Challenges faced by secondary school teachers in integrating ICT into the curriculum: A multiple case study in the Grahamstown Circuit

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ABSTRACT

The integration of Information and Communication Technology (ICT) into the curriculum has become the major issue worldwide. The education system does not only pursue the integration of ICT into the curriculum because of its popularity in the market system, but because of the role it is perceived to play in the changing curriculum (encourages active construction of knowledge). According to White Paper 7 e-Education policy (2004:17) every South African learner should be able to use ICTs confidently and creatively to develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community by 2013. The central role played by teachers in teaching and learning requires them to have a holistic understanding of ICT integration. Furthermore they should be able to analyse when ICT integration is appropriate according to what is expected from the learner in the teaching and learning process.

Drawing on the evidence from a survey of nine secondary schools in the Grahamstown Circuit of the Eastern Cape, this study examines how teachers from three different types of secondary schools: Former Department of Education (FDET) schools, Former House of Representatives (FHOR) schools and Former Model C (FMC) schools perceive the integration of ICTs in the curriculum. The salient ideas of how teachers perceive the integration of ICTs into the curriculum emerge from what they view as benefits of using ICT and what they view as challenges of integrating ICT into the curriculum.

Contrary to expectations, the degree of ICT integration within the curriculum did not correspond directly with the availability of sufficient hardware, software or Internet connectivity at the participating schools.

Dedication

I dedicate this to my mother

Nomathemba Susan Maholwana

If it was not because you cared for me from the day I was born I would not have reached this level.

Thank you so much Mama wam

I **love you**

Many thanks to God for letting you read this page before you die.
Your death has separated us, but I will never forget you.
Imfundiso zakho ziyakuhlala zihleli kum.

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Abbreviations

British Educational Communications and Technology Agency	BECTA
Computer Assisted Instruction	CAI
Computer Application Technology	CAT
Department of Education	DoE
Direct Instruction	DI
Eastern Cape Department of Education	ECDoE
Former Department of Education and Training	FDET
Former House of Representative	FHOR
Former Model C	FMC
Further Education	FET
General Education and Training	GET
Independent Schools	IS
Information Technology	IT
Information and Communication Technology	ICT
Information Society and Development	ISAD
Learning Area	LA
Life Orientation	LO
National Council for Educational Technology	NCET
National Curriculum Statement	NCS
Non-Governmental Organisation	NGO
KwaZulu Natal	KZN
Presidential International Advisory Council	PIAC
Revised National Curriculum Statement	RNCS
School Management Teams	SMT
Second Information Technology in Education Study	SITES
United Nations Educational, Scientific and Cultural Organization	UNESCO
United Kingdom	UK
United State of America	US
Zone of Proximal Development	ZPD

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Chapter 1

Research Context

"The rhetoric for change has been too associated with symbolic function of technology in society, which sits uncomfortably with teachers' professional judgements. So educational computing, it would appear, has yet to find its own voice" (Watson 2001:1)

1.1. Introduction

The advent of computers has led to developments and changes not only in business sectors but also in education. It is because of the technology revolution that many countries worldwide talk of integrating ICT into the curriculum. In the 1980s we talked of computers and education, but recently a new concept has emerged; "integration of ICT into the curriculum". What does this mean? The idea of using computers in education is not completely different from that of integrating ICT into the curriculum. The difference between the two is the manner by which computers were used in the past and the manner in which computers are used presently. The constant changes in technology that we use in our daily lives (e.g. cell phones) tempt me to believe that developments in computer hardware, software and connectivity are not static; they keep on changing along with other technologies. Technological changes imply changes in their use in education (Ravenscroft 2001). This means the integration of computers in teaching and learning should address the present curriculum needs.

The concept of "integration" is understood differently by those who perceive themselves as "integrating" ICT into the curriculum. According to Morrison, Lowther, & DeMeulle (1999) "integration" is successful when students use computers for their learning, thus giving them a chance to engage deeply and critically with computers. In this study, integration will be examined in its broadest sense as an "umbrella term" or being at the heart of the curriculum (Kennewell, Parkinson & Tanner 2000: 7). This means integration is examined not only with respect how it can benefit learners, but how it is integrated by teachers across the Learning Areas (LAs) or subjects in the secondary grades.

ICT policies reflect upon what the integration of ICT into the curriculum entails in education within different countries. In addition to the ICT policies I draw on the previous research to acquaint with the integration of ICT into the curriculum in the different countries.

1.2. Previous Research

Anderson (2002) identified 28 countries that are integrating ICT into the curriculum. His findings indicate that computer integrated activities (that are called "constructivist activities") allow students to work independently and constructively. The teacher is responsible for designing these activities, advising here and there and assessing the learner. The integration has been done differently in all these countries depending on the curricular goals of each country. Previous studies report that the integration of ICT into the curriculum remains problematic in the school context (John 2005). Amongst the problems encountered in the process of integrating ICT into the curriculum are teachers' perceptions of ICT.

"Teachers' perceptions of ICT in education are not only influenced by the discourse of official documents and guidelines, but also by their own experiences of using ICT" (Loveless 2003:315). Seemingly some teachers view ICT as a tool that reduces their work load (Granger, Morbey, Lotherington, Owston & Wideman 2002). Edward and Roblyer (2000) say that in the 1960's the developers of computers foresaw computers replacing many teachers' positions. Therefore the unwillingness of teachers to participate in ICT development plans may arise from this concern. However, Naisbitt dismisses this illusion by saying: "Whenever new technology is introduced into the society there must be a counterbalancing human response […] the more high technology it is the more high touch is needed", (Naisbitt 1984: 35 cited by Edward & Roblyer 2000: 12). In support of this notion Goodison says: "It is in the classroom that [the] fundamentals of education – what it means to know, understand learn are explained and modelled by the teacher" (Goodison 2003:1). To understand this perception I investigated the related issues that are often viewed as having negative influence on the teacher's perception of ICT.

Lee argues that "for teachers to rethink and restructure teaching and learning, they must first learn enough about […] technologies" (2002:5). According to Mooij and Smeets (2001) the lack of interest that has been displayed by teachers in most countries may be due to the misconception

of the concept "integration" which is due to the insufficient knowledge they possess. A further inhibiting factor would seem to be the lack of or inadequate teacher training. It is through the training of teachers that the objectives of integrating ICT can be clarified (Kennewell *et al* 2000:7). Furthermore, the attitude of the management in supporting the process is also viewed as influential to teachers' use of computers (Schiller: 2003). The attitude of the school management may not directly affect the teachers' perception of ICT, but may indirectly influence teachers' perception of the quality and quantity of ICT resources that the school needs (Mooij & Smeets 2001). Mumtaz (2000) identifies some inhibiting factors in integrating ICT into the curriculum; amongst these is lack of computer availability, lack of financial support and insufficient knowledge possessed by teachers.

As any other department within the school system ICT should be coordinated by an appropriate or ICT qualified teacher (ICT coordinator). The ICT coordinator together with the school management should craft an ICT policy for the schools and devise strategies of ensuring that ICT is integrated across the LAs' (Kennewell *et al* 2000). She or he should be able to decide on the hardware and software infrastructure and connectivity options. She or he should be able to make recommendations on the software to teachers for their subjects. This means teachers should be able to choose the appropriate software considering the outcomes they seek to achieve (Leask & Pachler 1999: 7). The ICT coordinator should also help teachers with ICT new developments (Goodison 2002: 216). However, the need for the school management in the planning committee remains crucial for funding purposes (Kennewell 2000 *et al*: 33). In the event that the school organisation is willing to meet the demands of ICT, there is the likelihood that teachers may take up the opportunities afforded by ICT. They may be able to highlight the benefits of using ICT in their subject areas.

1.3 Introducing ICT integration in South African schools

The advent of the new curriculum, Curriculum 2005, in South Africa has imposed many challenges to teachers in the process of teaching and learning, amongst other things, the introduction of Information and Communication Technology (ICT) into the curriculum (Department of Education 2002:7). The purpose of integrating ICT into the curriculum is to optimize the teaching and learning strategies and also to ensure the effective use of technology

in the classroom. Although the policy document of 1997 does not specify the use of "computers" within Technology it does indicate the need for effective and critical use of Technology (Department of Education 1997). The draft document of the Revised National Curriculum Statement (RNCS) (DoE 2003) Technology policy outlines how and in which LAs the application software (such as Ms Word, Ms Excel, Ms Access, Graphics and the CD ROM) can be used in teaching. Internet browsers form part of the software that the (RNCS) Technology policy document recommends for the integration of ICT into the curriculum. The Internet is the network of computers. Browsers software such as MS Explorer or Mozilla Firefox are the browsing software required to access the information contained on the various computers that form part of the Internet network. This resource is needed in all learning areas (LAs').

In South Africa ICT has been introduced as Information Technology or Computer Application Technology (CAT) in the Further Education (FET) band. IT is a subject of specialization which learners who are interested in programming computers and may want to study Computer Science at University take. On the other hand, CAT enables learners to integrate ICT into their curriculum. It provides them with an opportunity to use software such as *MS Word* and *MS Excel*. In 2004 the White paper 7, on e-Education indicated that every South African learner should be able to use ICT effectively and efficiently by 2013 (DoE 2004).

1.4 Potential value of the study

According to Hodgkinson-Williams (2005) the Eastern Cape Department of Education (ECDoE) did not have an ICT policy in 2004. This means the teachers who are integrating ICT in their teaching are integrating ICT without being informed by the provincial ICT policy. The experiences of the teachers from the Grahamstown secondary schools may provide guidelines on the ECDoE ICT policy. The School Management Teams (SMTs) may also use this study as their reference on what guidance the teachers expect to get from them as leaders of the school. Teachers may also use the findings as a resource to improve their integration of ICT in the curriculum.

1.5 Research Goal

The research seeks to establish how the secondary school teachers of the Grahamstown Circuit integrate ICT into the curriculum and how they cope with the challenges of integrating ICT into the curriculum. The intension is to be able to make recommendations on how these challenges can be addressed.

1.5 1 Research Questions

The major question that framed this study was:

- To what extent do teachers in the secondary schools of the Grahamstown Circuit integrate ICT into the school curriculum?

Subsidiary questions that were addressed were:

- What access do teachers have to computers?
- What software are teachers able to use?
- What type of training (if any) have teachers received in computer literacy and in integrating ICT into the school curriculum?
- How do teachers use computers at schools?
- What are teachers' perceptions of the benefits of using computers at school, including integrating ICT into the curriculum?
- What are the teachers' perceptions of the challenges encountered in integration ICT into the curriculum?

1.6. Research Sites and participants

I involved the three different school categories found in the Grahamstown circuit of the Eastern Cape, i.e. Former Department of Education and Training (FDET) schools, Former House of Representative (FHOR) schools and Former model C (FMC) schools. This is informed by the fact that the backgrounds of the three school categories are not the same. Because the integration of ICT is supposed to be implemented across the eight LAs of the General Education and Training (GET) band and the Further Education and Training (FET) band, I asked for Mathematics, Natural Sciences, Social Sciences, Languages and CAT teachers to be part of the study. This means I invited five teachers from each school (forty five overall) to participate in my study, however I ended up with 38 because of the teachers who did not respond to the call.

