of ICTs in schools. He believes that they are vital to support and sustain current and future teaching and learning practices. The first has been alluded to in paragraph 2.5 of this chapter i.e. the impact that senior school managers have on classroom and curriculum practices on the way in which ICT changes are introduced. The second is the increasing infusion of ICTs into all aspects of school practice and its impact on the practices of both teaching and non-teaching staff presently and in the future.

Fullan (1992) and Everard (1986) support Passey's first assertion by indicating the impact that senior management can have upon classroom practice in a largely non-ICT based environment, while Scrimshaw (1997) and Becta (2000, 2001a, 2001b) indicate the strong relationship between the management and classroom practice in ICT based environments. It must however be said that the context within which effective management is linked to higher achievement of learners through the use of ICT, must be kept in mind. One must understand the issues of vision, purpose, planning and implementation strategies within the use of ICTs for education. Scrimshaw (1997) and the Stevenson Report (Stevenson, 1997) highlight the implications for present and future management by infusing ICTs into all aspects of the education system, the second assertion. Furthermore, Passey et al. (1997) and Somekh et al. (2001) have explore the infusion of ICT in terms of other technological contexts in schools. Senior management ultimately decides on whether an ICT infrastructure should be installed at a school. Thus they directly and inadvertently influence classroom practices when they make those decisions. The above literature attests to the fact that school management must be convinced of the value of ICT and then trained in the use of ICTs, in order for integration to be effective.

2.9 Summary

The consulted literature makes it clear that there will be implications for all who are involved in educational management, whether it is on a strategic, policy-making, implementation or school level. It also includes those who manage the curriculum, administration and personnel. The fact that a number of different stakeholders are involved with ICTs in schools potentially necessitates a shift in educational practice. Managers and supervisors at all levels of the educational system will need to be able to understand how they can best manage the situation for each group of people under their supervision. Managers in turn should consult and collaborate with one another on a regular basis. This is particularly important for the planning process when introducing ICTs in schools. The lack of collaborative planning could only have a negative effect on teaching and learning with ICTs.

This chapter has examined and reviewed various literatures that supported my research aims and attempted to analyse it in terms of my research questions. The next chapter sets out my research design and methodology.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research design that was followed in this study. My primary research approach will be qualitative, with certain quantitative aspects and I commence by describing qualitative and quantitative research and the methodologies within them. I then proceed to compare qualitative and quantitative research in terms of specified issues. Thereafter I discuss my research design, namely, a case study, briefly discussing types of case studies, designing a case study and data collection. The discussion is then followed by an explanation of my research tools, namely the interview and observations, which includes types of interviews and observations. The chapter concludes with a brief summary.

3.2 Research methodology paradigm

3.2.1 Qualitative

Creswell defines the qualitative approach as a research paradigm in which the researcher uses constructivist and/or participatory perspectives to make knowledge claims (Creswell, 2003:18). Denzil and Lincoln further clarify this by saying that "… qualitative researchers study things in their natural settings, attempting to make sense of or interpret phenomenon in terms of the meanings people bring to them." (Denzil & Lincoln, 2000:3). This basically means that the researcher uses the significance of individual, situational, social, historical and political experiences to develop a theory or pattern pertaining to the research issue(s).

Qualitative research methodologies include the following research designs:

- *Ethnography*

An ethnography is a description and interpretation of a cultural or social group or system. The research examines the group's observable and learned patterns of behaviour, customs and ways of life (Creswell, 1998:58). This methodology defines a system or social group by observing what people actually do i.e. in terms of their actions

- *Grounded theory*

The intent of a grounded theory study is to generate or discover a theory, an abstract analytical schema of a phenomenon, that relates to a particular situation (Creswell, 1998:56). Grounded theory almost acts in the opposite way of scientific research, by first collecting data from a specific situation, collating it and then using the it to formulate a theory. Traditional scientific research starts with a theoretical framework and then applies it to a specific situation.

- *Case study*

A case study is an exploration of a "bounded system" or a case over time through detailed, in-depth data collection involving multiple sources of information rich in context (Creswell, 1998:61). Creswell's definition involves the research and documentation of a specific issue or situation and the analysis of data followed by conclusions reached. Case study is also done in a way that incorporates the views of the person in the case under study (Zonabend, 1992).

- *Phenomenology (essence of a phenomenon)*

Phenomenology is the in-depth study of the experiences and perceptions of selected persons in order to understand the essence and meaning of persons'' perspectives (Van Manen, 1990). Phenomenology is considered a philosophical perspective that emphasizes a focus on people's subjective experiences and interpretations of the world. A phenomenologist wants to understand how the world appears to others.

- *Observations*

Observation is a term that describes several methodological techniques and can be used to collect qualitative or quantitative data. Observations within qualitative research can provide researchers with ways to check for non-verbal expression of feelings, determine who interacts with whom, grasp how participants communicate with each other and to ascertain how much time is spent on different activities (Schmuck, 1997). The interpretation of these observations will inform the research.

The general characteristics of qualitative methodologies are that it generally takes place in the natural setting and uses multiple methods that are fundamentally interpretive i.e. it uses open-

ended questions. The researcher assumes the role of the interpreter. The researcher thus views social phenomena holistically and the outcomes are then emergent rather than tightly prefigured.

3.2.2 Quantitative

Quantitative approach to research, is where the researcher primarily uses post-positivist claims for developing knowledge (Creswell, 2003:19). This means that the researcher uses concrete or conceptual data that was collected and measures and compares it with a standard. Quantitative research methodologies include:

- *Surveys*

Surveying is the process of conducting a study from representative samples of a specific grouping. This methodology can use different instruments such as observation, interview or a questionnaire.

- *Observations*

This methodology, within quantitative research, involves watching and recording behaviours within a clearly defined area. The researcher plays the role of passive observer and is, therefore, outside the action/s being observed and recorded.

- *Questionnaire*

This instrument is usually used for collecting data beyond the physical reach of the researcher and mostly from a large or diverse sample of people. It can however also be used in an interview in structured, unstructured or semi-structured way. For quantitative research, structured questionnaire in which the questions asked are decided in advance and asked in the same sequence as written, are the most appropriate. Unstructured and semi-structured questionnaires are more suitable for qualitative research as it allows the researcher to ask questions in a random order as determined in the interview. It also allows for the introduction of unscripted questions to provide the researcher with more insight.

Quantitative research is objective and seeks explanatory laws. It generates reliable group based and data that can be generalised and is well suited to establishing cause-and-effect relationships.

3.2.3 Comparative characteristics of quantitative and qualitative research

The table 2 below shows a comparison between quantities and qualitative research based on specific issues.

Table 2: A comparison between quantities and qualitative research

Issue	**Quantitative**	**Qualitative**
Nature of reality	Reality is objective and singular, separate from the researcher.	Reality is subjective and multiple, as seen by participants in the study.
Relationship of the researcher to what is being researched	Researcher is independent from what is being researched.	Researcher interacts with what is being researched.
Relationship between facts and values	Facts are value-free and unbiased.	Facts are value-laden and biased.
Language of research	Formal	Informal
Process of research	Deductive	Inductive
	Cause and effect	Mutual simultaneous shaping of factors
	Static design - categories isolated before the study	Emerging design -categories identified during research process
	Context-free	Context-bound
	Generalisations leading to prediction, explanation and understanding	Patterns and theories developed for understanding
	Accurate and reliable through validity and reliability	Accurate and reliable through verification

(Chantler, 1990:11)

The table provides an insight into the reasons for me using a qualitative as opposed to quantitative research and a case study as my research approach. The very nature of ICT infrastructure provision and integration is unpredictable and interpretation of process can be

subjective and biased. The qualitative approach allows me to interrogate claims made by individuals against those of others. The provision and use of ICTs differ from person to person and from institution to institution and thus any data gathered will be biased towards their specific motivation for using ICTs.

3.3 Research design – A case study

3.3.1 Defining the case study

I used the case study as my research design as it allowed me to examine the interaction of all issues pertaining to ICT in the Western Cape in order to provide as complete an understanding of the ICTs infrastructures in public schools. I arrived at this type of comprehensive understanding through an in-depth description of the types of ICT infrastructures available to schools, the motivation for using ICTs, as well as the challenges that schools face and best practice scenarios that schools display. The above provided me with the circumstances under which ICT infrastructure is distributed, the characteristics of the people involved in it, and the nature of the community in which it operates. This supports Cresswell's definition in paragraph 3.2.1 which explains the case study as a form of qualitative descriptive research, which involves the collection, and presentation of detailed information about a particular participant or small group. Frequently including the accounts of subjects themselves, the case study looks intensely at an individual or small participant pool, drawing conclusions only about that participant or group and only in that specific context. Hartley (2004:323) supports this view and articulates case study research as consisting of "…a detailed investigation, often with data collected over a period of time, of phenomena, within their context," with the aim "to provide an analysis of the context and processes which illuminate the theoretical issues being studied."

3.3.2 Types of case studies

As stated above case study methods involve an in-depth examination of a single instance or event. It is a systematic way of looking at what is happening, collecting data, analyzing information and reporting the results. Datta (1990) provides a framework for types of case

studies blow. It must be noted that each type is selected for use depending upon the goals and/or objectives of the research.

- *Illustrative Case Studies*

This type of case study is descriptive and use one or two events to show what a situation is like. This type attempts to make the unfamiliar familiar and to provide a common language and understanding about the topic. The chosen research topic should be typical of important variations and contain a small number of instances to sustain interest. They do however require presentation of in-depth information on each instance and there may not be time on-site for in-depth examination. The most serious problem is with the selection of instances. The instances must satisfactorily represent the research program, but where significant diversity exists, it may not be possible to select a case.

- *Exploratory Case Studies*

Exploratory case studies are shorter case studies, which are done before larger research. Where uncertainty exists about research operations, goals and results, exploratory case studies help identify questions and develop measures for implementation. Significantly, they assist protecting investments into larger studies. Although the findings may seem convincing enough to be released, because the exploratory study is ahead of the bigger study, its findings might not be deemed to be conclusive.

- *Critical Instance Case Studies*

Critical instance case studies is mostly applied when one researches a situation of unique interest, with little or no interest in generalisation. It is also less frequently used when a universal assertion is called into question and it can be tested it by examining one instance. This method is particularly suited for answering cause-and-effect questions about the instance of concern. One could however run into some trouble if the evaluation question is inadequately specified.

- *Program Implementation Case Studies*

The program implementation case study determines whether implementation is in accordance with its intent. Generalization is wanted in this case and extensive reports of what has happened over time can set a context for interpreting a finding of implementation variability. The main

concern with program implementation is the maintenance of quality as the demands of data management, quality control and validation procedures, may lead to cutting too many corners.

- *Program Effects Case Studies*

Program effects case studies can determine the impact of programs and provide conclusion about reasons for success or failure. It also require generalization and it may be difficult to answer the questions adequately and retain a manageable number of research sites. To overcome this, one can first conduct the case studies in sites that were chosen for their representivity and then verify these findings through examination of administrative data, prior reports, or a survey.

- *Cumulative Case Studies*

Cumulative case studies aggregate information from several sites collected at different times. This can either be *prospective* i.e. structuring a series of investigations for different times in the future or *retrospective* i.e. collecting information across studies done in the past. The latter allows generalisation without cost and time of conducting numerous new case studies, while prospective cumulation allows generalization without unmanageably large numbers of cases in process at any one time.

In summary, it is clear for the above that the case study is a method of learning about a complex instance through extensive description and contextual analysis. The end result is an expression of why the instance occurred as it did and what issues may be significant to investigate in similar situations. My research design is the illustrative case study method, as it illuminate the various issues that exist with the implementing of ICTs in Western Cape public schools. It also attempts to create a common understanding of the constraints regarding this issue and allow the interviewees to speak from a common point of view.

3.3.3 Designing a case study

In designing the case study, it is important to be explicit about the questions to be explored and the theoretical perspective from which the case is approached. The three most commonly adopted theories are:

Individual Theories
These focus primarily on the individual development, cognitive behavior, personality, learning and disability, and interpersonal interactions of a particular subject.
Organisational Theories
These focus on bureaucracies, institutions, organizational structure and functions, or excellence in organizational performance.
Social Theories
These focus on urban development, group behavior, cultural institutions, or marketplace functions.

Colorado State University (1993)

I approached my research from an organizational theory approach as it involves the investigation of institutions, structures and level of support for ICT infrastructure in schools.

An illustrative case study within organisational theory provides the ideal research design provided a plan for getting from beginning to end. Since case studies are conducted on numerous diverse topics it is virtually impossible to outline any strict or universal method or design for conducting the case study. Yin (1994) however, offers five basic components of a research design namely:

i. Research questions.
ii. The research propositions (if any).
iii. Units of analysis.
iv. The logic linking of the data to the propositions.
v. The criteria for interpreting the findings (Yin, 1994: 20).

In addition to these five basic components, Yin also stresses the importance of clearly articulating one's theoretical perspective, determining the goals of the study, selecting one's subject(s), selecting the appropriate method(s) of collecting data, and providing some considerations to the composition of the final report. All of the above is clearly articulated in Chapter 1.

3.3.4 Data collection

Stake (1995), and Yin (1994) identified at least six sources of evidence in case studies namely documents, archival records, interviews, direct observation, participant-observation and physical artifacts.

Documents could be any paper based items such as letters, memoranda, agendas, administrative documents, newspaper articles or any other document that is relevant to the research. Documents however can also lead to false leads in the hands of inexperienced researchers.

Archival documents can be any type of records that have been stored in one format or the other. One should establish the accuracy of these records before using them since even if they are quantitative, they might still not be accurate.

Since I'll be using *interviews* as my primary data collecting tool it is being dealt with extensively in 3.5.1. One should however note that the researcher should not depend on a single source for the interview, but look for data from other resource to verify its authenticity. I have thus also used observations as a means to gather data.

Direct observation occurs when a researcher visits a site to study the subject during a case study. This could help to provide additional information about the topic being researched. When more than one observer takes part, the reliability is improved.

When the researcher becomes actively involved in the observation process, its called p*articipant-observation.* By being an active participant, the researcher could alter the course of events. This may not hamper the research.

Physical artifacts relates to physical evidence that may be collected during the study as part of a field visit.

Yin (1994) asserts that not all sources are relevant for all case studies. The researcher must be able to deal with them all, but each case study will present different and unique opportunities for data collection.

3.4 Research tools

I used the interview and direct observations as my research tools for gathering of data.

3.4.1 Interviews

3.4.1.1 What is an interview?

Frey and Oishi (1995:1) define an interview as “a purposeful conversation in which one person asks prepared questions (interviewer) and another answers them (respondent)". The purpose of the exercise is to gather information on a specific topic to be researched. Interviews can be a very useful tool which can open up the way for further research using observations. Interviews can either structured (closed interview style) or unstructured (open interview style) or semi-structured.

3.4.1.2 The unstructured interview

Nichols (1991:131) defines open-ended or unstructured interviews as "an informal interview, not structured by a standard list of questions. Fieldworkers are free to deal with the topics of interest in any order and to phrase their questions as they think best." This allows the interviewer to ask a wide range of questions in any order depending on how the interview develops. It further allows the interviewer to probe deeper into the initial responses of the respondent to gain a more detailed answer to the question (Wimmer and Dominick 1997:156). The quality of the data is therefore entirely dependent on the interviewer as he must decide how much or little he should probe or say himself.

Wimmer and Dominick (1997:139) assert that the advantage of unstructured interviews is that it could illuminate issues that the interviewer had not considered before. A further advantage is that it gives the interviewee the confidence and freedom to respond in any way they wish and responses are thus not coerced. However, the later advantage also brings out the disadvantage of this type of interview. The varied nature of the responses makes it necessary to use a content analysis technique to analyse it. This makes the process time consuming (Wimmer and Dominick 1997:139). Open-ended questions can also be confusing, either because the interviewee does not understand the question or the interviewer cannot understand or interpret the answer. In summary though, open-ended questions are very important since it allows people to tell their stories and open-ended questions allow them to talk freely.

3.4.1.3 The structured interview

Nichols (1991:131) defines closed or structured interviews as a social survey where "the range of possible answers to each question is known in advance." In most instances the interviewer lists the standardized possible answers and then just ticks of the interviewee's reply. This method allows little room for flexibility as each interviewee is given the same questions (Wimmer and Dominick 1997:139 and 156). The advantage is that the information and responses can be easily verified and compared. However, because of the lack of flexibility in this approach, there is "little room for unanticipated discoveries" (Breakwell, Hammond and Fife-Schaw 1995:231). Also some of the answer provided might not fit into the prearranged list of answers. This will leave the researcher with the dilemma of how and where to fit this data in.

3.4.1.4 The semi-structure interview

Semi-structured interviews can be used to receive or provide information. They are open by nature and not all questions are drawn up before the time. The majority of the questions are formulated during the interview and this allows the interviewer and the interviewee with the flexibility to probe for further details. Cohen and Crabtree (2006) state that semi-structured interviews " allow informants the freedom to express their views in their own terms." They further assert that this type of interview is used best when there are several interviewers and they only have one chance to interview someone.

3.4.1.5 One on one versus focus group interviews

The two types of interviews used in everyday research are one to one and focus group interviews. One to one interviews, also known as personal or intensive interviews, use a small sample of people to interview individually. Open-ended questions are used and it normally requires the interviewer to establish a good rapport with the interviewee to allow the interview to talk freely (Nichols 1991:13 and Wimmer and Dominick 1997:100). Follow-up questions are dependent on the answer to the lead question. This allows for a flexible approach and as stated earlier it allows for the interviewee to provide information that was not directly asked for.

Wimmer and Dominick (1997:100 and 158) however warns that the fact that the questions are not standardized could make it difficult to generalize the data on a larger scale.

The focus group interview is defined by Wimmer and Dominick (1997:97) as "a research strategy for understanding audience/ consumer attitudes and behaviour". Ideally the member of the group should be known to one another and even have similar backgrounds. Nichols (1991:14) goes further and says that hey should be of the same sex to allow them to be comfortable in each others presence. The interviewer can then use either structured or unstructured to guide the discussion while the group share opinions with one another. Because they are less inhibited the group's answers are more complete. However group discussions run the risk of one person trying to dominate the conversation. Wimmer and Dominick (1997:461) writes that:

> Some researchers claim that the focus groups are not a good research methodology because of the potential influence of one or two respondents on the remaining members of the group. These critics say that a dominant respondent can negatively affect the outcome of the group and that group pressures may influence the comments made by individuals.

Due to its flexible nature, unstructured and semi-structured interviews allows for questioning to be guided as the interviewer wants it. The results is however dependant on the willingness of the interviewees to give accurate and complete responses. Wimmer and Dominick (1997:162) warns that interviewers might often lie because they feel embarrassed, inadequate, lack the knowledge on the topic or nervous. On the other hand, they may also provide you with very elaborate answers in an attempt to figure out the purpose of the study. This might compromise the validity and reliability of the interview data (Breakwell, Hammond and Fife-Schaw 1995:238-239).

3.4.1.6 Interview methods used in this thesis

I have used mostly one on one, unstructured and open-ended interview techniques when gathering information for this thesis as this provided me with the flexibility to probe for a deeper understanding of the issues. Furthermore, most of the interviewees were experts in one or the other field in ICT and could not be gathered together in focus groups. It was for the above-mentioned reasons that I only used one interview schedule. All the relevant questions are

contained therein and it allowed me the freedom to follow-up with different questions to different interviewees. Structured, defined questions were only used to gather data on technical ICT infrastructure issues such as hardware and software specifications. This direct communication through in-depth interviews with persons at various levels within the Western Cape Education Department provided me with information regarding:

- The reasons for using ICTs in the schools;
- The level and structure of curriculum and technology support within the province;
- The process to follow when procuring equipment and planning training;
- Problems that might hinder service delivery; and
- The different training programs being offered to teachers and officials for the implementation and integration of ICTs in schools.

The interview allowed me the opportunity to reassure the interviewee when s/he was reluctant to participate. The opportunity for feedback to the respondent was also a distinct advantage and questions, responses and instructions were immediately clarified. This research method allowed me to make recommendations as to how greater cooperation could be established and the possible constraints that might hinder collaboration within the province and amongst provinces.

I used a tape recorder and writing notes to capture data during the interviews. I used both, as the Khanya facilitator and the technician did not feel comfortable to be recorded. Writing down their responses was a slower process than using the tape recorder and I could therefore not cover all the questions in the time allotted for the interview. The tape recorded interviews were faster and easier to manage. However, transcribing this took much longer than expected as I had to use a start-stop process to transcribe the exact wording and noises on the tape. Thereafter, I had to "clean-up" the transcriptions to remove unclear articulation on the tape recorder. The transcribed interview with the Director: Information Technology, WCED' is attached as an example.

3.4.1.7 Interviewees and access

Permission was obtained from the Director-General of Education in my capacity as Chief Education Specialist at the DoE to interact with the provincial representative for ICT in schools

in the Western Cape, namely the Director: Information Technology. Further permission was then granted through his office for me to interview the persons below.

The following persons were interviewed:

- Director : Information Technology, WCED
- Head: Khanya Project
- Deputy Director: IT , Centre for e-Innovation
- Khanya facilitator
- Khanya technician
- Khanya project manager
- A principal, WCED
- Three teachers, WCED
- Curriculm advisor, WCED

Interviewees were chosen on the basis of their positions within the WCED with respect to school and ICT policy implementation (Director, Head and Deputy Director), direct involvement in the provisioning of ICT (project manager, facilitator and technician), persons receiving and using the ICT in schools (principal and teachers) and advisors responsible for the integration of ICT (curriculum advisor).

3.4.1.8 Summary

In summary it is clear that there are different types of interviews as well as different styles an interview can take. It is significant to note that the success of the interview is dependant on the ability of the interviewer to ensure objectivity. In my opinion the interview is a valuable tool to gather information on the research topic, but also for baseline to pursue further research using a different method.

3.4.2 Observations

3.4.2.1 What are observations?

The typical form of data collection in field research is the observation of participants within their natural surroundings (Mclure, 2002). The data obtained from observations can be used to describe the physical setting, activities taking place, who is participating in the activities and how participants are experiencing the activities. Observation can enable the researcher to see things that participants themselves are not aware of, or that they are unwilling to discuss (Patton, 1990). Skilled observers should be able to monitor and observe verbal and non-verbal incidences in the process of their research.

3.4.2.2 Observation strategies

There are several observation strategies available and the role of the observer can vary depending upon the level of involvement desired. One strategy is to watch without being seen or being as inconspicuous as possible without interacting with the participants. This strategy may result in the researcher's own perception of what is happening and will give bias to the result. A second strategy is to have limited interaction with the participant and to only intervene for clarification purposes or to get specific data. This strategy could give a more accurate account of what is transpiring during activities. Finally, an observer can fully participate in the observed activity, keeping in mind that your participation may introduce a distortion of the natural scene. An observer must keep the consequences as mentioned in mind when choosing a strategy (Schatzman and Strauss, 1973). The above strategies, reveal two distinct types of observation, namely participation observation and direct observation.

3.4.2.3 Participant observation

Participant observation is probably the most common methods for qualitative data collection, but possibly also the most demanding as it requires a period of intensive social interaction between the researcher and the participant, in the latter's natural environment.

Participant observation "simultaneously combines document analysis, interviewing of respondents and informants, direct participation and observation, and introspection" (Patton, 1987: 75). This method is often chosen when the observer feels it will be most beneficial to experience the event as well as record it. This often requires months of participation as the researcher must become part of and accepted in the natural environment in which the participants are observed.

3.4.2.4 Direct observation

Direct observation is distinct from participant observation in the sense that the observer does not attempt to become part of the participants' natural environment. The direct observer strives to be as unobtrusive and detached as possible in order to limit personal perceptions and biases since the activity is experienced first-hand. Thus, direct observation tends to be more focused than participant observation as the researcher is watching rather than taking part. It leads to the observer identifying routine, unconscious things, often overlooked by the participants. Furthermore, since it is more focused, direct observation does not take as long as participant observation.

3.4.2.5 Observation method used in this thesis

I have used the direct observation method as part of the information gathering process for this thesis as this provided me with a focussed approach while observing ICT infrastructure at a school in the Western Cape. By using direct observation, I could verify data supplied by teachers during my interviews and this could be done in a short space of time.

3.5 Data analysis

The qualitative nature of the case study makes for an atypical data analysis. Analysis often happens as data is collected and not afterwards. The analysis must also be an iterative process whereby initial data collection, through either interviews or observation can be reflected upon for further data collection. I have drawn several quotes form the interviews as a basis for my

presentation of findings and analysis. I have tried to avoid generalisations and have stayed with the data provided by the interviewees and gathered through observations.

3.6 Summary

In this chapter, I have discussed my qualitative research approach and the case study as my research design. I have also discussed my data collection tools and data analysis methods and the reasons for using them.