1.7. Research Methodology

This study is undertaken within the interpretive paradigm. This seemed to be the most suitable paradigm for conducting this research because of its flexibility in understanding that humans differ in understanding about the world around them. My intentions were to "understand" as suggested by Winberg (1997) how teachers in the Grahamstown secondary schools perceive the integration of ICT in their teaching curriculum, share feelings and to offer possibilities rather than certainties (Bassey 1999).

1.8 Research Methods

A survey was conducted to collect data through questionnaires followed by interviews to probe in-depth the teacher's views and concerns. The computer infrastructure was assessed by an MSc student, Ingrid Brandt, through survey conducted with the ICT teachers, coordinator or technician from each of the schools. Therefore data for infrastructure was adapted from Brandt (2006). In-depth interviewing does not only help the researcher to get the answers but also make the respondent part of the research since s/he becomes the centre of the process (Seidman 1991). A research journal was kept for keeping records of observations made during interviews from each site and to keep track of my data.

1.9 Ethical Issues

In conducting research, the researcher has to consider that she or he does not share the same feeling about what she or he has identified as the problem. The fact that the "research gives participants a chance to be heard by providing them with a platform, a chance to make their viewpoints heard and eventually read" (Wellington, 2000:72), does not mean they are obliged to accept the study. As the informed researcher I consulted my target participants through writing letters inviting them to participate in my study. During interviews participants signed a consent form to confirm that they have agreed to be interviewed. After transcribing the interviews I sent the transcripts back to interviewees for them to confirm that what is reflected on the transcript is a true reflection of what they said. This is known as a member check or member-checking.

1.10 Limitations of the study

Firstly I intended to involve all 13 secondary schools of the Grahamstown circuit, i.e. the FDET schools, FHOR schools, FMC schools and the Independent schools (IS). But because of the number of questions that I asked and the number participants from both questionnaire and interviews I ended up with a considerable amount of data, I decided to leave out the IS school. I initially chose the IS schools because they are not funded by the government; therefore their case is different from the three school categories. However, I still believe that there is a need to find out how the IS secondary teachers integrate ICT into the curriculum in order to be able to compare and contrast the experiences of Government school with that of the IS schools (see suggestions in Chapter 5)

1.11 Outline of the study

In Chapter 2 I present the literature reviewed whilst I carried out the study. The focus is on reviewing what other authors say about issues that are relevant to my study. I look at the international studies, African studies and then South African studies.

Chapter 3 I presents the research orientation to the study. I examine the research aim, research methods, describe the participants, research tools and techniques and further explain how the data was collected and analysed.

In Chapter 4 I present the findings of my study as I interpreted them during the data analysis process. I present it in different themes that I deduced from the data. I further relate the findings to the literature reviewed in Chapter 2.

Chapter 5 is linked to Chapter four. In this chapter I summarise the findings by deliberating on the themes I view as outcomes of the study. This chapter ends with recommendations and suggestions for further research.

Chapter 2

Teachers' use of ICT in schools

2.1 Overview

Although Information and Communication Technologies (ICT) in education can be viewed as being driven by business and industrial representatives in the private sector (Becta 2002), a substantial number of central government initiatives around the world have encouraged the implementation of computers in schools (Selwyn 1999). The implementation of computers in schools started in the 1980's when Computer Assisted Instruction (CAI) was introduced. The ongoing innovations in technology have informed changes in the implementation of computers in education (Ravenscroft 2001), hence today we have open learning through the use of telecommunications and the Web (Watson 2001).

Having considered the fact that the core implementation of computers takes place in the classroom where teachers teach, I examine how the implementation of computers (from CAI to telecommunication and the Web) affect teaching practice. Watson (2001) argues that the implementation of computers demands consideration of some more fundamental educational issues. In addressing these "educational issues" I examine the implementation of ICT in education using the central object in the process, that object is the "teacher". Kearsley, Hunter and Furlong (1992) argue that teachers teach the way they were taught. This means teaching is influenced by teachers' beliefs. Teachers' beliefs are informed by the learning theories they hold. To juxtapose these issues (the teacher, teacher's belief and the learning theories) I first look at the place of ICT within pedagogy which will inform how ICT is used within pedagogy. I then discuss the underpinning theories and the role of the teachers as informed by learning theory.

Because this study examines the integration of ICT, I find it imperative to discuss the concept of "integration" of ICT. I extend the discussion to the processes that are believed to take place where ICT is integrated. I then review the previous research on ICT integration taking cognisance of teachers' perceptions of the integration of ICT into the curriculum, with a closer

view of the benefits and challenges perceived. Because ICT integration is also guided by policy, I reviewed the ICT policies of a selection of developed countries and developing countries and then examine the South African policy in particular. This exercise leads me to examine how ICT may widen, rather than narrow the inequalities that already exist in education. I then discuss the digital divide as addressed by developed countries, developing countries and later by South African ICT policy.

2.2 ICT in pedagogy

Before examining ICT within pedagogy, I discuss the concept "ICT" to assist in determining the position of ICT within pedagogy.

2.2.1 What is ICT?

The Qualification and Curriculum Authority in the United Kingdom (UK) (cited in Kennewell, *et al* 2001:1) defines ICT as "the range of tools and techniques relating to computer-based hardware and software; to communications including both directed and broadcast; to information sources such as CDROM and the Internet; and to associated technologies such as robots, video conferencing and digital TV." This means ICT is an extension of Information Technology (IT) that includes hardware, software and Internet connectivity. Connectivity provides access to the Internet, local networking infrastructure, and videoconferencing and thus provides communication within IT (Shelly, Cashman, Gunter & Gunter 2003). Hence today we speak of ICT not IT alone.

Toomey's definition elaborates upon the underlying purposes of using ICT's in education. He defines ICT as a tool for teaching and learning that "relates to those technologies that are used for accessing, gathering, manipulating and presenting or communicating information" (Toomey 2000 cited in UNESCO 2003). This means ICT is a dynamic resource or tool that can be used for different purposes in the pedagogical environment.

2.2.2 Placing ICT in a pedagogical context

It is important to understand what is meant by pedagogy in order to be able to locate the place of ICT within pedagogy. *Pedagogy* is defined in many ways, but is broadly based on the common understanding that pedagogy is the science of teaching (Webb & Cox 2004). According to

Watkins and Mortimore (1999 cited by Webb & Cox 2004) pedagogy does not remain static over a period of time. Webb and Cox assert that pedagogical changes are influenced by "growing knowledge that has become […] more differentiated and more integrated [and that the] developments in our understanding of cognition and metacognition has influenced the conceptualisation of pedagogy" (2004:237). Therefore pedagogy can be changed to suit the needs of the time. Watkins and Mortimore describe the current model of pedagogy as:

> "Offer[ing] an increasingly integrated conceptualisation which specifies relations between its elements: *the teacher*, the classroom or context, content, the view of learning and learning about learning" (1999: 8 cited by Webb & Cox 2004:237 my italics).

The first identified element "the teacher" is responsible for organising all the other elements in order for learning to take place. Cloke and Sharif (2001) view pedagogy as being about teachers' behaviour in the classroom. Mumtaz (2000) highlights that the teachers' behaviour in the classroom is influenced by the teachers' pedagogical content knowledge. Pedagogical content knowledge includes knowing what s/he wants to achieve (the outcomes of the lesson), knowing the learners' level of knowledge (learners' knowledge), knowing the subject content (subject matter) organising the subject matter to fit the learners' knowledge (lesson planning) and organising the relevant teaching and learning materials that can be accessible in the learning environment (affordances) (Mumtaz 2000).

ICT is one of the resources that can be organised to be accessible in the learning environment. Therefore in teaching, ICTs are placed under the affordances (Shulman 1987 cited by Webb & Cox 2004). Gibson (1979 as cited by Armstrong 2005) suggests that any tool provides affordance as perceived by the user. Therefore affordance is the kind of support the tool provides a user in terms of the user's perception and belief. Webb and Cox view ICT as a tool that increases the degree of affordance; however suggest that teachers "need to be able to identify affordances in any suitable software […] for exploring and developing the ideas and skills that are to be taught" (2004:238).

In light of the fact that ICT is a relatively new resource and that most of the teachers were never exposed to use of ICT in their training (Kearsley, Hunter & Furlong 1992), it is useful to reflect upon how this affects the teachers' role in the classroom. In doing so, I need to discuss the role of the teacher and the use of ICT within teaching. Cloke and Sharif argue that: "Teachers' beliefs and [learning] theories about teaching are major factors in influencing teachers' use of ICT in their teaching" (2001:8). I therefore discuss the teachers' role and the use of ICT with reference to the key learning theories: behaviourism, cognitive constructivism and social constructivism. Under each learning theory I discuss how the theorists view knowledge and the role of teacher. Subsequently I discuss the role of ICT as underpinned by each learning theory.

2.3 Behaviourism

2.3.1 General description

In the past the teaching approach was strongly influenced by behaviourism which emphasised that learning takes place when there are observable changes in learners' behaviour (Orlich 2005). Skinner, the behaviourist, believes that we know because of the world that acts on us; we "grasp or take in" what the world brings to us (Skinner 1968 cited by Ozman & Craver 1986). In elaborating upon the behaviourist approach Hinchey (1998) argues that behaviourists believe that knowledge is out there to be found and as such constitutes factual and verifiable information. The role of scientist is therefore to discover the "true facts" about the world and bring them as tied or fixed knowledge to the recipients of knowledge. The recipients include the teacher who cannot argue against what scientists claim to be "true" knowledge. In other words the teachers' understanding of knowledge is subject to what scientists believe to be true. In turn, teachers view learners as tabula rasa which suggests the teachers' role as "passive transmitters of knowledge" (Elbaz 1981:43) to learners who cannot argue against what teachers believe to be "true knowledge".

Kennewell *et al* (2000) views the behaviourist approach as implying a very limited role for the teacher. The teacher is seen to be the deliverer of instruction or the transmitter of knowledge that cannot be contested by the learner. Instructivist teachers begin their lessons by presenting information from lower order tasks to higher order tasks. As the knowledgeable elements in the teaching process the teachers: "identify the type of discrimination required in a particular tasks,

and design a specific sequence to teach the discrimination so that only the teacher's interpretation of the information is possible" (Magliaro, Lockee & Bruton 2005:44).

Within the behaviourist perspective, the teacher repeatedly presents facts to the learner. Repeated presentation encourages memorisation of facts by learners (Magliaro *et al*. 2005). Corno and Snow (1986 cited by Magliaro *et al*. 2005:43) refer to this as "Direct Instruction" (DI) which describes a "range of instructional models used in face-to- face [teaching and] learning contexts – all designed to promote on–task student behaviour by the teachers' effort to monitor and control student classroom attention and persistence". Over and above teacher control, face-to-face teaching is used to ensure that learners remain active participants in the teaching and learning process even if their participation is non-verbal:

> *"It is important to emphasize that student does not passively absorb knowledge from the world around him but must play an active role, and also that action is not simply talking. To know is to act effectively, both verbally and nonverbally"* (Skinner 1968:5 cited by Magliaro *et al.* 2005:42).