In the next chapter I will present the data gathered from my interviews with the persons listed in paragraph 3.4.1.7 and my observations at the school visited and show how it links to my research questions.

CHAPTER 4

PRESENTATION OF RESEARCH FINDINGS

4.1. Introduction

This chapter presents and discusses the findings of interviews with officials and teachers at three schools in the Western Cape. It commences with a discussion of the motivation for using ICTs in schools by the province. I then provide a detailed configuration list of the type of hardware and software infrastructure models that the WCED offers to schools and how these are funded. This is followed by a brief discussion on the technical support provided to schools for these models. Thereafter I discuss how curriculum integration takes place and how it is supported through teacher development programmes. I then briefly discuss the WCED's future plans, taking into consideration the constraints and critical issues in the province. To conclude, I discuss the recommendations from officials and teachers in the province.

4.2. Motivation for using ICTs in schools

In order to get an overview of ICT infrastructures in schools in the Western Cape, I first interviewed the person responsible for the ICT provision in the province, namely the Director for Information Technology. In response to the question regarding the main reason for using ICT in schools, he replied that the use of ICT in WCED schools has its origins in the Telecommunications Project that was started in 1998. "We initially gave each school two computers, one for administration and the other for curriculum delivery", he said. He explained that the idea was that administration staff and an appointed staff member could download curriculum resources. Rollout was staggered until all schools had at least one computer. On training, he said that: "The principal, an administration officer and at least one teacher from each school received eight hours of training on the basic operation of a computer, accessing the Internet and communicating through e-mail." The limited provision of hardware implies that only certain staff members have access to the computers. In most cases, this is only the principal and school secretary and use of these computers are restricted to administrative tasks. The inadequate training only provide operational skills and not skill in curriculum integration.

The Director also stated, “The Telecommunications Project evolved into the Khanya Project in 2000. Khanya is now a project of the WCED and will be integrated into its formal structures as soon as the necessary structures within the WCED are established”. He added that the WCED developed a provincial policy for ICT provision based on the DoE’s White Paper 7 on e-Education (DoE, 2004). The Head of the Khanya project who stated, “The role of Khanya is primarily to implement ICT infrastructure whilst that of the WCED is to ensure that ICTs are used for curriculum integration”, confirmed this. The fact that Khanya is a project and not part of the WCED’s curriculum delivery process, could possibly bring the Khanya facilitators in conflict with the WCED officials when supporting schools. This can be avoided with open communication lines between officials and facilitators. The integration of Khanya into WCED structures could also be problematic, as some of the Khanya staff are paid ICT market related salaries and will have to fit into government salary scales.

The main factors that motivated the expanded use of ICTs in WCED schools and the establishment of Khanya, according to the Director and the Head of Khanya were:

a) *The shortage of teaching capacity*. The Director stated:

> The continuous decrease in the numbers of adequately qualified teachers, particularly Mathematics and Science, together with the reduced number of entrants into the education profession, required the WCED to explore and harness technology to strengthen the system, which is at risk. The approach that is being adopted is to assist teachers to increase their capacity through the use of technology rather than to replace them.

b) *The need to co-ordinate efforts*. The business sector in the Western Cape recognises the need to significantly contribute towards ensuring that an adequately qualified workforce is developed for the future. As the Head of Khanya remarked:

> The business sector, various NGOs, national and international donors and other stakeholders are willing to make a contribution, but not in an uncoordinated and often wasteful manner. It is for this reason that the WCED created the Khanya project to co-ordinate efforts.

c) *Bridge the Digital Divide***.** In some schools, the environment has been created in which technology is being integrated into the curriculum delivery process. In most schools, however, parents cannot afford contributing towards the high cost of ICT in schools. The result is that the digital gap between the "haves" and the "have-nots" is

continually widening. A concerted effort was needed to reverse this situation.

d) *Preparing the Western Cape for the Knowledge Economy of the 21st Century.* In view of the vision of the province to become a "leading learning region that successfully equips its people and businesses to acquire and apply knowledge effectively in a rapidly changing world", all available means, including technology, are to be used to achieve this goal**.**

The above mentioned factors for the expansion of ICT use in schools are relevant but could also be seen as idealistic. It is important for teachers to know that they have the support of the provincial education authorities in all the aspects of education, not just technology support. Failing this, I believe that we will continue to see an exodus of educators from the classroom especially in secondary schools. It also seems pointless to spend time capacitating teachers if they do not have the ICT resources necessary to put their skills into practice with their learners. Furthermore, the exorbitantly high cost of training teachers in ICT is a constant issue and underlies the challenges mentioned in Chapter one. Legislators in South Africa need to revisit to what extent they value ICT in education and provide more funding for ICTs in schools through provincial and national education budgets.

The Project Manager of the Khanya project explained that, “The goal of the Khanya project is to promote learning and maximise educator capacity by integrating the use of appropriate, available and affordable technology into the curriculum delivery process”. In further discussions with the Project Manager, it became apparent that this goal is to be realised through the implementation of the primary objectives of the project, which are to:

- Increase educator capacity and effectiveness by means of technology;
- Harness the power of technology to deliver curriculum;
- Enhance the quality of the learning experience in the classroom by providing an opportunity for learners to benefit from a variety of learning styles;
- Integrate appropriate and available technology into the curriculum delivery process;
- Use technology to assist all disabled learners to maximise learning;
- Improve Senior Certificate and Further Education and Training Certificate (FETC) results, as well as learner outcomes in all grades, in terms of number of passes and

quality of results;

- Increase the number of learners taking Mathematics and Science on the higher grade and coping successfully;
- Increase the number of learners qualified and competent to enter tertiary education institutions after obtaining their Senior Certificates and FETC; and
- Improve numeracy and literacy in lower grades in order to build a stronger foundation for future matriculants.

The Project Manager added that the further benefits of the projects that will accrue are:

- Learners will be prepared for the Information Age;
- The digital divide will be narrowed;
- A technology rich province will be created ; and
- All teachers and learners in the province will be provided with an e-mail address.

4.3 Implementation model and Infrastructure

4.3.1 Overview

The Head of Khanya was asked how Khanya is managed and administered. He replied, "The implementation of the Khanya project occurs through a Steering Committee of three persons at Deputy Director-General, Chief Director and Director level. This Committee oversees the project and is the decision making body". He added that an Executive Committee co-ordinate the project in the following manner:

- A Project Manager manages the project and ensures co-ordination and completion of deliverables on time, within budget and meeting the required specifications;
- The project is implemented through a series of discreet, well-defined sub-projects, where each sub-project is defined in terms of scope, deliverables, required resources and time frames;
- Sub-Project Managers manage the sub-projects and ensure deliverables;
- A Project Support Office administers the project;
- Pilot projects are initially used to gain insight and test assumptions;
- The Project Support Office, based on the insights gained from the pilot projects,

develops a methodology for introducing technology into schools; and

- Ongoing evaluation and quality assurance of project deliverables takes place throughout the duration of the project.

When interviewing the project manager as to how the Khanya project is managed, his response was, “Each school is viewed as a separate entity in terms of requirements. Before any infrastructure is provided, schools are assessed for their level of readiness to receive technology, which includes the required infrastructure and efficient management.” In essence he said that the assessment of a school will determine its order of priority for the installation of technology. This was confirmed by a teacher who said: “We were visited by a delegation from the Khanya office and asked us a range of questions and also checked out the school buildings and grounds for a possible room for the computers.”

The project manager explained that where a school is already using some ICT technology, plans need to be devised to ensure that it is used for curriculum delivery, thus capitalising on existing investment. “In many instances, the needs analysis regarding infrastructure and management development identifies the level of preparatory work required before technology installation”, he said. From the schools point of view, a teacher explained further:

> A school is required to submit a project plan on its requirements to Khanya for consideration for support. Once Khanya approves the plan, the school is then required to state what it will contribute toward the implementation of the strategy. This includes approaching the School Governing Body, local business, corporate sponsors, the community, etc., for support.

From the above it seems that a deliberate effort is being made by Khanya to involve schools in the planning of ICT infrastructure provisioning. When all stakeholders are consulted, it ensures that the whole school community has ownership in the project. The above process seems to have been successful since about 300 schools in the Western Cape have been provided with Khanya laboratories. State funding has largely been used to provide the hardware.

4.3.2 Infrastructure specifications

In and era of rapid technology development, problems can be encountered if there is no standardisation of the ICT equipment provided to schools. The Head of Khanya stated in this

regard, “Although Khanya is not responsible for technical norm setting and support, it did initially adopt a set of standards for schools”. These initial standards were provided by the Head of Khanya and are specified below in Table 3.

Table 3 Initial Khanya hardware specifications for new equipment

Basic Unit	**Presentation Unit**	**Medium File Server**	**Large File Server**
P4-CELERON 2.4GHZ (478PIN) PRESCOTT P4 (478PIN) COOLING FAN Intel LA Crosse M/ATX with 100/1000 LAN 256 MB-DIMM (PC400) SEAGATE 40 GIG IDE UDA 100, 7200RPM HARD DRIVE Mecer 17" SVGA colour monitor WIN XP HOME OEM Mecer PS/2 K/BOARD M/SOFT OEM OPTICAL INTELLIMOUSE -USB CK1009 Micro ATX case with P/Supply 9200SE AGP 8X 64MB DDR RAM W/TV-OUT 16X DVD DRIVE AMPLIFIED 200W PMPO SPEAKERS A-OPEN DELUXE DUAL HEADSET AUDIO SPLITTER	P4 2800 W/512 SOCN PC5300 (478 PIN) COOLING FAN Intel LA Crosse M/ATX with 100/1000 LAN 512 MD Dimm PC400 Barracuda 120GB 7200RPM 8MB CACHE MECER 17" SVGA MONITOR BTC DVD +CD writer combo Mecer Ext Amplified Speakers WIN XP HOME OEM M/SOFT OEM OPTICAL INTELLIMOUSE -USB CK1009 Micro ATX case with P/Supply STANDALONE MICROPHONE SAMSUNG 1.44 STIFFY DISK DRIVE MECER PS/2 K/BOARD 9200SE AGP 8X 64MB DDR RAM W/TV-OUT PAL-I PCI TV CARD RAVE CAPTURE CARD	INTEL XEON 2.8GHZ 533FSB Clearwater 533Mhz Dual Xeon Board DDR PC266 REGISTERED 256MB DIMM Intel PED SC5200 BASE CHASIS Barracuda 120GB 7200RPM 8MB CACHE Mecer 15" SVGA colour monitor 16 X Speed IDE DVD ROM Drive SuperTrak SX6000-64MB - IDE Raid controller - 6 CH with 3 IDE H/Swop brackets Mecer PS/2 K/BOARD Optical Mouse Samsung 1.44 stiffy Disk Drive Superswap hotswap drive chassis and housing Additional Bracket for Hudson Chassis Promise Raid 128 Meg Memory WIN XP HOME OEM	INTEL XEON 2.8GHZ 533FSB Clearwater 533Mhz Dual Xeon Board DDR PC266 REGISTERED 512MB DIMM Intel PED SC5200 BASE CHASIS Barracuda 120GB 7200RPM 8MB CACHE Mecer 15" SVGA colour monitor 16 X Speed IDE DVD ROM Drive SuperTrak SX6000-64MB - IDE Raid controller - 6 CH with 3 IDE H/Swop brackets Mecer PS/2 K/BOARD Optical Mouse Samsung 1.44 stiffy Disk Drive Superswap hotswap drive chassis and housing Additional Bracket for Hudson Chassis Promise Raid 128 Meg Memory WIN XP HOME OEM
Other Hardware		**Switches:**	
Symantec Ghost APC 1000VA, ON-LINE Duxbury Ext ISDN TA	HP Scanjet 3770 HP LaserJet 2420N + USB cable	3Com switch 4250T (48x 10/100 + 2 x 10/100/1000) 3Com switch 4226T (24x 10/100 + 2 x 10/100/1000) Accton Switch 8port 10/100/1000 TX	

(Khanya, 2008)

A Deputy Director in Khanya added that the specifications have been updated and revised. The increase was necessitated as operating systems and application programmes become more sophisticated and require more hard-drive space and more RAM in order to process faster. The main differences between the initial specifications and the revised specifications are the increase in hard-drive space, from 40 Gigabytes to 160 Gigabytes, together with an increase in the size of the random access memory (RAM). The Deputy Director provided the current Khanya hardware specifications for new equipment, which are listed below in Table 4.

Table 4: Current Khanya hardware specification for new equipment

Standard Workstation	**Presentation Workstation**	**Server**
• M/ATX 300W Tower Case • INTEL MATX DDRII800 Motherboard • INTEL CELERON 2.4 GHZ CPU • 512MB DDRII 800MHZ DIMM • Western Digital 160GB 7200RPM SATAII Hard Drive • 17" CRT Monitor • OPTICAL MOUSE • Multimedia KEYBOARD • WIN VISTA STARTER EDITION OEM • Headset • Audio Splitter	• M/ATX 300W Tower Case • INTEL MATX DDRII800 Motherboard • INTEL CORE 2 DUO 2.4 GHZ LGA CPU • 1 GB DDRII 800MHZ DIMM • Western Digital 320GB SATA Hard Drive • 17" CRT Monitor • OPTICAL MOUSE • Multimedia KEYBOARD • WINDOWS VISTA HOME OEM • AMPLIFIED SPEAKERS • STANDALONE MICROPHONE • 20X DVD+RW SUPER MULTI OPTICAL DRIVE •	• Intel Snow Hill Server Board • 2 x 2048MB DDRII ECC DIMM = 4 GB • 3x WESTERN DIGITAL SATA 3 RAID EDITION 500GB HARD DRIVES • 20X DVD+RW SUPER MULTI OPTICAL DRIVE • INTEL CORE 2 QUAD 2.4 GHZ CPU • 1U Black Bezel • 1.44MB Stiffy Drive • 17" LCD monitor • BLACK OPTICAL MOUSE • KEYBOARD • WINDOWS VISTA HOME OEM

Switches	**Other Hardware**	**Lan**
• Dlink 48-ports 10/100/1000Mbps + 4 Combo SFP web Smart Switch • 24-10/100/1000Mbps Gigabit Ethernet ports with 2 Combo SFP (Mini GBICs) • 8-port 10/100/1000BASE-T with 2 x SFP Combo Ports	• APC 1000VA, ONLINE UPS • ADSL modem • SCANNER • Brother HL6050DN - A4, 24ppm, 32MB, 1200x 1200 dpi, PCL-6	• Category 6E cabling

Support Software		
• Ghost imaging software for network • NETOP School / SYNCHONEYES monitoring and remote management for network • Norton anti-virus for network		

(Khanya, 2008)

The Deputy Director added that, at the time of writing, 813 schools had been provided with technology facilities. These facilities consist of the typical computer laboratory, with between 25 and 40 computers each. The computers are linked through a local area network (LAN) and have access to the internet.

It must be noted that it is a function of the Centre for e-Innovation in the Provincial Government of the Western Cape to develop hardware specifications.

4.3.3 Funding

Funding is a crucial issue in any ICT infrastructure provision initiative in education. This is particularly so, because neither the national nor the provincial education departments have dedicated and sustainable funding available for the implementation of ICT in teaching and learning. When asked how Khanya was funded in the context of limited funds being available, the Head of Khanya replied, "The Western Cape Legislature provides core funding for administering the Khanya Project. Funding from this source, however, is never adequate for the complete implementation of the Khanya project. Alternative forms of funding are therefore also sought. The Western Cape Education Trust is a means whereby donors to contribute towards the project".

When donors contribute directly to schools, the Khanya project acts as a facilitator to ensure alignment with Khanya objectives. The principal of a Secondary school confirmed this and explained, "Our school has a specific budget and expenditure item for Khanya ICT matters. This sustainability plan for continuous funding for the school's ICT infrastructure is done with the aid of the Khanya coordinator for the region". The Head of Khanya added, "Each school must contribute as much as possible to the implementation of technology at that school". Funds are only spent if, in considering the poverty indicator of a school, there is a reasonable chance that technology implementation in that school will be successfully utilised.

The Head of Khanya explained further,

> The development of business plans by schools is used as a basis for budgeting and sourcing funds. Khanya's budget has increased from R17 million in 2001/2 when the project started to R93 million in the 2008/9 financial year. This covers operating costs and salaries for staff of 60, which amounts to R18

> million per annum. Other funding strategies include approaching the private sector. An example is that Cisco Systems is to fund the establishment of Cisco Academies in state institutions. In 2005, Cisco contributed R17 million toward the project and this was increased to R35 million in 2006.

The Head of Khanya also stated that Khanya has already raised more than R10 million from sponsorships. Funding for ICTs can be erratic if a concerted effort is not made to secure sustainable funding. The WCED through legislation and the efforts of the Khanya staff have managed to adopt funding model that allows them to place computer laboratories in about twenty schools per year. They have also succeeded in not over extending themselves and have only committed to the amount of schools for which they budgeted for annually. The sustainability comes from encouraging schools to plan for and take responsibility for insurance, electricity, connectivity and other operating costs. This ensures ownership and ongoing responsibility for the project.

4.4 Technical support offered

Major problems are experienced if ICT support to schools consists only of the “box-dropping" of computers at schools. The Khanya project manager explained, “In the implementation of the Khanya project, it was found that a project is bound to fail if equipment only is supplied to schools”. Khanya has thus employed facilitators in the form of support staff at district offices and these facilitators have been the key to success of the Khanya project. A further success indicator has been the empowering of teachers to do first level technical support at schools. The project manager concluded by saying that, “We have also found that it is a mistake to over-facilitate support. Of Khanya’s staff of 60, 40 are used to provide full-time technical support on an ongoing basis”.

The Centre for e-Innovation has assigned a staff member at the level of Deputy Director to each school region in the Western Cape to provide technical support. During my interview with him, the Deputy Director explained, “I am supported by 3 technicians to provide hardware and software support at schools.”

The lack of technical support can lead to teachers not using technology. By providing full-time technical support and empowering teachers to do technical support, the WCED has attempted to

remove one of the obstacles to successful ICT integration. The provisions of technical support can only lead to the more effective and efficient use of ICTs in schools.

4.5 Curriculum integration and support

On of the challenges being faced in the use of ICT in schools is to use ICT effectively for curriculum delivery. According to an interview with a Khanya facilitator, she stated, “The Khanya project is curriculum driven. No technology installation takes place unless it can be linked, directly or indirectly, to curriculum delivery”. The goal of Khanya is to integrate technology fully into the curriculum delivery process, the ultimate aim is thus to make technology available in each classroom. She added, “One Khanya facilitator is assigned to about 5 schools with the intention to support teachers in the use of technology for curriculum delivery and in their everyday teaching tasks”. When speaking to a WCED curriculum adviser, he said, “The Curriculum Directorate has the responsibility of ensuring the quality of curriculum content offered through Khanya. Curriculum advisors in each district work very closely with the Khanya facilitator to ensure that work related boundaries are not crossed”. The communication between the Khanya facilitator and the curriculum adviser is vital to ensure that the correct message is conveyed to the teacher. The curriculum adviser is the subject expert, while the facilitator is deemed the ICT integration expert. If these two roles can be merged, it would ease the integration of Khanya into the WCED, as mentioned in 4.1.

The facilitator added, “Khanya makes sure that the most appropriate, cost effective and efficient curriculum content is sourced from a variety of sources. This includes packaged software and web-based material. Where no required curriculum content is available, sub-projects are initiated to develop such content. This is done in collaboration with curriculum advisors”. Year and term plans, lesson plans, and other material useful in teaching are also included in the term "curriculum content”. Where curriculum content has been provided, it is made available to all schools of the WCED.

Currently, mathematics-tutoring programmes, such as Master Maths and CAMI together with a curriculum management system, are provided to schools for curriculum integration. A Mathematics teacher confirmed this, but who also added, “Computer laboratories are not always

available for the senior learners and that they used the mathematics programmes only for revision. Other programmes, such as agricultural software, ALICAD and the Pastel accounting programme, are also being used, to good effect".

Plans are now afoot to supply and use ICT facilities to implement the NCS for the FET band. Curriculum planners have already linked software such as ALICAD and Pastel to the subjects. Khanya is also training curriculum advisers in the use of Pastel and ALICAD.

It is encouraging to hear that Khanya is looking to link software to the NCS, however I am concerned with the shortage of locally developed, contextually relevant course content for both teachers and learners. It is vital that considerably more emphasis be placed on developing contextually relevant South African or African digitised content so that our teachers can realise their full potential of ICT in order to transform their teaching practice.

4.6 Teacher development programmes

The biggest challenge facing the introduction of ICT into teaching and learning situations is the need to train and develop teachers to use ICT effectively. The Khanya facilitator explained, "Educating teachers in the use of technology for the delivery of curriculum is a key activity of the Khanya project and is ongoing". The facilitator added that Khanya stipulates that teachers within the WCED must be:

- Sensitised to the use of technology;
- Equipped with basic technology skills; and
- Provided with functional training in the integration of technology with other modes of curriculum delivery.

She added further that 19 750 educators have already received basic IT training and receive ongoing training through the Khanya process of using facilitators.

A WCED curriculum adviser collaborated this, stating, "Training to use various software in NCS subjects has started. It is being done as required per subject and as new software for a specific subject becomes available".

4.7 Future plans

With regard to the current state of affairs at Khanya, the Head of Khanya stated, “The project is proceeding well and progress is being made in the delivery of ICT infrastructure”. Consideration, however, has to be given to the future direction of Khanya. The Director for IT stated, “A work-study report is currently being awaited regarding the organisational structure of a proposed e-learning component of the WCED”. It is envisaged that e-learning is to be the responsibility of the curriculum advisors. If this is to happen, curriculum specialists have to be trained to become e-enabled. The further e-training of the curriculum advisors could have budgetary implications on an already stretched funding model. It is here that Non Governmental Organisations can play a big role. The capacity building of officials and even teachers in a systemic way should be created in partnership with all relevant stakeholders.

Curriculum planners are recommending not only a computer laboratory, but also that key subject areas also have a computer for the classroom. Consideration is being given to installing the HP 4-4-1’s for this purpose. The 4-4-1 configuration allows four users to simultaneously access one PC. Each learner has his or her own keyboard, monitor, mouse, audio capability and can independently browse the Internet, send e-mail, use engaging educational software as well as run office productivity applications, such as word processing. This option as a classroom solution is low cost and has the potential to allow in-classroom technology integration, as opposed to a computer laboratory based one.

There is a future need for more coordination between curriculum implementation and ICT technical infrastructure. The Head of Khanya stated in this regard, “There is a need for a ICT coordinating structure, what could possibility be termed an ICT Governance Structure.” He elaborated that the Steering Committee that has been in place has outgrown its usefulness and that there is now a need to align curriculum, logistics and ICT specialists. “This will require commitment from the Minister’s office and the Premier”, he said.

The Head of Khanya reiterated, “As with other provinces, the WCED alone does not possess the capacity required to implement all aspects of the envisaged ICT infrastructure”. He continued to say that co-operation with internal directorates of WCED and other bodies within the provincial

administration of the Western Cape also takes place. However, it seems that more efforts are to be made to use external agencies to execute certain functions in public-private partnerships, either in partnership with the WCED or as fully outsourced activities. These functions could include training aspects as alluded to in above.

4.8 Constraints

Khanya is deemed successful in terms of curriculum delivery, teacher development and in providing infrastructure and support. The Head of Khanya emphasised once again, "The lack of a coordinating structure within the WCED is a major constraint". The Director for IT agreed with the Head of Khanya when asked for his opinion on the matter. The teacher that was interviewed, however, did not support this view. The teacher stated, "As far as I am concerned, the project is delivered by the WCED and not by a separate entity". The Head of Khanya added, "A major constraining factor at a strategic level is the lack of sustainable funding. There may be dedicated budget, but many more schools could be provided with infrastructure if more funding was provided.

4.9 Critical issues

The constraints mentioned above are resonated in some of the critical issues highlighted by the interviewees below.

a) Broader bandwidth was a common constraint. The Deputy Director stated, "There is a great need for more bandwidth at lower cost because the associated costs inhibit greater use of ICT facilities". The technician went further to say that, "… bandwidth limits the abilities of teachers to download resources at the small spectrum slows down downloading when large files are copied from the web". A teacher added, "The effectiveness of using ICT for teaching and learning is restricted by the "slowness" of the Internet. Downloading resources takes so long and is very costly".

   I believe that the need for bandwidth depends on your educational objectives, the technologies that are available in your area and the required bandwidth, which is related to the number of simultaneous users and the type of applications that are executed.

Bandwidth does not have to be a constraint for ICT integration. By planning internet research and downloads, a teacher can use the internet just as effectively with a narrow bandwidth.

b) Another constrained highlighted especially by teachers, were technical support. One teacher said, "Technical support is crucial and I sometimes have to wait more than a week for hardware support". Another teacher complained that, "… even if I take it to the district office as a 'walk-in' client, still do not get immediate help". The Khanya technician added, however, "Schools do not report technical faults immediately and then expect quick response while we have other schools to deal with". Turn around time for technical support is clearly a big issue for teachers.