It is therefore, within the teacher's capacity to create an environment that will trigger learners' behaviour in the classroom. Because behaviourists believe in "quantity" of content they believe that the factual knowledge presented to learners should be timeously measured by teachers. Frequent testing is used as an instrument to measure changes in learners' behaviour (Kanuka & Anderson 1999). "Teachers use some form of behaviour modification with a reward system to reinforce students for displaying appropriate behaviours" (Orlich 2000:47). The purpose of using the reward system is to strengthen the occurrence of positive behaviours (Schunk 2004).

2.3.2 ICT underpinned by behaviourist principles

Even before the sophisticated ICT's came into being, computers were already being used for teaching. In the 50's, technology was introduced in education in the form of teaching machines which were invented by Skinner to assist teachers with the delivery of instruction during the teaching process He believed that the teaching machine would perform the teaching role far better than teachers (Kennewell *et al* 2000). The machines were programmed so that they

presented the learners with the facts or information that they (learners) had to acquire. Memorisation of facts was done through drill and practice. After continuous drill and practice the machine was able to test the learners' knowledge and if the learner performed well, the machine would provide the learner with the next tasks, which acted as a type of reinforcement. According to Magliaro *et al*, "Nowhere is DI more evident than in computer-aided learning environments, from computer [assisted] instruction [of the 1980s] to distance learning experiences [of the 2000s] [where] the basic tenets of DI are infused with greater and lesser fidelity" (2005: 43).

In the 1980s computer based activities were designed to assist the teachers in the teaching process. Amongst these was Computer Assisted Instruction (CAI) which Taylor (1980) termed the '*tutor mode'*. He defines the tutor mode as the process where computers are programmed by experts to act as a "surrogate teacher" (Reeves & Hedberg 2003:6) instructing the learner through a predefined lesson on the computer. Instead of the teacher, the computer courseware delivers instruction on the assumption that learners will acquire information as it is repeatedly presented by the instructor (Clark & Mayer 2003). In the same way as the teaching machine, the tutor mode used drill and practice to encourage acquisition of knowledge by the learner. Similar to the role of the teacher in behaviourism, the tutor mode is able to "provide […] routines necessary […], such as combining text and graphics, answer judging, and student control functions" (Alessi & Trollip 1991:341). Jonassen (1996) refers to this traditional way of using computers as learning *from* computing. He views this process as a process whereby computers present static knowledge to the learners. Jonassen (1996) believes that learning *from* computers plays no role in developing the learners' cognitive structures.

Hartley (2007) and Magliaro *et al.* (2005) argue that even though drill-and-practice programs are aligned with behaviourism, they are most commonly used to support learners with learning barriers in the classrooms today. Drill-and-practice programs are designed to develop students' "specific often quite limited competencies and abilities" (Reigeluth, 1987 cited by Bottino 2004:555). In addition to remedial teaching, DI is used in distance teaching where computers are used as stand alone to represent the teacher (Hartley 2007).

With regard to the Web of the 2000s, Lankshear (2000:18) highlighted that even though the Internet is viewed as transforming teaching and learning by some, for others "the Internet can seemingly be understood as an elaborate infrastructure for transmitting, receiving and manipulating information." Manipulation of information and other related practices are viewed in a similar vein as possession of knowledge by scientists (Thagard 1997 cited by Lankshear 2000). This means the use of the Internet depends on the user; it can be used to facilitate the traditional teaching approach underpinned by behaviourist principles.

In short, "the metaphor that prevails [in the use of ICT-based educational tools in the transmission model] is that of the system as an environment where knowledge is transmitted in order to be acquired by the user" (Bottino 2004:556).

2.3.3 Role of the teacher

Lajoie and Derry "believe that the teacher, whether human or machine, has […] roles to play while students are engaged in […] learning activities" (1993:294). While Skinner's intension was to replace teachers with the machine, Hartley maintains that instead of replacing the teacher: "the teacher and the technology work together – one is not pitted against the other" (2007). Magliaro *et al.* (2005) recognize that the teacher remains responsible of choosing the learning objectives that must be mastered by the students and further selects appropriate CAI programs which present information from lower level tasks to higher level tasks.

Although the computer is able to provide tutoring to the learners, it is the teachers' role to monitor the learners' progress on tasks (Kennewell *et al* 2000). This means the teacher has to observe the learners' performance during the tutoring process. As an instructionist, the focus of the teacher in a CAI classroom is to encourage learners to acquire knowledge through information delivery (Hartley 2007).

2.4 Cognitive Constructivism

2.4.1 General Description

In contrast to behaviourism, cognitive constructivist Piaget argues that "the child acts on the world, with expectations about consequent changes, and, when these are not met he enters into a

state of cognitive conflict or disequilibrium" (Ravenscroft 2001:136). Schunk (2004) describes cognitive development as a process that is depended on four factors: biological maturation, experience with the physical environment; experience with the social environment; and equilibration. The effects of the first three depend on the fourth [equilibration]. "Equilibration is the central factor and the motivation force behind cognitive development. It coordinates the actions of the other three factors and makes internal mental structures and external environment reality consistent with each other" (Schunk 2004:447). This means before new knowledge is constructed, the new experiences need to conflict the old experiences. Therefore the constructivists view knowledge as based upon individual constructions that are not tied to any external reality, but rather to knower's interactions with the external world" (Jonassen 1990:32 cited by Kanuka & Anderson 1999:5).

In further elaborating Piaget's theory, it is noted that it is through the process of learning that "the child becomes socialized, the incidence of egocentric speech declines, a decline which Piaget regarded as a surface manifestation of fundamental changes in underlying cognitive schemata" (Duncan 1995:460). Tudge and Rogoff (1989) argue that even though Piaget believes in self discovery or individual learning, he understands that in order for learning to take place the child should be socialised in the environment. Although Piaget criticised the adult-child interaction, he "allowed for possibility that adults may be able to interact with children in a cooperative fashion" (ibid 24). Piaget argues that "it is despite adult authority, and not because of it, that the child learns. And also it is to the extent that the intelligent teacher has known to efface him or herself, to become an equal and not a superior, to discuss and examine, rather than to agree and constrain morally" (Piaget 1977: 231 cited by Tudge & Rogoff 1989: 24). Therefore in applying cognitive theory teachers should consider the role of designing the environment for conceptual change to take place, not to decide on how learners should create meaning and understanding of the new concepts provided in the learning environment. In designing the learning environment the teachers are supposed to first consider learners' prior knowledge which serves as a base in the construction of new knowledge.

2.4.2 ICT underpinned by cognitive principles

Inspired by Piaget's theory, Seymour Papert (1980) developed a language program which was known as LOGO. The "LOGO was designed to prompt a purely learner-centred interaction in which the student "told the computer what to do' and observed its response" (Ravenscroft 2001:136). LOGO was programmed in the computer to act as curriculum innovation program through which learners were encouraged to learn through self discovery; allowing them to develop their own knowledge and understanding without guidance from the teacher. This means that "learning is progressively considered as being based on the active exploration and personal construction, rather than the transmission model" (Bottino 2004:556).

Taylor (1980) termed this type of program "*tool mode*". The "tool […] relieves the learner of routine and tedious mechanical tasks" (Hodgkinson-Williams 2006:4). In contrast to learning *from*, Jonassen (1996) argues that when using computers as tools the learner constructs knowledge. This means learner is no longer learning from the computer, she or he learns *with* the computer. Jonassen and Reeves (1996) argue that software tools do not improve teaching when they are relegated to service of traditional instructivist pedagogy. Instead Jonassen and Reeves suggest that software tools should be "employed as *cognitive tools* to solve challenging problems, pursue personal learning goals, or accomplish authentic tasks" (1996:694 my italics).

2.4.2.1 Cognitive tools

Before the concept "cognitive tool" was introduced, some authors came up with similar views of how the computer as a tool helps in developing the capacity of the human mind. In 1985 Pea referred to computers as "cognitive technologies" responsible of reorganising our mental functioning structure. Salomon, Perkins and Globerson (1991) use the term "intelligent tools" to show the potential of computers in changing the cognitive capacities. They maintain that intelligent tools influence the lasting changes in general cognitive capacities. This means with computers as "cognitive tools" conceptual change will not only be effective at the moment of being engaged with the computer, but also when students are away from the computer. Salomon *et al.* (1991) refer to this as the *effect of* computers. Lajoie and Derry (1993) viewed computers as performing a different role from the expert teacher. In elucidating the role of computers, Lajoie and Derry argue that computers extend the mind; hence they are also referred to them as

cognitive tools. With cognitive tools there is "little or no artificial intelligence […] incorporated into the […] instructional systems, because planning and decision-making control over the learning process is largely relegated to system users" (Lajoie & Derry 1993:5).

Jonassen and Reeves (1996) termed computers "cognitive tools" to differentiate between the uses of computers to transmit knowledge to that of using computers to construct knowledge. This distinction helps teachers to create computer integrated learning environment "wherein learners use cognitive tools to help themselves construct their own knowledge representation. Cognitive tools can help […] learners organize, restructure and represent what they know" (Jonassen & Reeves 1996:695).

The use of notion of "tool" can be understood better when referring to the relationship between humans and the "tool" which was proposed by Bruner in the 1960's (Hodgkinson-Williams 2006). Bruner (1966: 81) defines the tools as "amplifier of human capacities and implementers of human activities". This definition refers to both tangible and intangible tools. In elaborating upon his definition Bruner further provides a distinct classification of the human capacities amplified by the tool. These are motor capacities, sensory capacities, and ratiocinative capacities. Because software can be construed as being intangible powerful tools (Jonassen & Reeves 1996) provided by the computer, computers can be classified as ratiocinative amplifiers. This means computers (software) are amplifiers of reasoning capacities (Stott 2004). According to Jonassen and Reeves (1996) cognitive tools include all software that is

- distinctly different from traditional conceptions of instructional technologies
- does not encode information in predefined educational communications that are used to transmit knowledge to students

and all software that provides learners with opportunity to act as designers using technologies as tools for

- analyzing the world
- accessing information
- interpreting and organizing learners' personal knowledge and representing what they know to others (1996:694).

2.4.3 Role of the teacher

Although the teacher's role is more facilitative than concerned with direct instruction as in the traditional approach, the teacher decides on the lesson objectives. The choice of appropriate software for the lesson is made by teacher to ensure active cognitive reorganisation (Duffy & Cunningham 1996). This is guided by the fact that it is the teacher who knows the mature and less mature learners in his or her classroom (Lajoie & Derry 1993). It is further argued that the teacher should always be around the learners during the use of computers as cognitive tools "since learners can become highly confused and demoralized by undetected errors" (Anderson *et al*. cited by Lajoie & Derry 1993:147). It is the teachers' role "to determine when and how the observed knowledge-construction activity of a particular student deviates from a predetermined set of solution path" (Derry & Hawkes cited by Lajoie & Derry1993:147). In this way the teacher can create an environment that will encourage and stimulate learners to construct knowledge using cognitive tools, such as computers.