This issue was dealt with in 4.4, but I further think that teachers should not become dependant on technicians, as this will only frustrate them and hamper progression. They should rather capacitate themselves to do the troubleshooting on their own.

c) Pedagogic support is one that was highlighted by the WCED curriculum adviser. He said, "While advisors are experts in their subject areas, integrating this with technology becomes a problem if they have not been provided adequate training in how to use technology within a specific subject. "This", he added, "leads to computers becoming "glorified typewriters" and not being used for their true purpose".

The call from curriculum advisers for more ICT training, stems from the assumption that they are increasingly becoming more frustrated at having to call on the Khanya facilitators to assist them in the computer laboratories.

d) ICT support to schools that are not part of the Khanya project is also a critical issue brought to my attention by the Director for IT in the WCED. The Director of WCED stated, "We do not have capacity outside Khanya to support schools that are not on the project. The Shuttleworth schools as an example. The Shuttleworth Foundation is active in 80 WCED schools. The only benefit of the TuxLabs, however, is in developing computer literacy and not curriculum integration". TuxLabs only allow the use of open source software (OSS) and a very limited number of educational programmes are

available on OSS. OSS therefore tends to be used to develop computer literacy skills only. Also, TuxLabs provide only refurbished computers and these tend to break down frequently. A dedicated technical support unit is required for TuxLabs, which is not being adequately provided by Shuttleworth Foundation. The Shuttleworth Foundation tends to give hardware under conditions that are not conducive to providing good educational value and that are in conflict with Khanya's approach.

4.10 Recommendations of the WCED

All the interviewees agreed that Khanya has achieved its initial outcome of providing an ICT infrastructure in schools that was supported by software for curriculum delivery. However, the people interviewed below felt that more could be achieved if the WCED would heed the recommendations of the interviewees listed below.

a) A curriculum advisor stated, "There was an urgent need for a unit to be established to evaluate and recommend digital learning material". Ideally, this unit should be within the provincial curriculum head office component and it should support all the districts.

b) The Director for IT recommended, "A coordinating governance structure should be established within the WCED to formalise and integrate Khanya. I also suggest that a coordinating governance structure be established at a central level". The Head of Khanya, however, did not share this sentiment, "I feel that the project would get "bogged down" in bureaucratic processes."

   These two conflicting views shows that there might be a potential conflict between the thinking of those within the bureaucracy and those overseeing the actual implementation of ICTs in WCED schools. This poses a possible implementation threat going forward that could lead to a slowdown in ICT provisioning.

c) The Khanya project manager felt that, "The valuable lessons learnt from the project should be shared with other provinces in the country". He mentioned the following:

- Implementation will be focussed if it begins with a project outside the formal structures. Integrating the project into the formal structures is important, but it remains a challenge;
- There must be buy-in from all stakeholders, which include teachers, parents, the community, the private sector and NGOs;
- Adequate funding models need to be developed, particularly through Public-Private Partnerships, to sustain ICT usage; and
- Staff must be appointed to support schools, both technically and pedagogically.

4.11 Infrastructure at a secondary school

By way of a case study to corroborate what interviewees said, a secondary school situated in Malmesbury in the Western Cape was visited and the principal interviewed. The observations at the school showed that the school has two computer laboratories. The principal explained that one was acquired through school funds and has 20 freestanding computers (PI, PII). The other is a Khanya laboratory with 24 workstations and a server. A third room has been equipped with an electronic whiteboard. The teacher assigned as ICT coordinator at the school said, that as a further development the third room has also been equipped with a video camera and monitor. The camera and monitor is, in turn connected to a monitor and camera in a fourth room respectively. This allows for teaching to take place in one room but to be transmitted to the next. The rooms also have microphones, which makes them interactive. This initiative has been so successful that a two more rooms will be added to the system.

The Khanya laboratory is predominantly used for Mathematics and Science teaching and consolidation in grade 11 and 12, while the older laboratory is used for teaching computer literacy. The teacher for Mathematics at the school had only praise for the way that Khanya has assisted teachers to help learners improve their understanding of Mathematical concepts. Commitment from school management and staff is evident and community involvement was ensured through their active involvement in preparing the infrastructure to house the computer hardware. A community computer literacy program has also been in place since 2005.

4.12 Conclusion

This chapter has focused on the presentation of data and findings of the research by discussing the models of ICT infrastructure provision for schools in the Western Cape. The chapter began by considering the motivations for using ICTs in schools with specific reference to the Khanya project. The chapter also focused on the types of infrastructure configurations and specifications for hardware and software and how this is funded. In addition, the chapter discussed the integration of ICT and the type of teacher training provided. The recommendations from three officials from Khanya, two from the WCED, one from the provincial administration and three teachers in addition to the critical issues and constraints identified provide an insight into ICT practices province. The chapter concludes with an overview of the ICT infrastructure at one school in the Western Cape to corroborate what has been said.

In the next chapter, I analyse certain issues that have emerged form the research, draw conclusions and provide recommendations with respect to them.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The research in Chapter Four illustrates that the WCED is promoting the use of ICT for more effective teaching and learning through the implementation of a structured project. Through the Khanya Project, ICT infrastructure in schools is provided, curriculum delivery using ICT is advocated, technical support is made available and teacher development programmes are implemented. The project has a clear funding model and a dedicated budget provided by the WCED. The research also indicates that while sound implementation practices with high educational value are evident, there is also evidence of unsound practices that have little educational value. This chapter identifies key issues that have emerged from the research findings and provides recommendations to improve the provision of ICT infrastructure in schools.

5.2 Conclusions emanating from the research

My main research question was to determine "What are the issues that influence ICT infrastructure utilisation in public schools in the Western Cape?" The research undertaken has led to the following conclusions being made and which are listed below.

5.2.1 ICT model developed and implementation programme

The WCED has developed a specific ICT model and implementation programme for schools under its jurisdiction. This model includes the provision of hardware, a hardware configuration model (computer laboratories), technical ICT support, guidelines for the pedagogic use of ICT and curriculum integration, pedagogic support for teachers and, although limited in its scope, a teacher ICT development programme.

5.2.2 ICT has an empowering and transformative impact

The literature review in Chapter Two shows that there is a widespread belief that ICTs can and will empower teachers and learners and that ICTs can transform teaching and learning in the process. I have, however, found very few resources with convincing arguments to support this belief. The use of ICTs on its own cannot make up for poor teaching methodologies and content. I am of the opinion, though, that ICTs can enable teachers to transform and enhance their teaching practices.

5.2.3 The lack of technical support could retard ICT integration

The lack of technical support in some areas has led to networks in schools becoming idle and teachers becoming cynical regarding the value of ICT for curriculum delivery. Problems are exacerbated when technical support is outsourced or provided free of charge by outside agencies, who then do not deliver. The procurement of hardware is costly, but over and above that, the cost could be even higher if no strategy is in place to provide technical support to maintain Infrastructure. ICT technical support, including maintenance and ICT training, may account for as much as a third of the total cost of ICT resource procurement.

5.2.4 Use of ICT does not guarantee improved teaching and learning

The use of ICT is not guaranteed to enhance teaching and learning in any subjects or learning areas. Teachers' motivations for using ICTs are often centred on replacing board and chalk through the production of multimedia presentations. This may enable learners and teachers to reapply the skills learnt through ICT literacy lessons, but if they focus on too narrow a range of learning, this may not be a good investment of time in the context of the curriculum.

5.2.5 Curriculum support for the use of ICT is vital to enable effective implementation

It is also clear from the research that curriculum support for the use of ICT is paramount to ensure effective implementation. The common belief that computer literacy training for

teachers is a suitable aim for using ICTs in schools is a serious under-utilisation of a powerful teaching and learning resource.

5.2.6 Integration of new technologies should be adequately supported

Any new technology initiative brings with it great promise for the future. There is a danger, however, in not being able to fulfil the promise due to inadequate funding. Teacher and learner expectations mostly exceed a district, province or country's ability to support the introduction of new technologies. Without proper support, only those who can afford technology will persevere. The WCED has shown commitment to ICT infrastructure provision, by dedicating a budget for the procurement of hardware and the training of staff.

5.2.7 Consider all costs

Many ICT initiatives fail because of the sustainability costs are not properly taken into account. These costs include increased telephone costs, repairs to equipment, insurance, printing, stationery, ink, security, etc

5.2.8 Train teachers adequately

One aspect that the research findings highlighted as not receiving enough attention is teacher development. The Khanya facilitator mentioned that teachers received basic ICT training, and need more time to do substantive ICT training. Not all educators, administrators, parents or community members agree, however, that educators need more time for professional development (Fullan & Miles,1992). Many argue that educators should hone their skills *before* entering the profession and/or on their own time. They argue that the school district is in the business of educating learners, *not* educators. Some educators may also see little value in investing more time in professional development if their previous experiences have been predominantly negative. Other educators may resent taking time away from their learners. Professional development can be particularly troublesome when substitutes are used to release educators for planning and professional growth activities. Even educators who find professional time valuable are often uncomfortable with the disruption caused by the use of substitutes.

5.2.9 Innovative use of ICT can lead to learning gains

It is clear from the research that certain teachers are making meaningful learning gains through the innovative use of ICTs for curriculum delivery, even though they have very basic ICT facilities and training. The reality, on the other hand, is that large numbers of teachers are going to need substantial support and guidance.

5.2.10 Schools need an ICT "Champion"

The WCED's processes for determining whether a school is ready to accept an ICT infrastructure is based on the staff's willingness to take charge of the infrastructure. Normally this means that the responsibility is placed on one willing teacher, who then becomes the ICT "champion" at the school. Schools being adequately prepared and ready to receive ICT infrastructure is a major determinant in the success or failure of ICT usage in schools.

5.2.11 Consider all learning factors when determining school ICT readiness

Another important aspect for determining school readiness to receive ICT infrastructure are learning factors. These factors include, among others, the relevant context in which learning takes place, active roles for learners and supportive roles for teachers.

5.2.12 Provide teachers with sufficient digitised learning material

Some schools have made little progress beyond teaching basic ICT skills. In some instances, teachers blame the lack of progress in using ICT for curriculum delivery on not having been provided with adequate digitised learning material as opposed to utility software programmes.

5.2.13 Encourage school community ownership

The Khanya model is geared towards community engagement. This implies that schools that are approached for ICT implementation must ensure that the facilities are made ready by employing

community skills to install infrastructure like desktops, electrical points, carpeting or tiling and even curtains and blinds. This contributes to "ownership" of the whole project and a greater community engagement and tenure.

5.3 Recommendations

In view of the conclusions that were from the research, certain recommendations are made. These are listed below.

5.3.1 Curriculum and technical support

Curriculum and technical support, together with teacher development programmes are essential for the success of any ICT infrastructural model. Technical support must be delivered by external providers or staff employed by schools. Technical support staff could also be shared between schools to make it more cost effective. The extent to which the WCED is able to offer these three key elements is a key factor to the ongoing success of the Khaya initiative.

5.3.2 ICT infrastructure models

ICT infrastructure must be developed with the needs of the provincial education department and individual schools in mind. Highly sophisticated options, such as installing wireless networks in computer laboratories, need careful consideration concerning their practical implications and ease of use. The practicalities of both centralised and decentralised distribution models also require careful consideration. Morgado, Twani and Igarashi (2009) writes that:

> An IT infrastructure evolves like the school system… It grows and becomes more complex as the teaching and learning experience evolves. If we did not prepare for it, it could end up…, diminishing the success of educating students adequately.

5.3.3 Cost implications

The cost for the initial outlay, maintenance and replacement of ICT hardware is high and should therefore be carefully considered. All variables connected to the cost involved in implementation of ICT must be identified. It needs to be acknowledged that the cost of hardware

and software are connected to other costs such as support, training and downtime. Piecemeal and erratic funding eliminates the ability to provide a coherent technology program and negates teaching and learning gains made through e-Education. Sustained and predictable funding is necessary for the implementation of e-Education. Schools need to be made aware of these issues and they, in turn, should show they how they will cover these costs before they are centrally equipped with ICT infrastructure.