2.5 Social Constructivism

2.5.1 General Description

Parallel to Piaget's cognitive constructivist theory, is the social constructivist theory proposed by Lev Vygotsky, which still influences many of the teaching approaches in the 2000s. Vygotsky and Piaget share the idea that knowledge is constructed, however they differ on how knowledge is constructed. Vygotsky viewed learning as an activity that takes place through mediation processes which cannot be facilitated without the use of tools (Bannon 1997). The tools include psychological[1] and semiotic tools. The semiotic tools are "both the tools that facilitate the co-construction of knowledge and the means that are internalised to aid future independent problem-solving activity" (Palinscar 1998 : 353). Conceptual development takes place during this internalisation process. Extending Vygotsky's argument of knowledge, Rorty says knowledge transforms as the learner continues to participate in different socio-cultural activities. He defines knowledge as "a consensus of beliefs, a consensus open to *continual negotiation"* (Rorty 1991 cited by Duffy and Cunningham 1996:178).

[1] Psychological tools are those symbolic artifacts-signs,text, formulae, graphic organiser - that when internalized help the individuals master their own natural psychological functions of perception, memory,attention, […] (Kozulin 2003:15).

Unlike in behaviourism and cognitive constructivism where the role of the teacher is viewed to be limited, Vygotsky views the teacher as the key driver of the teaching and learning process. In the classroom situation the teacher designs an environment where learning takes place in a form of dialogue with others (i.e. group learning or collaborative learning). The dialogue continues until the learner reaches a stage where s/he experiences tensions between scientific experiences (systematic-cultural arranged abstract concepts) and spontaneous experiences (unsystematic everyday concrete concepts) (Ravenscroft 2001). Vygotsky called this a Zone of Proximal Development (ZPD):

> *"The zone of Proximal Development [ZPD] is defined as the distance between the actual developmental level of the child as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers"* (Vygotsky cited by Duffy & Cunningham 1996:183).

In order for learning to be successful the teacher or capable peers should support or "scaffold" the learner within his/her ZPD to encourage conceptual change. Because teachers are in possession of "authentic knowledge of the subject - that is organised, systematic in reasoning, and because of its more abstract language, less dependent on contextual reference [they can] assist in enculturating the learner with their scientific knowledge and understanding" (Ravenscroft 2001:141). Therefore in social constructivism "the idea of teaching [is] characterised as support within the ZPD" (Kennewell *et al* 2000:91), and is called scaffolding (Wood 1988 cited by Kennewell *et al* 2000).

Social constructivism suggests that interaction within socio-cultural activities and scaffolding are the key components that help in knowledge construction. How can ICT support social constructivist principles?

2.5.2 ICT underpinned by social constructivist principles

Social constructivist authors such as Duffy and Cunningham (1996) argue that computers are grouped under the semiotic mediation tools which Vygotsky considers to have indirect communicative actions in teaching and learning processes. These include computer mediation tools such as computer conferencing and electronic mail (Romiszowski & Mason 1996). "Pedagogically, mediation tools are based on cooperative learning precepts" (Johnson & Johnson 1987 cited by Hodgkinson-Williams 2006). "ICT does not exist in isolation: it is interwoven with the rest of the tools and participants in the learning environment" (Lim 2002:411).

According to Lagos, Nussbaum and Capponi (2005) ICTs "mediators" are used to mediate interactions between actors in the classroom. Their role is more than just communicating tools since information is transformed in the process of mediation. Mediators such as Personal Digital Assistants "act as instruments that support and regulate relations between actors, and provide:

- Organization of information
- A negotiation space
- Coordination between activity states" (Lagos, Nussbaum & Capponi 2005:264).

What transpires from Lagos, Nussbaum and Capponi's arguments on mediators, is that there are ongoing conversations that take place during the use of ICT for teaching and learning. This process provides an opportunity for the development of higher order learning objectives associated with problem-solving and critical thinking skill (Romiszowski & Mason 1996).

It is evident then that the concept of "cognitive tool" is also appropriate for a socio-cultural learning environment. In support of this notion, Azevedo uses the concept "metacognitive tool" which he describes as "any computer environment […] that resides in a specific learning context where peers, tutors [or] humans […] may play some role in supporting students' learning by serving as external regulating agents" (2005: 194). This means computers are used as tools that encourage interaction with others in order to encourage thinking about thinking. "Research indicates that cognitive conflicts embedded in a social interaction are more conducive to cognitive growth than is an individual's experience with conflicting viewpoints within his or her own mind" (Lajoie & Derry 1993:295). The ZDP emerges when there are conflicting viewpoints within the learners' mind. It is through scaffolding that the conflicting ideas within the learner's

are developed to the next level of understanding. "Scaffolding refers to support provided so that the learner can engage in activities that would otherwise be beyond their abilities" (Jackson *et al.* 1998:187 cited by Sherin, Rieser & Edelson 2004:391). According to Sherin *et al* (2004) the scaffolding metaphor is extended to learning artifacts such as computer educational software. This means computers can provide the learner with necessary support when she or he is stuck with new concepts. What is implicit in this discussion is that computers act as "catalysts" in the socio-cultural learning environment.

2.5.3 Using computers as catalysts in teaching

Before examining how computers are used as catalysts in teaching, we need to understand the concept "catalyst" as used in a computer based environment. The Collins Concise dictionary (1989) defines a catalyst as *the substance that increases the rate of a chemical reaction without itself suffering any permanent chemical change*. In a computer based teaching environment, there may be no chemicals, however there are reactions.

Hawkridge (1990) proposed a catalytic rationale of using computers in education. In Hawkridge's view the catalytic rationale is the rationale with most hidden power. The catalytic rationale aims at changing both the teacher and the learner (Hawkridge 1990). More control is given to learners who are expected to take charge of their learning. Hawkridge argues that in the catalytic rationale "computers will help children move away from rigid curricula, rote learning and teacher-centred lessons, by giving children more control to of their own learning" (ibid 3). Therefore in this rationale learning is transforming from one that is teacher-centred to one that is learner-centred. Teachers are expected to change their roles because of the new role that learners play in their learning. Furthermore the use of computers as catalysts can help teachers develops skills that are needed in the changing curriculum. The catalytic rationale seems to be in line with the use of computers that aims to transform pedagogical practices.

2.5.4 Role of the teacher

In a social constructivist computer classroom some of the traditional teacher's roles are retained (e.g. class leader, discussion leader). McGhee and Kozma (2003) identify the following as the roles of the teacher in a computer classroom underpinned by social constructivist tenets:

- Instructional designer

- Collaborator
- Advisor
- Team coordinator
- Monitoring and assessment specialist

In elaborating these roles, I use Lajoie and Derry's (1993) descriptions of the role of the tutor in a computer classroom where the use of computers is underpinned by social constructivist principles.

Instructional designer: As is the case with roles of teachers in the classroom informed by traditional principles and in the classroom underpinned by cognitive principles, the teacher in the classroom informed by social constructivist principles first decides on the lesson objectives of his or her lesson. This includes choosing appropriate ICT resources that support knowledge construction.

Collaborator: Teachers are no longer knowledge transmitters; they act as partners, co-workers in the learning process.

Advisor: The role of being an advisor is one of the main roles that the teacher plays when engaging learners in collaborative activities. They argue that the teacher provides advice when it is needed. This means teachers can support learners in "carrying out assigned tasks, much like mentor or coach" (ibid:294).

Team coordinator: Team coordination is applied by "providing quality control over peer critiquing and other collaborative activities, […] ensur[ing] that students learn what they are expected to learn, and do not mislead one another" (ibid:294).

Monitoring and assessment specialist: Teachers monitor learners work throughout the learning process. She or he manages all the activities; she or he identifies the learners' problems and selects an appropriate task for the learner (ibid). The teacher decides on the type and time of assessing the learner.

In summarising the use of computers as underpinned by the three learning theories I use Table 2.1 to clarify how computers are used from a behaviourist perspective, cognitive constructivist perspective to a social constructivist perspective.

Table 2.1: Summary of ICT and the underpinning principles

ICT integration	**Behaviourism**	**Cognitive Constructivism**	**Social Constructivism**
Role of ICT	Acts as a tool for transmission of knowledge	Acts as cognitive tools that enhance learning	Acts as cognitive tools mediation tools and catalyst that enhance and transform learning and teaching
Purpose	Encourages knowledge acquisition	Supports self discovery learning where learners are encouraged to construct knowledge	Support learners in constructing knowledge through social interactions
Participation	Active teacher Passive learner	Active learner Limited participation by the teacher	Active learner Active teacher
Teaching Process	The teacher monitors the process to attest the acquisition of knowledge by learners	The teacher provides guidance to assist learners with errors while using the computer, but not with discovering	The teacher scaffolds, and mediates when learners get stuck by assisting learners find out how the computer can provide more support to his or her lesson. The knowledgeable peer supports learners with difficulties
Learning process	Encourages drill and practice for memorisation of facts	Encourages cognitive development through self discovery	Encourages cognitive development through social interactions with partners in the learning process

Having considered what the role of the teacher is when using computers as underpinned by the three principles (behavioural principles, cognitive constructivism principles and social constructivism principles), it is clear that the effective integration of ICT remains within the teachers' competence and sphere of influence. I examine the concept "integration" in the context of ICT next and then look at the different phases of integrating ICT as proposed by different authors.

2.6 Understanding the "integration" of ICT into education

2.6.1 What does the concept "integration" mean in the context of ICT?

The concept of "integration" is understood differently by those who perceive themselves as "integrating" ICT into the curriculum. In understanding what it means to integrate ICT into the curriculum it is argued that ICT integration applies across the curriculum, it is not a separate course as others might think (Flanagan & Jacobsen 2003). At the most elementary level integrating of ICT can simply mean using word processing to type school projects and at the most sophisticated level, "integrating" ICT can refer to a simulation that would not be possible without computer technology. However the definition alone does not clarify what it means to integrate ICT across the curriculum. Further examination is needed to clarify how schools can integrate ICT into the curriculum.

2.6.2 Integrating ICT into the curriculum

Many attempts have been made to clarify what is understood by "integrating ICT into the curriculum". This encompasses a range of approaches that different school teachers use to integrate ICT into their school curricula. According to Bottino "three models can be singled out as a starting point for eliciting ideas about crucial issues in ICT based learning systems:

- The transmission model;
- The learner centred model;
- The participative model" (2004:555).

The transmission model is nothing else but the drill-and-practice programs that are used to assist learners with development of limited abilities together with tutorial systems that substitute teachers as transmitters of knowledge. The learner centred model is based on the interest that learners learn more when given opportunity to explore and discover concepts on their own. This

means considering active exploration and personal construction of knowledge rather than acquisition of knowledge. Lastly is the participative model where learning activities are organised to take place in a social environment (Bottino 2004). In his models, Bottino confirms the relationship between the learning principles and the use of computers in the classroom. In elaborating this I discuss the three levels of ICT integration by McCormick and Scrimshaw that are similar to Bottino's models of integrating ICT into the curriculum.

In studying the relationship between ICT and pedagogy McCormick and Scrimshaw suggested that ICT integration takes place through three levels of pedagogical change:

- *improving efficiency and effectiveness*
- *extending the reach of teaching and learning with ICT and*
- *transforming the concept of the subject with ICT* (2001:44-45).

Improving efficiency with the use of ICT helps teachers to improve their practice by providing the teacher with accurate and efficient tools. These include use of spreadsheets to plot graphs and word processing for writing compositions.

Extending the reach of teaching and learning with ICT refers to the use of Internet that enables teachers to extend the resources found in the teaching environment. This provides opportunity for both the teacher and the learner to search for world wide up-to-date information. However the teacher should monitor the searching process by educating learners on how to use Internet for them to research an agreed question.

Transforming conception of the subject with ICT: During this level teachers support learners to develop a sense of independence through the use of ICT. Learners are free to explore and interact with all sorts of data on their own. The teachers' role is to develop learners' judgment skills and their ability to appraise critically what is of particular importance (ibid).

Similar to the three levels by McCormick and Scrimshaw are the three levels of ICT integration by Bialobzerska and Cohen (2005). Bialobzerska and Cohen suggested three levels under which ICT can be integrated:

- *Functional practice:* Computers are used to assist in tasks that can be done by other means such as being hand written, which includes use of spreadsheets and word processing.

- *Integrative practice*: Teachers begin to make use of the computer in a way that learners could benefit the learner, e.g. when learners are asked to write compositions using the computer, they use editing tools to check grammar mistakes, spelling mistakes and more appropriate words. The teacher expects learners to draft and redraft and by doing so new insight is gained.
- *Transformational practice*: This level considers "learning which occurs as a result of activities and opportunities which do not exist in computer less environments" (ibid 33). This includes the use of communicating tools whereby learners interact with learners from other countries (ibid).

Table 2.2 illustrates how I juxtapose the three ICT integrating models within the learning theories, with further association to Hokanson and Hooper's approach of using computers.

Table 2.2: Integration models of Bottino (2004), McCormick & Scrimshaw (2001), Bialobzerska & Cohen (2005) and Hokanson & Hooper's (2000) approach

Underpinning Learning Theories	**Integrating models**			**Hokanson & Hooper's' approach**
	Bottino (2004),	**McCormick & Scrimshaw** (2001)	**Bialobzerska & Cohen** (2005).	
Behaviourist	*Transmission mode:* Substitute the teacher as transmitter of knowledge	*Improving efficiency and effectiveness:* support teacher's practice by improving the teachers' delivery of instruction.	*Functional practice:* Improves what could be done by hand.	Representational approach: Merely changes the medium in which the information is represented
Cognitive constructivist	*Learner centred mode:* Self discovery learning	*Extending the reach of teaching and learning* Increasing learner centred activities	*Integrative practice*: Increasing learner activities	Generative
Social constructivist	*Participative model* Socially constructed knowledge	*Transforming the concept of the subject* Increasing social learning activities	*Transformational practice* Increasing socialising strategies for learning & teaching	Generative

While the authors mentioned above considered the levels of change by teachers, UNESCO (2003) and Yeun, Law and Wong (2003) move beyond ICT integration by teachers only to the broader context of ICT integration within a school environment.

In the study conducted by UNESCO (2003) four stages of ICT integration within school environment were identified:

1. *Emerging*,
2. *Applying*,
3. *Infusing* and
4. *Transforming* (ibid 19).

Emerging stage: is evident when the school is in possession of few computers that can be used only by teachers and the administration. During this stage teachers are learning how to use computers. The purpose of this stage is to familiarise teachers with ICT literacy skills. Teachers are trained to use variety of tools and applications. Teachers begin to understand why they have to apply ICTs into their teaching (UNESCO 2003). The major aim is to develop teachers in order for them to feel comfortable and at ease with the application programs and confident in their use (Becta 2005).

*Applying stage***:** is evident when teachers feel reasonably confident with ICT applications. They can use application software and communication tool and browse the Internet confidently (ibid). Teachers are ready to implement or apply new technologies in the teaching of LAs. Teachers decide why, when, where and how ICT tools will contribute in the objective of the lesson. Teachers should then be able to choose the appropriate ICT tool that will benefit the learner in understanding the new concepts of the new lesson. This includes being able to choose when the whole class or group multimedia presentations will be useful. It is also important for teachers to understand when and how they will assist learners to find, compare and analyse information from the Internet or from any other research source specific to the LA. At this stage not only teachers are applying ICT's in teaching, the management, secretaries as well as librarians are beginning to apply ICTs in administering their tasks (UNESCO 2003).

Infusing stage: is noticeable when teachers begin to use all what they have learnt in every aspect of their teaching. ICT is incorporated in lesson preparation and management. What becomes critical is for teachers to explore the use of ICTs and to be creative. Through their creativity they are able to stimulate and manage learning of learners using different learning styles to achieve their goals (ibid).

*Transforming stage***:** is visible when teachers use ICT tools with confidence. They are able to apply them in their teaching as well as in other aspects of their teaching. At the stage of transformation the focus changes from being centred on the teacher. The integration of ICT takes

a new phase where the process of integrating ICT tools is no longer manipulated by the teacher. Teachers cease to be drivers and repositories of ICT related knowledge. Learners are actively involved in the ICT activities and teachers assist and guide their learners during the process of constructing knowledge. Collaborative skills are developed. Learners work as groups in solving real life problems. They also work with other learning groups from other places using communicating tools by accessing resources on the Internet. Because of the change in learning style, teachers change their assessment strategies (UNESCO 2003).

Using a slightly different conceptual framework, Yuen, Law and Wong (2003) suggested three models of ICT integration:

1. *Technological adoption;*,
2. *Catalytic integration;* and
3. *Cultural innovation*.

Technological adoption model: At this stage the school looks at the adoption of technological infrastructure, formulating organisational structure and teacher technical skills. The teachers' concern is to be able to use computer effectively for the production of documents that can help them in presentation and evaluation of their lessons. At this stage the management is actively involved in the facilitation of technology adoption by teachers. They set targets and timetable for achieving specific ICT competencies. It is mentioned that at this stage the key element is to enhance teaching by stimulating learners interests with the use of multimedia in teaching. Learners' involvement is limited (Yuen, Law & Wong 2003), therefore technology adoption cannot be classified as a stage implementing effective integration of ICT, it is still a learning curve for knowledgeable teachers to help other teachers master computer skill and gain confidence.

Catalytic integration model: At this stage the integration of ICT is an integral part of both teaching and learning. ICT is integrated across all the LAs. Learners, as well as teachers explore the use of ICT in the teaching and learning process. Teachers are able to design activities that are problem based, task based and underpinned by a social constructivist approach. It is through interacting with problem based activities that learners get maximum control of their learning. The integration process is led by the school principal. S/he ensures that all teachers are able to

integrate ICT in their LAs. Teachers work in collaboration to achieve the outcomes of curriculum innovation (ibid)

Cultural innovation model: This model refers to schools where there is no conflict with infrastructure and teacher development. ICT is treated as part of the school mission and vision. There is multiple leadership style, which means that the principal does not bother much about monitoring the use of ICT as the teachers are free to use ICT according to their beliefs. This means they integrate ICT into the curriculum when they feel the use of the tool will benefit the lesson. Teachers do more than just integrating ICT in their teaching; they develop ICT packages that can be used by other school teachers. There are no formal teacher development sessions. Teachers empower one another in informal setting through information sharing. Learners are free to explore the use of ICT in different aspects of learning such as in extra curricular lessons (Yuen, Law & Wong 2003).

Looking at Yuen, Law & Wong's (2003) model, it would seem that their technological adoption model conflates the emerging and applying phases suggested by UNESCO (2003). The effectiveness of this approach is obscure since the phase does not specify how long the training of teachers will take before they start implementing ICT in their subjects. Figure 2.1 below illustrates how the models of Yuen, Law and Wong (2003) and UNESCO (2003) differ and indicates the stages that I propose to use in the analysis of the data in this study.

Table 2.3: UNESCO (2003) and Yuen, Law & Wong (2003)'s models and my proposed stages

UNESCO (2003)	**Yuen, Law & Wong (2003)**	**Proposed stages**
Emerging	Technology adoption	Emerging
Applying		Applying
Infusing	Catalytic	Infusing
Transforming		Transforming
	Cultural	Innovating

While UNESCO's model specifies that during emerging (the first level of integrating ICT) the number of computers received may not be enough for teachers to use them for their teaching ICT,

Yuen, Law and Wong's (2003) first phases of integrating ICT (Technological adoption) does not specify the number of computers that may be available at that stage, however it fuses the adoption of ICT infrastructure together with teachers' use of computers. From my point of view teachers may not be able to use ICT confidently when they are still in the process of being trained. Hence UNESCO separates the training of teachers from the use of computers. In my view the separation of teacher training from the use of computers seeks to ensure that teachers have sufficient time to acquire the relevant skills that are needed in the integration of ICT.

After technological adoption Yuen, Law and Wong's model conflates infusing and transforming levels by UNESCO, where both the teacher and the learner confidently explore the ICT. Thereafter Yuen, Law and Wong introduced a new stage where ICT forms the integral part of the school culture. In revisiting UNESCO' model I found that the last stage of Yuen, Law and Wong is not considered. I therefore proposed a new model based on UNESCO's model with the additional stage where ICT will form the integral part of the school culture, i.e. innovating stage. Therefore in my view the integration of ICT should take place in five levels: emerging, applying, infusing, transforming and innovating.

In the light of the above interpretations of "integrating ICT into the curriculum", I now examine what the previous research says about the integration of ICT in as far as teachers are concerned.

2.7 Previous research on the integration of ICT into the curriculum: Perception of teachers

It is notable that "teachers' perception of ICT in education are not only influenced by the discourse of official document and guidelines, but also their own experiences of using ICT for personal reasons within social and professional context in which the profile of access to ICT resources is fast-changing" (Loveless 2003:315). In addition to that "it is also notable that individuals' attitudes, confidence levels, cognitive and emotional styles, and social identities can influence their voluntary participation in the use of ICT" (Hennessy *et al*. 2007:162).

2.7.1 Perceived benefits of integrating ICT into the curriculum

Before discussing the benefits perceived by teachers in other studies, it is important to note that the benefits of integrating ICT into the curriculum only emerge where ICT is used effectively (National Council of Education Technology 1994 cited by Lee 2002; Selwood & Pilkington 2005). Becta (2005:26) argues that the benefits of integrating ICT into the curriculum are achievable by teachers who are confident and competent in using ICT.

Internet connectivity: Lee reported that the National Council for Educational Technology (NCET) stated a number of potential benefits, amongst those is access to richer source materials (Lee 2002). According to the studies conducted by Granger *et al.* (2002), Carnoy (2004) and Becta (2005) teachers are of the view that the Internet is a useful resource that can provide access to a number of materials relevant to the curriculum. In responding to Lankshear, Peters and Knobels' concern of "recognis[ing] the way academics understand and approach the Internet" (2000:20), Granger *et al.* mention that teachers used Internet for browsing readings, to interact with family and friends, on-the-job discussions, and collaboration with peers and /or students (2002:483). Internet provides learners an opportunity to participate in electronic projects that "facilitate a constructivist approach in which students work in teams on the design and building artifacts and complex systems, in a rich learning environment" (Barak 2005: 241). In Carnoy's study teachers from rural areas asserted the benefit of using email for collaborative teaching:

> "ICT system has made priority of connecting rural schools to the Internet and thereby integrating them more tightly into the larger educational system, and hooking them up to the outside world. Many school districts and almost all universities now communicate internally and externally largely through e-mail" (2004:5).