This is particularly relevant in the light of the rapid change in technology and that some components of the ICT infrastructure require periodic renewal to keep the infrastructure current. Thorough research, planning and analysis should be made before strategic investments are made. Training or re-training of staff to use technology effectively can also be costly and therefore resourceful ways of finding sustainable funding for ICT projects should be applied. It therefore makes sense that when using ICTs for educational purposes, the emphasis should not be on the technology, but rather on how technology can be used to improve teaching and learning. I believe that schools in developing countries must use technology to meet their own educational goals and needs and not just to follow the commercial trends in developed countries and the agendas of ICT vendors.

5.3.4 Curriculum integration

ICT-based learning works best where it is led by the learning outcomes of the subject or learning area being taught. Emphasis must be placed on learning *with* and *through* ICTs rather than *about ICT*. Morgado, Twani and Igarashi (2009) assert, "Teachers and students are coming closer to technology more than ever before. The IT infrastructure is the foundation for providing an effective contribution to the learning experience. This assertion further emphasises that investment in ICT must be used to make educational gains in the delivery of the curriculum. As stated in the e-Education White Paper (DoE; 2004:24), the introduction of learning through the use of ICT is not about creating interesting tasks for learners or to only teach them about computers. It is rather to deepen their understanding using higher-order thinking skills and taking learners beyond the recall, recognition and reproduction of information phase into cognitive realms of evaluation, analysis, synthesis and production of arguments, ideas and performance. To this end, it is vital that ICT strategies be aligned with the implementation

strategies of the National Curriculum Statements for GET and FET. We should therefore expose teachers to the use ICTs for higher levels of cognitive development as well as curriculum delivery. A clear distinction can between persons who facilitate the use of ICT in the curriculum and the persons who provide curriculum support through ICT. The later uses ICT as an enabling tool to deliver curriculum, while the aforementioned person will use the curriculum as content to facilitate the computer literacy.

5.3.5 Training for curriculum advisers

Curriculum advisors must be trained in the pedagogic use of ICT in order to provide sustainable support to teachers.

5.3.6 Support for novice ICT users

Individuals who are just beginning to see the promise of technology need to be supported, encouraged and nurtured by continuous exposure to ICTs in the workplace. Becker and Riel (2001:2) found that "the more extensively involved teachers were in professional activities, the more likely they were to... use computers more and in exemplary ways."

5.3.7 Teacher ICT skills

Teachers should have the academic and technical knowledge, skills and resources to confidently and effectively integrate ICT into teaching practices. I must be stress that although ICT skills for teachers are vital to curriculum integration, this should only be the starting point. Holland (2001:2) argues that "current best practices suggest that while staff development may begin with such training, it should move quickly beyond to efforts that support teachers' development as professionals involved in decision-making, inquiry, and leadership in classroom teaching". It is thus vital to identify teacher ICT skills relevant to teaching responsibilities and to develop incentive-driven programmes to encourage teachers' ICT skills development. Furthermore, staffing strategies that provide teacher ICT support and dedicated personnel should be considered to improve teachers' access to computers and

5.3.8 New roles for teachers

Educational transformation requires that educators learn new roles and ways of teaching. This means that educators require a long-term developmental programme that focuses on changing their own practice. However, the issue of where educators will find the *time for developmental change* in their already busy schedules needs to be addressed, since the “demands posed by daily teaching and other aspects of the reform continue to absorb a bulk of educators' energy, thought, and attention" (McDiarmid, 1995).

5.3.9 Strategies for teacher development

In my opinion, educators should take the following steps to ensure that time is provided for professional development:

- Establish a provincial and/or district task force on professional development that focuses on identifying the time, resources, and opportunities for professional development as well as on gaining the support of policymakers for professional development. The task force would bring together a broad-based group of officials, educators and policymakers
- Meet with businesses, community groups, and parent organizations to explain school goals and the role of professional development in meeting them. A developmental plan could stem from such a meeting and ensure parent and community support.
- Try and involve the school governing body, non-academic staff and educators in a study group. This group could study example plans for finding time for professional development from other provinces, regions or schools. They could also review literature that suggests a need for additional time for professional development and consider alternative ways in which that time will be used.
- The group could also discuss and assess the elements of quality professional development programs and review descriptions and examples to ensure they are building bridges between where educators are now and where they need to be to meet the needs of their learners.

5.3.10 Schools' readiness

Consideration should be given to developing processes whereby schools show their readiness to become e-enabled. This would entail stating specifically what the school's role, responsibility and contribution will be before the central provisioning of ICT infrastructure occurs. Starting with management factors, such as leadership style, knowledge and financial management, budget resources and professional development, one can put together a tool to access whether schools are ICT ready. This tool would also include physical infrastructure factors such as the availability of electricity, telephone lines, a facility for the ICT infrastructure and adequate security are vital for determining the schools readiness. The issue of security must be highlighted, since poor security is a major cause for some ICT initiatives being severely compromised. This issue needs to be clearly dealt with before infrastructure is provided to schools. Security related problems can be eased if schools fully engaged with community structures to become involved in establishing and sustaining the ICT facilities. In addition to these factors, issues such as access, connectivity, maintenance and the availability of teacher and learner support should also be reflected in an ICT school readiness tool.

5.3.11 Community engagement

In his address at the 23rd World Conference on Open Learning and Distance Education of the International Council for Open and Distance Education, Abdul Waheed Khan, Assistant Director-General for Communication and Information Technology at UNESCO said that:

> Technology alone will not bridge the information and knowledge divides but political and social environments have to be developed that enable knowledge creation, preservation, acquisition and sharing.

It is therefore important that implementation strategies should include community engagement, since, as stated earlier, it is a key factor to the security and, to a lesser extent, sustainability of ICT networks in schools. Khan further stressed that if ICT enhanced knowledge acquisition and sharing is to be applied successfully, sustainably and for the benefit of larger segments of society, we must create enabling environments, build adequate infrastructure and establish multi-stakeholder partnerships. Community "ownership", which includes establishing public/private partnerships, as well as programmes for communities to benefit from ICT facilities that are

available at schools, are factors that need to be taken into account when installing an ICT infrastructure in schools.

5.3.12 Ethical use of ICTs

Creating awareness around the uses and misuses of ICT amongst teachers and learners is important. Using ICTs allows learners to work independently and to they are often exposed to the dangers of the Internet. Learners therefore need to be prepared and guided through information literacy programmes, restricted from entering certain areas of the Internet and be given opportunities to work independently, responsibly and collaboratively. Moor (1985) states that "A typical problem in computer ethics arises because there is a policy vacuum about how computer technology should be used." He explains that often no policies exist or the existing policies are inadequate. Computers provide us with new capabilities and these in turn give us new choices for action. The internet and plagiarism is a typical example. Davidson and Saubers (2004) assert that "Students must be made aware of the meaning of plagiarism. Students must be made aware of the sanctions they will face if they are found guilty of plagiarism." They further insist that school authorities must take the necessary steps to ensure that misuse of computers are not tolerated or excused. A clear policy on computer use will be a good start to guarantee correct computer use. However the real test comes in "policing" this policy as learners will find constantly try to circumvent the policy. .

5.3.13 Available learning material

Teachers need to be made aware of, but also need to do their own research on, what learning material is available on the Internet, libraries or other resource institutions. The Thutong Education Portal is on such example. By having this information beforehand, teacher can guide and direct learners to the relevant Internet sites in order to help them retain information from lessons covered in class. Guiding learners in this way helps build their' self-confidence and fosters better learning habits as "computer-based instruction can individualize instruction and give instant feedback to students" (Coley, Cradler and Engel, (1997:37).

5.4 Conclusion

The main research question of this dissertation was to determine "What ICT infrastructures are available for public schools in the Western Cape?" The research has shown that a substantial ICT infrastructure is evident in Western Cape schools. The research has also shown that, besides the perennial needs for sustainable funding and security, the ICT infrastructure is made functional and viable if accompanied by adequate provision to refresh and maintaining the hardware, suitable educational software to address the pedagogic requirements of individual schools and responsive teacher development programmes.

From a school provisioning perspective, the process needs to evolve beyond the concept of only establishing a computer laboratory of a certain amount of networked computers. One or more computers for the classroom now also need to be considered. This will allow more flexible use of the Internet as and when it is required, enhance classroom teaching and allow larger groups of learners to be taught, particularly through computerised smart-board technologies. At another level, ICTs can be used to change the way teachers and learners engage with one another, as was seen in one of the WCED schools. In this instance, ICTs were used to provide learners with greater autonomy and responsibility for their own learning, with increased emphasis on collaborative learning. ICTs can make it possible to overcome the barriers of time-, place- and pace- based learning, particularly at the secondary and further education levels of learning.

Not only can ICT significantly change the nature of pedagogic engagement between learner and teacher and between learner and learner, it can also enhance the way in which schools are run and organised. ICT supports the whole school workforce and many schools are now beginning to realise the potential of ICT. The model of initiating ICT projects as external projects and then integrating it into bureaucratic government structures in order to make it more sustainable, seems to be one that can be replicated in other provinces. The exciting challenge of how to achieve this successfully remains.

These are perhaps issues that could be considered in further research projects.

References

Anderson, R.E. (2002). Guest editorial: international studies of innovative uses of ICT in schools. *Journal of Computer Assisted Learning*, 18(4), 381-386.

Becker, H.J. (1994). How exemplary computer-using teachers differ from other teachers: implications for realizing the potential of computers in schools" *Journal of Research on Computing in Education, 26* (3), 291-321.

Becker, H., Ravitz, J., & Wong, Y. (1999). Teaching, Learning, and Computing: 1998 National Survey Report #3. Teacher and teacher-directed student use of computers and software. Irvine, CA: Center for Research on Information Technology and Organizations.

Becta (2000). *A Preliminary Report for the DfEE on the Relationship Between ICT and Primary School Standards*. [On-line]
Available at: http://www.becta.org.uk/research/reports/ictresources.html

Becker, J. & Riel, M. (2000). Teacher professional engagement and constructivist-compatible computer use. *Teaching, Learning and Computing Report #7*. Center for research on technology and organizations. University of California, Irvine. [On-line] Available at: http://www.crito.uci.edu/findings.html

Becta (2001a). *Primary Schools of the Future – Achieving Today*. Coventry: Becta.

Becta (2001b). The Secondary School of the Future – *A Preliminary Report to the DfEE by Becta*. Coventry: Becta.

Bloemen, P., Carleer, G., Boer, W. de, Fisser, P., Kamp, I., & Remmers, E. (1999). *Evaluatie TeleTOP en C@mpus+ 1998/1999. Eindrapportage*. Intern Rapport. Enschede: Toegepaste Onderwijskunde, Universiteit Twente.

Bloom, B. S. (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain.* New York: David McKay Co Inc.

Breakwell, Glynis M, Sean Hammond & Chris Fife-Schaw (1995). *Research Methods in Psychology*. London: Sage.

Bosco, J. (2003), Viewpoint: Seven leadership challenges for the digital age, eSchool news. [On-line]
Available at: http://www.eschoolnews.com/news/top-news/index.cfm?i=35122&CFID=14497893&CFTOKEN=64716010

Carter, Kim, (2000). Staffing Up for Technology Support, *Technology and learning Vol. 26 No1*.

Cable in the Classroom. (September, 1997). The use of cable and the Internet/World Wide Web in elementary and secondary classrooms. [On-line.]
Available at: http://www.ciconline.org/iwwwexec.htm

Chantler, K. (1990). *'Developing your research idea'* (Page 11) by R&D Manager, Central Manchester and Manchester Children's University Hospitals.

Colburn, L.K. (2000). *An analysis of teacher change and required supports as technology is integrated into classroom instruction.* Unpublished dissertation, Vanderbilt University, Nashville, TN.

Coley, Cradler & Engel. (1997). Computers and Classrooms: The Status of Technology in U.S. Schools, p. 37. [On-line]
Available at:
http://eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/15/05/3d.pdf

Cohen, D. & Crabtree B. (2006). Qualitative Research Guidelines Project. [On-line]
Available at: http://www.qualres.org/HomeSemi-3629.html

Colorado State University (1993). Writing Guides: Case Studies. [On-line]
Available at: http://writing.colostate.edu/guides/research/casestudy/com2b2.cfm

Cox, M. J, Rhodes, V. & Hall, J. (1988). The use of Computer Assisted Learning in primary schools: some factors affecting the uptake. *Computers and Education* Vol 12(1). pp. 173-178.

Cox, M.J, (1993). Information Technology Resourcing and Use. In Watson, D.M. (Ed.) *Impact - An evaluation of the Impact of the Information Technology on Children's Achievements in Primary and Secondary Schools*. King's College London.

Creswell, J.W, (2003), *Research design. Qualitative, quantitative and mixed methods approache*s. Thousand Oaks, CA: Sage.