Even in the SITES Module 1, the use of email was found to be providing teachers an opportunity to communicate with peers from other schools within and/or outside the country (Howie *et al.* 2005:66).

Use of ICT Applications: The teachers from Howie *et al.*'s (2004) study indicated having perceived the integration of ICT as providing an opportunity for using ICT applications. These include:

- Simulations of natural or man-made systems
- Dynamic modelling and graphical modelling of mathematical functions
- Software for simple manipulation and statistical analysis
- Word processing /desktop publishing
- Spreadsheets
- Software supporting creative works (music /art)
- An interactive multimedia encyclopaedia on CD-ROM (2005:64).

Juxtaposing the opportunity of using ICT applications in the integration of ICT, Becta (2005) reported that teachers perceive subject specific software as playing an integral role in the integration of ICT in their LAs.

Improvement of administration and storage facility: Central to the benefits of using ICT applications is the improvement of administration for both teachers and school management. For managerial purposes, teachers use word processing and spreadsheets for designing school timetables, planning and finances. For general purposes word processing is used for organisation of school records, equipment and all clerical work (Selwood & Pilkington 2005). "Some schools are using specially prepared software packages that allow teachers and the school to measure student gains on tests" (Carnoy 2005:7) and for administering and storing student personnel data . This means in some schools computers became a permanent fixture in the schools offices (Carnoy 2005:5).

Reducing teacher workload: Excessive teacher workload has been a concern in the teaching profession. The use of ICT applications for administration purposes has the possibility to reduce teacher workload (Selwood & Pilkington 2005). However, this is only possible when teachers have access to adequate computers (Selwood & Pilkington 2005) and are able to use ICT effectively (Becta 2005). Effective use includes sharing responsibilities with other teachers from other schools within and outside the country. This reduces preparation time and releases time for teachers to engage with their learners (Selwood & Pilkington 2005).

***Transforming teaching**:* In the adoption of new technology, teachers view their roles as changing (Pearson & Naylor 2006). Teachers who use ICT most frequently seem to shift from the paradigm where they act as transmitters of knowledge to a paradigm where they act as co-constructers of knowledge (Lee 2002:8) and perceive ICT as a catalyst in transforming their teaching (Dede 2000). In Mumtaz's study it is highlighted that:

> "[teachers] perceive that their practices became more students centred […] the more extensively involved teachers were in professional activities, the more likely they were to have teaching philosophies compatible with constructivist learning theory" (2000:324).

This means ICT can act as a catalyst that changes teaching-learning process from that of being teacher-oriented to that of learner-oriented. Learners' roles change from being passive to being active "partners in developing learning experiences and generating knowledge, and then collaborative construction of meaning is enhanced" (Dede 2000:284). Teachers extend their roles from worksheet designers to web designers (Dede 2000).

***Development of skills**:* In addition to this, ICTs offers the potential for effective group work encourages cooperative learning practices, develops learners' talents and skills in marketing, sales, public speaking design, administration, entrepreneurship, writing and editing (Granger *et al*. 2002:5-6).

2.7.2 Perceived challenges of integration ICT into the curriculum

While the effective use of ICT contributes towards a number of benefits in the integration of ICT, teachers cannot be able to use ICT effectively if there are factors that hinder their pedagogical practices.

***Unavailable infrastructure*:** The integration of ICT depends on the availability of infrastructure. Hardware, software and buildings are the essential components of the implementation of ICT in the school curriculum. According to Granger *et al.* (2002) the lack of appropriate up-to-date equipment restrains the integration of ICT into the curriculum. Williams, Coles, Wilson,

Richardson & Tuson. assert that "access to technology tends to override all other factors in determining use" (2000:313).

***Hardware and Software*:** Veen argues that "without hardware and software there could not be any use of information technology at all" (1993:1). In support of this notion Granger *et al.* (2002) argue that one of the factors that inhibits the integration of ICT in schools is lack of appropriate and up-to-date materials. The unavailable equipment includes the lack of software that fits the subject knowledge (e.g. History knowledge) and the lack of technical support to ensure that day-to-day practices take place without being hindered by unreliable equipment (Veen 1993).

Buildings: It is without doubt that in any country ICT cannot exist without buildings. The study by Becta reveals that "buildings restrict the development of ICT, including the ability to site computers" (2005:10).

The lack of Internet access: Apart from subject specific software, it is Internet connectivity that has been perceived as hindering the process of ICT integration and includes where connectivity is not readily available or the Internet access is slow (Becta 2005). Teachers who have access to ICT mentioned bandwidth as problem in their access of Internet (Becta 2005). In the schools where there is no connectivity, the predominant constraint is the cost of Internet connectivity (Hodgkinson-Williams, Sieborger & Terzoli 2007).

Lack of ICT competent teacher and training: Often mentioned by a number of researchers, is the lack of ICT competent teachers who are able to integrate ICT comfortably with confidence (Hennessy *et al.* 2007; John 2005; Loveless 2003 and Lee 2002). Incompetence seems to lead to lack of confidence. According to Somekh "teachers need to be convinced of the value of ICT because many teachers tend to perceive themselves to be technologically incompetent and often feel deskilled and demoralised when they first begin to use computers in the classroom" (1997 cited by Lee 2002:5). Even computer literate teachers may not be in a position to use computers in their teaching. The major problem with using ICT in the teaching-learning process is the complexity of a key aspect of curriculum knowledge in ICT (Webb 2002:246). This means computer skills alone cannot help teachers with the integration of ICT in their teaching; further

training that entails how computers can be used together with curriculum knowledge is necessary. The knowledge acquired in such training can help the teacher to select appropriate representations for particular task and to be able to identify the problem that learners have with particular software (Webb 2002:246).

Insufficient training: Howie *et al*. (2004) argue that the incompetence of teachers is due to insufficient training they receive. Even in the event of ICT competent teachers, continuous staff development is necessary to ensure that teachers are coping with changing technologies (Howie *et al*. 2004). This means teachers should undergo some form of training before they are able to integrate ICT effectively in their teaching. However, there are teachers who resist change and this becomes a hindering factor in integrating ICT into teaching (Lee 2002).

Resistance to change and insufficient knowledge possessed by teachers: The teachers who resist change may be technophobics (Becta 2005) or may have a different perspective on why ICT are integrated in their teaching, or may fear the loss of authority (Granger *et al*. 2002). Mumtaz referred to this phobia "avoidance" because of teachers tend to "distance themselves from computers […] [or] sustain […] a very low level of interaction" (2000:320). Insufficient knowledge possessed by teachers may give rise to the reluctance of using ICT in teaching. Lee argues that:

> "for teachers to rethink and restructure teaching and learning, they must first learn enough about the relevant technologies to apply them in their professional work, and to translate them to their students as part of the integrated learning of the subject matter" (2002:5).

This means that teachers as the key drivers in the implementation of ICT, should be able to apply new technologies in their pedagogical practices to allow students to construct knowledge. It is argued that the resistance to change is due to insufficient knowledge possessed by teachers, e.g. teachers may lack the skills to use Internet effectively (Lee 2002). This resistance to change does not exclude school leadership. According to NCET (1994 cited by Mooij & Smeets: 2001) the attitude of school leadership is influential in the integration of ICT in the schools. School

leaders' "commitment and decisions are expected to be relevant to the ICT innovation processes" (Mooij & Smeets 2001:266).

The availability and accessibility of unfiltered or uncensored information: This is also viewed as inhibiting the integration of ICT. Because the Internet is unable to control who accesses what, when and where, it allows all kinds of information to be accessed by students as argued by Kerr:

> "The Net's beauty is that it is uncontrolled, […] its information by anyone, for anyone. There is a racist stuff, bigoted, hate-group stuff, filled with paranoia; bomb recipes; hot to engage in various kinds of crimes, electronic and otherwise; scams and swindles" (cited by Oppenheimer 1997:15).

Technical support: One of the important aspects to consider in integrating ICT in schools' curricula is that computers require maintenance. This cannot be done by every teacher. Carnoy found out that "even if teachers are familiar with ICT, additional technical support is needed to make ICT a tool for curricular change in the teaching-learning process" (2004: 9). He further recommends the appointment of full time technicians who will monitor and fix serious technical problems.

Insufficient funding: ICT and its components demand financial support. According to Howell , Lundall and Patrick (2000) the cost of ICTs in schools includes teacher training, additional advisory and technical staff, hardware, software, telecommunications infrastructure (e.g. phone lines) and content development. Mooij and Smeets (2001) argue that in order to achieve ICT goals the national authorities should make financial means available to schools.

Lack of appropriate ICT policies: The effectiveness of ICT integration needs guidelines on how the process will be followed from national down to school level. The reluctance of schools in designing their own policies is the most frequently mentioned inhibiting factor around the ICT policies. Teachers argue that it is impossible to integrate ICT when the school time-table does not integrate ICT access. Hennessy *et al.* argue that the fact that teachers have "little say in the designing and implementing development plan for using ICT within their schools" (2007:157) is

hindering the use of ICT in teachers practices since they are "highly politicized and do not attend to the culture of classroom practice and the pivotal role of the teacher in effecting change[..]" (Olson 2000 cited by Hennessy *et al*. 2007:157).

In response to the above "lack of appropriate ICT policies" I examine the ICT policies from developed countries to developing countries.

2.8 ICT Policies

Worldwide countries have developed policies for ICT integration into the curriculum. In UK the integration of ICT aims at supporting innovation in schools for improving effectiveness of schools and teachers in particular, by using ICT to reduce the burdens placed on teachers and to modernise delivery (UK Connecting schools and networking people 2002). The Canadian ICT policy "expects that the introduction of ICT in schools will improve the academic performance equity among students and ultimately, students' ability to use and apply technology and software in the jobs" (Corbett & Willms 2002:9).

In Africa there are number of countries that are using computers in specific non-governmental organisation (NGO) educational projects (Hodgkinson-Williams 2005:1), however "the development of well elaborated national policies on ICT education […] seems to be in the making" (Howie, Muller & Paterson 2005). In Southern African region ICT policies that seem to exist are very few, and even those that exist are vague to interpret and make little reference on how ICT implementation is to take place (Butcher 2001:5 cited by Howie, Muller & Paterson 2005: 4).

In South Africa the goal of the White Paper 7 on e-Education is to ensure 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 2004:17). The success of this goal depends on the adoption of the policy strategies by nine provinces of South African. According to Hodgkinson-Williams, "the Department of Education

in each province is responsible for adapting and implementing national policy to address specific provincial conditions" (2004:2). While other provinces have already made progress in implementing ICT in education, the Eastern Cape is presently busy putting e-Learning into perspective (N.MaAwu[2]. April 2007. e-Learning Workshop).

Even before the White Paper on e-Education(DoE 2004) was released, South African Technology policy document, the Revised National Curriculum Statement (RNCS) for the General Education and Training (GET) Band stated that ICT should be integrated across the eight Learning Areas (LA) (DoE 2003), while the National Curriculum Statement (NCS) for Further Education and Training Band extended the use of ICT by introducing two computer-related subjects (in which learning is directed to the development of specific ICT skill) namely: Computer Applications Technology (CAT) (previously known as Computyping) and Information Technology (previously known as Computer Studies) (DoE 2004).

Regarding computer hardware provision, the White Paper on e-Education reported that in 2004 the Eastern Cape was the lowest in the country, with 8.8% of schools with computers while the national average of schools with computers was 39.2%. In view that Eastern Cape is predominantly rural; it is unsurprising to have only 4.5% schools with computers using computers for teaching and learning. Table 2.4 illustrates how the number of computers in the Eastern Cape schools differs from other provinces

[2] N. MaAwu : e-Learning Specialist from the Provincial Office of the ECDoE

Table 2.4: Schools with computers in South Africa as per province (adopted from DoE 2004)

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%
Limpompo	13.3%	4.9%
North West	30.5%	33.9%
Western Cape	82.4%	56.8%
National	**39.2%**	**26.5%**

This then reveals that even though ICT integration is expected to increase effective learning strategies for all societies, inequality may still arise due to local backlogs. This means instead of narrowing education inequalities ICT may widen the gap between the societies; this is known as the "digital divide". As a country with different societies informed by the past education, how is South Africa addressing the digital divide? Before addressing this question I first discuss how other countries deal with the digital divide.

2.9 Digital divide

The digital divide (inequalities brought on by lack of ICT resources) may arise where the conditions are not favourable to the implementation of ICT. This includes where there is no access to ICT or where there are no ICT capable teachers. In countries such as (UK) the Government has set up a plan to address the digital divide that may arise in the absence of ICT in schools. This has been done to avoid social inequalities that may be perpetuated by the integration of ICT into the curriculum in certain schools. "It is argued that if individuals are excluded from ICT[s] they will be excluded from many benefits that ICT can bring" (Selwyn 2004:342). Wills (cited by Selwyn 2004:342-343) argues, "the very technology that has the

power to empower us all also has the potential to increase the problems of social exclusion unless we act to bridge the digital divide". Even in the technologically developed countries such as United State of America (USA) the digital divide is claimed to reinforce inequalities that "threatens to create an increasingly larger body of under educated and underserved Latinos, expanding social and economic stratification within the United States even further" (Warshauer, Knobel & Stone 2004:563).

Having noted that the digital divide exists in developed countries, there is no doubt that the developing countries such as South Africa are too faced with a digital divide amongst its social cultural groups. South Africa is one of the countries that have been experiencing inequalities amongst social groups in education. How is it going to respond to the digital divide that arises? The White Paper on e-Education indicates that a Presidential International Advisory Council (PIAC) on Information Society and Development (ISAD) was established to advise the Government on addressing the digital divide. The Department of Communications, the Electronic Communications and Transactions ACT (2002) also have an initiative in assisting the Department of Education (DoE) with electronic transactions. In addition to these the DoE has promised to invest in national initiatives to increase access, boost the capacity of managers, teachers and learners, and provide electronic, resources of the highest quality (DoE 2004: 10-11).

2.10. Summary

The integration of ICT into the curriculum is underpinned by various explicit and implicit theories. Many countries have already made attempts to integrate ICT into the curriculum. The research studies conducted in these countries have established to some extent how teachers perceived the integration of ICT into the curriculum. According to teachers' perceptions, the integration of ICT has both benefits and challenges. Different models are proposed on how to integrate ICT into the curriculum. According to the proposed models, the integration of ICT requires not only computer literate teachers, but teachers with computer knowledge that can help them choose appropriate educational software and to be able to assist learners with the use of software without wasting teaching time. In the event of insufficient ICT knowledge, the integration of ICT poses a challenge to teachers. In addition to this, it is noted that insufficient computer hardware is one of the major stumbling blocks in integrating ICT into the curriculum.

The challenges raised by teachers can inform policy makers on how best the integration of ICT can be facilitated in schools. The digital divide is highlighted as a factor that is noted by policy makers, especially in a developing country such as South Africa where policy makers seem to consider the use of ICTs within the curriculum as a way of minimising inequalities in education rather than perpetuation them.

While recognising the effort made by policy makers, it is important to note that the key role in the integration of ICT remains with the teacher. This means the success of ICT integration depend to the teachers' capabilities. Their capabilities, including their ability and willingness, influence how they perceive ICT integration.

This then trigged my interest to find out how the teachers of the Grahamstown circuit perceive the integration of ICT into the curriculum. Hence I conducted a research study which is outlined in the next chapter.

Chapter 3

Research Design

"Qualitative and quantitative are not distinct, yet in many social science quantitative orientations are often given respect. This may reflect the tendency of the general public to regard science as related to numbers and precision. It is not the purpose of this text to argue against quantitative procedures. Instead, it demonstrates the fruitfulness and often the depth of understanding [...] derive[d] from qualitative procedures"

(Dabbs (1982) cited by Berg 1998:2)

3.1 Introduction

Research design provides details of how a research process is conducted. This chapter describes these processes starting with the research orientation that informed my study; the nature of reality, the conception of knowledge and the selection of the methodology which guided my study and helped to maintain coherence throughout the study. The aim of the study is achieved through addressing the research questions. The research sites are clearly described to inform the reader about the specific environment in which the data was collected and includes a description of the participants; how they were selected; and how they were involved in the study. The chapter then explains the method, tools and techniques of collecting data. The process of collecting data is linked to a discussion of the measures adopted to ensure the quality of data collected. Following this is a discussion of the ethical issues, which describes the process of involvement of participants in the study and of how participants were respected throughout the research process. The chapter ends by discussing how the data was analysed; including the methods of analysing data and the tools used.

3.2 Research orientation

My study was informed by the interpretive paradigm (Terre Blanche & Durrheim 1999). According to Terre Blanche and Durrheim (1999:6) "paradigms are all-encompassing systems of interrelated practice and thinking that define for researchers the nature of their enquiry along

three dimensions: ontology [that] specifies the nature of reality that is to be studied and what can be known about it; epistemology [that] specifies the nature of the relationship between the researcher (knower) and what can be known; … methodology [that] specifies how the researcher may go about practically studying whatever he or she believes can be known". The interpretive paradigm in particular "seeks to understand the meanings which people give to their own social interactions" (Winberg 1997:106). The purpose of interpretive research is to "advance knowledge by describing and interpreting the phenomena of the world in [an attempt] to get shared meanings with others" (Bassey 1999:44). Furthermore Bassey maintains that "interpretation is a search for deep perspectives on particular events and for theoretical insights. It may offer possibilities, but not certainties, as to the outcome of future events" (1999:44).

In order to obtain these "shared meanings" the interpretive researcher uses methodologies such as interviewing and participant observation "that rely on a subjective relationship between researcher and subject" (Terre Blanche & Durrheim 1999:6). As Pring notes: "To understand particular events one must see things from the point of view of the participants or of the people who are involved – how they interpret events and thereby constitute those events of a certain sort" (2005:98).

Terre Blanche and Durrheim (1999) use the concept of "design coherence" to describe the appropriate fit between the paradigm, ontology, epistemology and methodology. This study attempts to attain "design coherence" by using the interpretive paradigm to inform the choice of methods (self-completion questionnaires, semi-structured interviews and a researcher's journal) and the choice of the inductive approach to the analysis of both qualitative and quantitative data.

3.3 Research aim and research questions

3.3.1 Research aim

The study seeks to establish whether secondary school teachers in the Grahamstown Circuit integrate ICT into the curriculum and if so, how they integrate ICT into the curriculum and how they cope with the challenges of integrating ICT into the curriculum.

3.3.2 Research questions

The major question that framed this study was:

- To what extent do teachers in the secondary schools of the Grahamstown Circuit integrate ICT into the school curriculum?

The subsidiary questions posed to address the major question were:

- What access do teachers have to computers?
- What software are teachers able to use?
- What type of training (if any) have teachers received in computer literacy and in integrating ICT into the school curriculum?
- How do teachers use computers at schools?
- What are teachers' perceptions of the benefits of using computers at school, including integrating ICT into the curriculum?
- What are the teachers' perceptions of the challenges encountered in integrating ICT into the curriculum?

3.4 Research environment and sites

As the South African Department of Education (DoE 2003) is seeking to bridge the gaps that existed prior to 1994, my study will report on 9 of the 10 public secondary schools in Grahamstown according to the categories determined by the previous government.

1. Former Department of Education and Training (FDET) Schools: These schools were run by the Department of Education and Training (DET), the structure that was voted in 1979 to take charge of black schools (Hartshorne 1992). Although the purpose of the DET was to improve black school conditions; the intentions were not to bring them to the same level as schools that served the needs of white, Indian or so-called Coloured learners. Hence these schools were commonly known as underprivileged schools. Under the new dispensation, these FDET schools are treated as public schools alongside all other public schools. Although FDET schools have learners from the same background as FHOR schools (discussed below), their learners are from the poorest areas and parents generally cannot afford to pay school fees, even though the school requests a minimal amount in

terms of school fees. This means that the FDET schools are completely dependent on the government or donor agencies to provide resources such as computers.

2. Former House of Representative Schools (FHOR): These were coloured schools that received better services from the government than the DET schools during the previous dispensation; but now they also belong to the same public schools category. FHOR schools now serve the needs of learners from coloured and black areas that are generally quite poor. The fees are determined according to what parents can afford, which is far less than what Former Model C school parents can pay. This leaves the FHOR schools with limited funds to acquire additional resources.
3. Former Model C (FMC) schools: Due to apartheid government policies that aimed to divide and segregate according to a hierarchy of power; these schools were prioritised in terms of financing, resources and quality (Hartshorne 1992). While the FMC schools are now treated equally to other government schools, they have a historical advantage in terms of resources. In addition, the learners who now attend these schools are socio-economically privileged, irrespective of the race group to which they belong. The ability of the parents or guardians of these learners to pay school fees on a regular basis has enabled the FMC schools to employ additional teachers and to acquire additional resources, such as computers.

My expectations were that FMC schools might have had computers even before 1994; but what was not clear was how the computers were being used for teaching and learning. In FHOR and FDET schools I doubted that there were computers before 1994. Even if schools had received computers after 1994; I assumed that they were used as resources for administration only; not for teaching and learning.

3.5 Research participants

This study formed part of a larger project funded by the National Research Foundation (NRF) which focused on the computer infrastructure at all secondary schools in Grahamstown (Brandt 2006) as well as the perceptions of the learners (Mbane 2007 forthcoming) and teachers on integrating ICT into the curriculum. My study formed part of the latter.