Creswell, J.W. (1998). *Qualitative inquiry and research design. Choosing among five traditions.* Thousand Oaks, CA: Sage.

Datta, Lois-ellin (1990). *Case Study Evaluations*. Washington, DC: U.S. General Accounting Office, Transfer paper 10.1.9.

Davidson, D. & Saubert, W. (2004). Classroom Concerns: Legal and Ethical Implications of Internet Misuse [On-line]
Available at: http://www.westga.edu/~bquest/2004/misuse.htm

Davis, F.D, Bagozzi, R.P & Warshaw, P.R., (1989). *User acceptance of computer technology: a comparison of two theoretical models. Management Science.* Vol 35(8). 982-1003.

Denzin, N.K. & Lincoln, Y. (2000). Introduction: The discipline and practice of qualitative research. In N.K. Denzin & Y. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp.1-17). Thousand Oaks, CA: Sage.

Department for Education and Skills (DfES), (2006). Learning, Teaching and Managing with ICT, *Funding Guidance for Schools and Local Authorities 2006-2007.*

Department of Education, (2009). Teacher Laptop Initiative. [On-line] Available at: http://www.education.gov.za/

Department of Education, (2004). White Paper on e-Education, (White Paper 7).

Department of Education, (2002). Policy: Revised National Curriculum Statements - Overview.

Department of Education, (1996a). South African Schools Act No. 84 of 1996.

Department of Education, (1996b). Technology Enhanced Learning Investigation in South Africa: A Discussion Document. Pretoria: Department of Education.

Department of Education, (1995). White Paper on Education and Training, Notice 196 (White Paper 1).

Enola G. Boyd, (1997). Training on Demand: A model for Technology Staff Development, *Educational Technology*, *Vol. 37 No. 4.*

Evans-Andris, M. (1995). "An examination of computing styles among teachers in elementary schools." *Educational Technology Research and Development*, *43* (2).

Everard, K.B. (1986). Developing Management in Schools. Oxford: Blackwell

Frey, J.H & S.M.Oishi (1995). *How to Conduct Interviews by Telephone and in Person.* London: Sage.

Fullan, M. (1992). Successful School Improvement: The Implementation Perspective and Beyond. Buckingham: OUP.

Fullan, M. & Miles, M. (1992). Getting reform right: What works and what doesn't. *Phi* Delta Kappan,73 (10)

Fullan, M.G., & Stiegelbauer, S. (1991). *"The new meaning of educational change"* (2nd ed.). New York: Columbia University Press.

Gates Bill, (1995). The road ahead. New York: Penguin books.

George Gerard, Sleeth Randall G. and Pearce C. Glenn, (1996). Technology-assisted instruction and instructor cyber phobia: Recognizing the ways to effect change, *Education, 116(4).*

Gersten, R., Woodward, J., & Morvant, M. (1992). Refining the working knowledge of experienced teachers. Educational Leadership,49(7).

Gore, A. *(*1994*).* Public Administration Review.

Govender, G. (1999). How do South Africans understand "educational technology", *South African Journal of Education, Vol. 19 No. 2*.

Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. American Journal of Education, 101, 261-315.

Hall, C. M. (1997). Effective change strategies for the implementation of instructional technology: A problem-based learning project for school administrators. Unpublished doctoral dissertation, Peabody College at Vanderbilt University

Hartley, J. (2004). Case study research. In Catherine Cassell & Gillian Symon (Eds.), *Essential guide to qualitative methods in organizational research* (pp.323-333). London: Sage.

Hassini, E. (2004). Student-instructor communication: The role of e-mail. *Computers and Education*, 47(2006), 29-40.

Hasselbring, T.S., & Williams Glaser, C. H. (2000). Use of computer technology to help students with special needs, *The Future of Children, 10* (2).

Hodgkinson-Williams, C.A. (2005). Dust on the keyboards: Policy gaps in the integration of ICT into the South African curriculum. *Proceedings of the 8th IFIP World Conference on Computers in Education 4-7 July*, University of Stellenbosch, Stellenbosch.

Holland, P. (2001). Professional development in technology: Catalyst for school reform. *Journal of Technology and Teacher Education*, 9, (2).

International Society for Technology in Education, (2000). *National educational technology standards for students: Connecting curriculum and technology*. Eugene, OR: Author. [On-line]
Available at: http://cnets.iste.org/students/s_book.html

Johnson, Allan G. (2000). *The Blackwell Dictionary of Sociology, Second ed.* Oxford, UK: Blackwell.

Jordan, W. R., & Follman, J. M. (Eds.). (1993). Using technology to improve teaching and learning. Hot topics: Usable research.Victoria, BC, Canada: British Columbia Ministry of Attorney-General.Greensboro, NC: Southeastern Regional Vision for Education.

Kearsly, G., Hunter, B. & Furlong, M. (1992). We teach with technology: New Visions for Education, Franklin, Beedle & Associates.

Kennedy, M. (1999, November). Form and substance in mathematics and science professional development. National Institute for Science Education, 3(2), 1-7.

Khan Abdul Waheed, (2009). Address 23rd World Conference on Open Learning and Distance Education of the International Council for Open and Distance Education, Paris.

Khanya, (2008). [On-line] Available at: http://www.khanya.co.za/

Kirkpatrick, H. & Cuban, L. (1998). Computers make kids right? *Techno quarterly for education and technology* 7(2):1-11.

Lewis, M. (1997). A Study of 21st Century Classroom Teachers' Perceptions Regarding the Training and Use of Technology in K-12 Public Schools in Tennessee. [On-line] Available at: http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/15/2b/3d.pdf

Locatis C & Atkinson F, (1984). Media and Technology for Education and Training, Charles Merrill Publishing.

Matthews, J. G. (1998). Predicting teacher perceived technology use: Needs assessment model for small rural schools. (ERIC Document Reproduction Service No. ED 418 828).

Maxwell, J. (1996). Using qualitative research to develop causal explanations. Harvard University: Harvard Project on Schooling and Children.

McClure, A. (2007). District Administration, Why Buy New When Used Might Do? *Refurbished computers help stretch technology budgets*, [On-line] Available at: http://www.districtadministration.com/viewarticle.aspx?articleid=1046.

McClure, R. (2002). Common data collection strategies effective in Qualitative studies using action research in technical/operational training programs. [On-line] Available at: http://www.evokedevelopment.com/pdfs/commonData.pdf

McDiarmid, G.W. (1995). Realizing new learning for all students: A framework for the professional development of Kentucky teachers. East Lansing, MI: National Center for Research on Teacher Learning.

McKenzie J. (1991). Designing Staff Development for the Information Age, *From Now On: The educational Technology Journal, 1(4).* April

Milken Exchange on Education Technology. (1998a). Report to the Commonwealth of Virginia: An analysis of the status of education technology available and usage in the public schools of Virginia, by C.Lemke, B. Quinn, A. Zucker, & S. Cahill. [On-line.] Available:http://www.milkenexchange.org/research/virginia_summary.html.

Milken Exchange on Education Technology. (1998b). Technology Counts. [On-line.] Available at: http://www.edweek.org/sreports/tc98

Mok, M. (2004). Learner-centered Approach: towards Education for Sustainable Development : International Progress, Trends, and Practices. Panel discussion at the 4th International conference on Education reform, Banglok, Thailand

Mooij, T. and Smeets, E. (2001). Modelling and supporting ICT implementation in secondary schools. *Computers and Education*, 36(3), 265 – 281.

Moor J, (1985). Computers & Ethics, Blackwell, pp.266 – 75. (A special issue of the journal Meta-philosophy.)

Morgado E, Igarashi D, Twani E (2009). Paving the way for a Dynamic and mature ICT Infrastructure in education: A case for schools in Emerging markets. [On-line] Available at: http://download.microsoft.com/download/2/0/a/20ac945c-34d0-4a60-8245-f80e80fe954f/Paving_the_way_0809.pdf.pdf

Msila, V. (2008). Teachers and Educational Technology: Perceptions on the use of Computers in South African Classrooms, *The International Journal of Technology, Knowledge and Society*, Volume 5, Issue 6.

Nichols, P. (1991). *Social Survey Methods*. Oxford: Oxfam.

Passey, D. (2002). ICT and School Management: A Review of Selected Literature, Department of Educational Research, Lancaster University, UK. [On-line] Available at: http://partners.becta.org.uk/uploaddir/downloads/page_documents/research/.

Passey, D., Forsyth, K., Hutchison, D., Scott, A. and Williams, N. (1997) Group D - Home-School Links: Final Report. Coventry: NCET.

Patton, M. (1990). *Qualitative Evaluation and Research Methods* (2nd ed.). Newbury Park, CA: Sage Publications, Inc.

Patton, M. Q. (1987). *How to use qualitative methods in evaluation*. Newbury Park, CA: Sage Publications.

Potter, R. (1996). What computers are good for in the literature classroom, *Computers and humanities*, Kluwer Academic Publishers, Printed in the Netherlands

Puk, A. (1997). Using technology to support Educational Reform, Washington DC: US Department of Education.

Rockmann, S. et al. (1997). Report of a Laptop Program Pilot: A Project for Anytime Anywhere Learning by Microsoft Corporation, Notebooks for Schools by Toshiba America Information Systems. Rockman et al: San Francisco, CA.

Ryan, A. W. (1991). Meta-analysis of achievement effects of microcomputer applications in elementary schools. Educational Administration Quarterly, 27(2), 161-184.

Schatzman, L., & Strauss, A. L. (1973). *Field research*. Englewood Cliffs, N.J.: Prentice-Hall, Inc.

SchoolNet Africa, (2004). Treat Refurbs and Africa With Respect, *Framework On Refurbished Computers For African Schools*, A Research Report. [On-line]

Available at:
http://schoolnetafrica.org/fileadmin/resources/Refurbished_computers_ExecSum.pdf.

SchoolNet SA-SCOPE, (2002). ICT in schools: *A toolkit for beginners.*

Scrimshaw, P. (1997). *Preparing for the Information Age: Synoptic Report of the Education Departments' Superhighways Initiative*. Cardiff, Belfast, Edinburgh, London: Welsh Office, Department of Education for Northern Ireland, The Scottish Office, Department for Education and Employment.

Sivin-Kachala, J.,& Bialo, E. (1996). Report on the effectiveness of technology in schools, '95-'96. Commissioned by Software Publishers Association, Washington, DC.

Schmuck, R. (1997). *Practical action research for change*. Arlington Heights, IL: IRI/Skylight Training and Publishing.

Somekh, B., Barnes, S., Triggs, P., Sutherland, R., Passey, D., Holt, H., Harrison, C., Fisher, T., Joyes, G. and Scott, R. (2001). *NGfL Research and Evaluation Series No. 2 – NGfL Pathfinders: Preliminary Report on the roll-out of the NGfL Programme in ten Pathfinder LEAs*. London: DfES.

South African Government Information website (2009). [On-line]
Available at: http://www.info.gov.za/aboutsa/education.htm

South African Institute for Distance Education, (2005), Managing ICTs in South African Schools, *A guide for school Principles,* SAIDE.

Stake, R. (1995). *The art of case research*. Newbury Park, CA: Sage Publications.

Stevenson, D. (1997). Information and Communications Technology in UK Schools: An Independent Inquiry. London: Independent ICT in Schools Commission.

Strudler, N. (1993). Staff development and technology: A position paper. *Journal of Computing Teacher Education*, *9*(4), 8-10. [On-line]
Available at: http://www.nevada.edu/~strudler/staffdev.html.

Toffler, A., Toffler, H. and Gibson, R (1998). Rethinking the Future: Rethinking Business Principles, Competition, Control and Complexity, Leadership, Markets and the World.

Trotter, A. (1999). Preparing teachers for the digital age. *Education Week, 19(4)*, 37-43.

Underwood, J. (1997). Breaking the cycle of ignorance: information technology and the professional development of teachers. in Passey, D. & Samways, B. (Eds.) *Information Technology. Supporting change through teacher education*. Chapman & Hall. pp 155 - 160.

United States Congress, Office of Technology Assessment, (1995). *Education and Technology: Future Visions*, OTA-BP-EHR-169 (Washington, DC: U.S. Government Printing Office,

United States Department of Education, National Center for Education Statistics. (1999). Teacher quality: A report on the preparation and qualifications of public school teachers, NCES 1999-080, by L. Lewis, B.Parsad, N. Carey, N. Bartfai, E. Farris, & B. Smerdon. Washington, DC: U.S.Government Printing Office.

Van Manen, M. (1990). *Researching lived experience: Human science for an action sensitive pedagogy*. Abany, NY: State University of New York Press.

Watson, D.M. (Ed.) (1993). *IMPACT - An evaluation of the IMPACT of the Information Technology on Children's Achievements in Primary and Secondary Schools.* King's College London.

Welsh Thomas, 1997. Designing Computer Based course materials for the information age, *Techtrends Vol. 4.*

Wenglinsky, H. (1998). Does it compute? The relationship between educational technology and student achievement in mathematics. Educational Testing Service. [On-line] Available at: http://www.ets.org/research/pic/dic/techtoc.html

Wimmer, Roger D & Joseph.R.Dominick (1997). *Mass Media Research: An Introduction*. Belmont, MA: Wadsworth.

Woodrow, J. (1990). Locus of Control and student teacher computer attitudes. Computers *Educ. Vol. 14. No. 4 pp 421-432.*

Yin, R. (1994). *Case study research: Design and methods* (2nd ed.). Thousand Oaks, CA: Sage Publishing.

Zher M, (1997). Teaching the teachers, *Education week*, Vol. XVII, Number 11. [On-line] Available at: http://www.edweek.org/

Zonabend, F. (1992). The monograph in European ethnology. *Current Sociology, 40*(1)

Appendices

Appendix A

Interview Questions

1. Motivation for using ICT

a. What is the main reason for using ICTs in schools?

i. Is it for administration purposes?

ii. Is it for teaching and learning ?

iii. Is it for teacher preparation?

iv. Are there any other reasons for introducing ICTs in schools?

b. Does the province have a policy for ICT in schools?

i. If yes, provide details?

ii. If no, are there plans to develop a policy?

c. If there is a policy in place, does the province have an implementation plan for the policy?

2. Infrastructure and model

a. How many schools in the province (primary and high school split)?

b. Does the provincial department provide schools with an ICT infrastructure?

i. If yes, what is the average amount? (1-10; 11-30; 30+)

c. How many schools have provided their own ICT infrastructure e.g. through school funds or donations?

d. How many schools have no computers?

e. What type of model is implemented in schools? E.g.:

i. Computers in classrooms?

ii. Computer laboratory with at least 20 computers?

iii. One administration computer?

iv. A hybrid of the above? Explain.

f. What are the technical specifications of the hardware supplied to schools?

g. Are these specifications standardize throughout the province or do schools have a choice?

h. How is software distributed to the schools?

i. Is it via a centralised system i.e. is software loaded via satellite/internet? Or

ii. Are schools free to use any software for administration and teaching and learning purposes?

i. List some of the software available to schools for administration and teaching and learning.

j. Are schools making use of the free software offer via the Microsoft schools agreement?

i. If yes, how many?

ii. If no, what is the province doing to promote this offer?

3. Funding

a. Does the provincial education department have a dedicated budget for ICT in schools?

i. If yes, how much?

ii. If yes, can expenditure be broken down into Hardware, Software and teacher training. If so, how much for each component?

iii. If no, how are computers in schools funded?

b. Does the province implement the e-rate to help fund internet connectivity?

4. Technical and pedagogical support

a. Is there technical support available at the schools?

i. If yes, at what level of expertise?

b. If no, does the province have technical staff available at the districts to support the schools? If yes, how many?

c. If no, how are schools with computers supported technically?

d. Does the province provide pedagogical support to the teachers i.e. support on how to use computers effectively in schools?

i. If yes, what is the nature of the support? (How, who, what, when?)

ii. If no, how are schools coping with using computers in their teaching and learning?

5. Curriculum integration support

a. Is the curriculum support staff trained to offer ICT support to teachers in their specific learning area and subject area?

i. If yes, how were they trained?

ii. If no, are there plans to provide them with the necessary training?

b. What other measures are available to support teachers with ICT –curriculum integration?

6. Teacher development programmes

a. Does the provincial education department have dedicated staff at district of provincial level to implement and evaluate ICT teacher development programmes?

b. What programmes have the province implemented to provide teachers with basic ICT skills?

i. If none, are there plans to develop and implement courses?

c. What programmes have the province implemented to provide teachers with intermediate and advanced ICT skills?

i. If none, are there plans to develop and implement courses for this?

d. How many teachers have participated in:

i. Provincial /district teacher development programmes in ICT?

ii. The Microsoft Partners in learning programme?

iii. The Intel teach to the future programme?

iv. ICDL training?

7. Future plans

a. What, if any, are the provincial education department's short-, medium- and long-term plans for ICT in schools? Specifically in terms of:

i. promoting the use of ICT in schools;

ii. procuring hardware and software; and

iii. implementing teacher development programmes in ICT

8. Constraints

a. What constraints, besides funding, are experienced in the province in the implementing of ICT in schools?

9. Critical issues

a. What in your opinion are the critical issues pertaining to the implementation of ICTs in schools in the Western Cape/your district/your school?

Appendix B

Transcription of Interview

Interviewee : Director: Information Technology, WCED

Interviewer : Lyndwill Clarke

Date : June 2006

Tape recorder was switched on after greetings and assurances of confidentiality.

LC : Thanks again for taking some time out of your busy schedule to do this interview with me. I will immediately start with the first question.

LC : What is or was the main reasons or motivations for the WCED to introduce ICTs into your schools?

Dir: Lyndwill, let me start by giving you some background. As far back as 1988/89, some of the schools under the Cape Education Department, like Westerford High School, started putting computers in a room for the use of teachers and learners (well they were still called students or pupils back then). These schools then went further, and with the help and assistance of the CED introduced Computer studies as part of their curriculum and as you know I later become the only subject adviser for Computer studies in the province. The schools in the then House of Representatives and House of Delegates , the Coloured and Indian schools, were at that time given two Commodore 64s with floppy drives. These were mostly glorified typewriters and the schools were supposed to type their letters and question papers on it. Of course no training was provided.

LC: So when did the WCED actually start introducing computers in all schools and why?

Dir: Well, as I was busy telling you, schools were operating on their own when it came to computers, but after 1994 when the Western Cape Education Department was established, the Department now had to look after all the schools and from the newly formed National Education Department there were various investigations into the use of computers in schools. One of them was the TELI-Report which basically gave us a starting point as it did not speak about just the use of computers, but the integration

thereof. We then started a process of providing the head office staff with computers and then initiated a project for schools called the Telecommunications project. The planning for this started late in the '97 and we started implementing it in 1998. We initially gave each school two computers, one for administration and the other for curriculum delivery. We staggered the roll-out, that is, not all the schools go computers at the same time..we tried to give at least one computer to a school. To tell you the truth, I think this whole project was started because the then MEC was frustrated with schools claiming that they did not receive circulars, and that he felt schools will not have an excuse if it was sent to them electronically… of course e-mail was quite a novel idea then and I don't think the MEC understood how Telkom worked at the time. (He soon learned though…) When Helen Zille became MEC in 1999, the project gained momentum and she was mostly instrumental in initiating the Khanya project.

LC: Was there ever a policy for ICT at that and if not when did you develop a policy for the province?

Dir: Well at the time we were just viewing this as an administrative task but we soon realised that it had to become more than that and had to be used for curriculum purposes as well, as the TELI report suggested. The Telecommunications Project evolved into the Khanya Project in 2000. Khanya is now a project of the WCED and will be integrated into its formal structures as soon as the necessary structures within the WCED are established. The National Department drafted a policy on e-learning, which was promulgated in 2004 as the White Paper on e-Education. We then developed our own policy based on this. The Khanya project business plan then became the implementation plan for the developed policy.

LC: What type of model is implemented in schools? E.g.:

iii. Computers in classrooms?

iv. Computer laboratory with at least 20 computers?

v. One administration computer?

vi. A hybrid of the above? Explain.

Dir: We followed the laboratory route and schools receive 20 Computers and teacher's workstation, as well as a scanner and a printer. The teacher workstation doubled as the

server. These are all networked. Schools have at least on admin computer supplied through the Telecommunications project as stated earlier. Khanya do have a research team that are currently exploring possible hybrid models, specifically with White boards.

LC: What are the technical specifications of the hardware supplied to schools?

Dir: I can't say off hand, but they are all new Pentiums fours. You'll have to speak to a Khanya technician to get it.

LC: Are these specifications standardise throughout the province or do schools have a choice?

Dir: We tried as far as possible to standardise them, but schools do have the option to ask for something specific and we will then either ask them to pay for it themselves or check the budget to see how affordable it is.

LC: Does the provincial education department have a dedicated budget for ICT in schools?

Dir: Well we had to have one didn't we, else where would the money come from? The skeptics in the department didn't want to give any money to computers as there were other priorities like teacher salaries (remember there were still some disparities between the ex-CED and other "apartheid" education departments), building of new schools, maintenance of old schools etcetera, etcetera… but eventually we convinced the SG and the Telecoms project was kick started with about two million rand. When Khanya was conceptualized budgets of over ten million rand a year was drawn up and that was just for hardware and software, but you must also keep in mind that we now also had to budget for Khanya staff, as Khanya was a project within the WCED but not run by WCED staff.. Eventually the Provincial Government also gave the WCED a few extra million, and the budget for 2001/02 was about seventeen million rand . As we brought more schools on-line and as the cost of technology increased the budget also grew and for the 2005/06 year we budgeted sixty eight million rand (R68m). I think we are looking at an amount of about seventy seven million for this financial year. Khanya has also opened a Public-Private Partnership section which deals with donations and other resources, which includes training and support.

LC: Does the provincial education department have dedicated staff at district of provincial level to implement and evaluate ICT teacher development programmes?

Dir: We use the Kahanya facilitators for this. Each facilitator is assigned 3 schools and they then rotate between the schools within a school week. The intention is that a facilitator will stay with a school for an initial period of two years. The frequency of school –based training will then decrease based on the teachers' developmental levels in ICT.

We do have however have a more pressing problem that we hope technology will alleviate for us… The continuous decrease in the numbers of adequately qualified teachers, particularly Mathematics and Science, together with the reduced number of entrants into the education profession, required the WCED to explore and harness technology to strengthen the system, which is at risk. The approach that is being adopted is to assist teachers to increase their capacity through the use of technology rather than to replace them.

LC: What type of programmes do the facilitators provide to teachers to equip them with basic ICT skills?

Dir: Well initially, when we provided the two computers to schools during the Telecommunications project, the principal, an administration officer and at least one teacher from each school received eight hours of training on the basic operation of a computer, accessing the Internet and communicating through e-mail. You can imagine that with only two computers at the school, only those trained had access to the computers. We also though that the admin staff could download resources for teacher, however that did not quite work out as the training provided led only to the secretary having more operational skills and that hardly any resources were downloaded for curriculum use. Of course once the Khanya project started, the whole staff was taken through a comprehensive training programme.

LC : What did this comprehensive training programmes entail?

Dir: You'll have to speak to the facilitators to get exact details, but basic operatoional skills, as well as e-mail, internet use and Microsoft office packages is part of the training.

LC: What, if any, are the provincial education department's short-, medium- and long-term plans for ICT in schools? Specifically in terms of:

- **promoting the use of ICT in schools;**
- **procuring hardware and software; and**
- **implementing teacher development programmes in ICT.**

Dir: A work-study report is currently being awaited regarding the organisational structure of a proposed e-learning component of the WCED. Ideally we would like the e-learning component to be part of the responsibilities of the curriculum advisors… of course these advisors will have to be trained as ICTis not their expertise and naturally this means a bigger budget is required… and our funding model is already stretched to the limit. It is in this area that I think partnerships can play a big role. The WCED is willing to partner with NGO and/or any other relevant stakeholders to assist in the capacity building of officials and teachers.

Appendix C

Letter to participants

Dear Participant,

Re: Participation in Research

The Western Cape Education Department has introduced computers in schools through its Khanya project. The provision of Information and Communication Technology to schools has been hailed as a positive step to equip our teachers and learners for the needs of the 21st century. However serious question with regard to the types of infrastructure and teacher support has come to the fore.

I, as a Chief Education Specialist: Curriculum Innovation with the DoE, am undertaking research to determine, amongst other things, what type of ICT infrastructure the WCED is providing to schools and how this influences curriculum integration and teacher development. The research is for my Masters degree, but more importantly, I hope that the research will be valuable enough to be used by other provincial education departments during their ICT provision processes.

Your voluntary participation in this study is greatly valued and you are assured that strict confidentiality shall be observed at all times. Further, note that, you as a participant can withdraw from this project whenever you wish to.

Kindly append your signature in the space below to indicate your willingness to be involved in the study.

Yours sincerely

_____
L Clarke
Researcher

_____
Signature of Participant