Ten secondary schools of Grahamstown circuit were invited to participate in the study, but one FDET school did not respond to the call. The nine participating secondary schools comprise: three FMC schools; one FHOR school and five FDET schools. Rather than use the names of the schools, the names of the schools were arranged alphabetically, grouped into their school categories; (e.g. FDET) and then awarded a number (e.g. FDET 1). Initially I invited 45 teachers, five teachers from each school considering the learning areas taught at the GET band and FET band. Teachers teaching Mathematics, Natural Sciences, Social Sciences, Languages and CAT were expected to complete the questionnaires, however some of the teachers did not respond to the call and I ended up with 38 participants. The questionnaires from the FDET, FHOR and FMC schools were completed by teachers ranging from the age of 23 to 60 years. Of the 38 questionnaires distributed 22 (57%) questionnaires were completed by male teachers and almost 40% of the questionnaires were completed by teachers within the age group of 30- 39 (Table 3.1).

Table 3.1: Age and gender analysis of questionnaire respondents

Ages	**23-29**	**30- 39**	**40 -49**	**50-59**	**60+**	***Total number of questionnaires***
Number of questionnaires completed	3	15 (39%)	11	9	0	38
Number of males	2	9	6	5	0	22 (57%)
Number of females	1	6	5	4	0	16

Because I wanted comparable data I requested that participating teachers should be teaching the same learning areas (LA's) in each of the sites; for example all schools were requested to have one of the Mathematics teachers complete the questionnaires. In some cases the sites could not honour this request as some LA's were not represented and as such there is irregularity when it comes to the number of questionnaires completed per LA. Table 3.2 below illustrates the LA's represented and the number of questionnaires that were finally completed.

Table 3 2: LA'S represented and number of questionnaires completed

Learning Area	Number of questionnaires Sent
Mathematics	9
Social Sciences	3
Natural Sciences	9
Languages	8
CAT	7
Economics and Management Sciences	1
Life Orientation	1
Total number of questionnaires	38

Although Life Orientation (LO) and Economics and Management Sciences (EMS) teachers were not invited to participate in the research, one LO teacher from one of the FMC schools and one EMS teacher from one of the FDET schools showed interest by completing the questionnaires.

3.6 Research methods, tools and techniques

3.6.1 Research method: case study

Yin (1993: 13) defines a case study as "an empirical inquiry that investigates a contemporary phenomenon within its real – life context, especially when the boundaries between phenomenon and context are not clearly evident". He further elaborates upon the reason for using a case study and suggests that "you would use the case study method because you deliberately wanted to cover contextual conditions –believing that they might be pertinent to your phenomenon of the study" (Yin 2002: 13). The case study method was adopted in this study to investigate the phenomenon within the different contexts of the three types of public/government schools.

I used an interpretive approach because I wanted to focus on the lived experiences of teachers, and because "interpretive case studies [...] contain rich thick description" (Merriam 2001:38). Because the research involved a number of different sites it was considered to be a multiple case study (Yin 2002).

3.6.2 Data collecting tools and techniques

Because I anticipated collecting large amounts of data I opted for a survey. A survey is defined as "the use of mailed, self administered questionnaires and interviews to gather large amounts of data on a topic from large number of people" (Hart 1998: 327).

In my study I used self administered questionnaires and semi-structured interviews. Although observations are commonly used by most researchers who conduct their studies through case studies, I have not used them due to the fact that I had quite a large number of sites to observe (Pring: 2005). Instead of using observations I made use of a journal to capture some points during the interviews. This procedure of using multiple tools in qualitative research is called triangulation (see 3.8 on validity).

3.6.2.1 Questionnaires

Hart (1998:357) defines questionnaires as "a series of structured questions which address a specific topic or issue and are used as the basis of the survey approach". In my study questionnaires were used to find out 'what' teachers know about ICT, 'why' they use ICT, and 'how' they use it. Even though the study did not focus on age and gender *per se*, such questions were asked to enrich the study.

This process was preceded by deep engagement in designing questions that were relevant to the aim of the study and able to provide sufficient data for me to be able to analyse and provide thick descriptions of the sites studied. Open-ended and closed questions were used as technique for collecting data. Six of the questions in the questionnaires were open–ended, nine questions had predefined options and three questions were closed questions (see Appendix A). The purpose of having predefined options for selection was to prompt the participants about particular issues and to keep them willing to participate through out the completion of the questionnaire by making the questionnaire fairly easy to complete. Additionally providing predefined options also helped during the coding process (see Appendix A question 8) allowing for a quasi-statistical style with predetermined categories (see 3.10).

Because the participants and I may have different perceptions, their responses to the questionnaires highlighted issues that I needed to clarify during the follow-up interviews.

3.6.2.2 Interviews

Merriam (2001:71) defines interviews as a "person to person [conversation] in which one person [researcher] elicits information from another". The purpose of interview is "to find out what is in and on someone else's mind" (Patton 2001:278). According to Merriam (2002:12-13) "interviews range from highly structured, where specific questions and the order in which they are asked are determined ahead of time, to unstructured interviews ,where one has a topic to explore, but neither the questions nor the order are predetermined".

In my study the interviews I used fell in between the two, namely semi-structured interviews. Because I used interviews guided by the case study method my questions were fluid not rigid (Yin 2002). In semi-structured interviews one has to be flexible enough to move from structured questions to unstructured questions guided by the responses of the participants.

Interviews were arranged with the first school to return the questionnaires. Thorough analysis of the responses provided in the questionnaires was done to prepare questions for the interviews. I did this to guide my focus; however I had to change some questions and follow the direction set by the interviewees. This meant during the interview session, I had to be analytic and attentive in order to probe in-depth what the interviewees were saying (Yin 1993). During the interviews a tape recorder was used for recording conversations. The subsequent transcribing process had two phases. Firstly I used a notebook to transcribe what has been recorded and later word processed the hand written notes. Additional clarification of data was obtained through the member checking process when the interviewees had to verify that the data transcribed was an accurate reflection of what they said during the interviews. Interviewees were also invited to add comments to the transcript if they wanted to include other comments not elicited during the interview. This process is discussed further under validity.

3.6.2.3 Journal

Bogdan and Taylor (1998:115) say "it is a good idea to maintain a detailed journal during your interviewing". Bogdan and Taylor (1998) mentioned two purposes of using journal; firstly they

say "journals should contain an outline of topics discussed in each interview. […] Second, the journal takes place of observer's comments recorded in participant observation field notes. Like the observer, you should make note of emerging themes, interpretations, hunches, and striking gestures and non verbal expression essential to understanding the meaning of a person's world" (Bogdan & Taylor 1998:115). In my study the journal was used for the second purpose. I made notes during interviews, especially about my hunches and the interviewees' gestures. This helped me to expand upon the teachers' attitudes and how they value the integration of ICT into the curriculum. The journal notes helped me to analyse what is said during the interview process which added depth to the interview analysis. I followed Holstein and Gubruim (1995:98 cited by Bogdan and Taylor 1998:115) recommendation that "the interviewer act as an ethnographer of the interview, who records for future analysis not only what is said but the related interaction details of how interviews was accomplished."

3.7 Validity

Schwandt (1997:168) defines validity as "a property of a statement, argument, or producer. To call [something] "valid" is to indicate that it is sound, cogent, well grounded, justifiable, or logically correct". Because researchers work within different paradigms, the criteria used to establish validity within studies differ. In quantitative studies "researchers normally use tried and tested measures, experimental arrangements and statistical techniques to ensure that accurate conclusions can be drawn from the research results" (Terre Blanche & Durrheim 1999:62). Contrary to this "validity in qualitative research has to do with description and explanation and whether or not the explanation fits the description. In addition, qualitative researchers do not claim that there is only one way of interpreting event. There is no one correct interpretation" (Denzin & Lincoln 2003:69). The validity process in this study is informed by an interpretive paradigm; hence criteria used are alternative to those used in quantitative "positivist" paradigm techniques.

In qualitative research trustworthiness is used as criteria parallel to conventional (positivist) research (Guba & Lincoln 1985). Trustworthiness criteria are "for judging adequacy (goodness, quality)" (Guba & Lincoln 1989:233) within analysed data that the researcher has collected in his

or her investigation. The techniques within trustworthiness criteria are credibility, transferability, confirmability, and dependability.

Van Ryneveld (2004:119) describes credibility "as the soundness of the research conclusions, and the production of findings that are convincing and plausible." Terre -Blanche and Durrheim (1999:63) elaborate further by saying that "credibility of research is established while the research is being undertaken. The researcher continually looks for discrepant evidence to the hypotheses she or he is developing as a means of producing a rich and credible account". Guba and Lincoln (1985) argue that credibility can be achieved through triangulation, peer debriefing and member checks. In this study triangulation (that is the use of questionnaires, interviews and a journal) was used to ensure the credibility of data produced. Triangulation means "to look at something from several angles [rather] than to look at it in only one way" (Neuman 2000:124).

I used direct [triangulation] and indirect [credibility] ways to ensure dependability of the research findings (Rossouw 2003: 183). Terre Blanche and Durrheim (1999:64) say that "Dependability refers to the degree to which the reader can be convinced that the findings did indeed occur as the researcher says they did." In order to produce a dependable study, I ensured that the description of my study shows how certain opinions are rooted in and developed out of contextual interaction by using the exact quotes from the interviewed teachers and elaborated upon what was said (Terre Blanche & Durrheim 1999).

According to Terre Blanche and Durrheim (1999:63) "transferability is achieved by producing detailed and rich description of context. These give readers detailed accounts of structures of meaning which develops in a specific context". Guba and Lincoln (1985: 124) claim that "the degree of transferability is a direct function of the similarity between the two contexts, what we shall call "fittingness". Fittingness is defined as a degree of congruency between sending and receiving contexts. If context A and context B are "sufficiently" congruent, then working hypotheses from the sending originating context may be applicable in the receiving context". Because the study described integration of ICT into the curriculum in different contexts; a thick rich description of data was produced.

Because subjectivity is acknowledged as being part of qualitative research, confirmability is used as a technique to avoid subjectivity (Denzin & Lincoln 2003). "Confirmability, is concerned with assuring that data, interpretations, and outcomes of inquires are rooted in context and person apart from the evaluation and are not simply figments of the evaluator's imaginations" (Denzin & Lincoln 2003:243).

Since this study started with questionnaire survey; I conducted follow-up interviews through face to face conversation with participants to seek more clarity, in-depth understanding, and confirmation and elaboration of the data presented in questionnaires. This was done also to ensure that the study produced sound conclusions from the data collected.

Guba and Lincoln (1989:238-239) describe member checks as "process [es] of testing hypotheses, data, preliminary categories, and interpretations with members of the stake holding groups from whom the original constructions were collected". In other words member-checks "ought to be dedicated to verifying that the construction collected are those that have been offered by respondents" (Guba & Lincoln 1989:241). Participants were allowed to make additions and corrections on what was presented in the form of transcripts to him/her. It is through that process that I was able to produce rich thick description of data on the investigated area. It is through this thick description of data that transferability and dependability of data collected started to emerge showing trustworthiness of the study.

3.8 Ethical Issues

Because the study was done as part of a bigger project funded by the NRF which constituted three sub- projects; there was one consent letter (see Appendix B) that was written by the three research students to all school principals to invite them to participate in the project. The letter described the entire project and explained who was responsible for which particular area of the project. In the letter I was described as a researcher who had an interest in the teachers' perceptions. The letters were then divided amongst the three researchers for delivery purposes. The letters were hand delivered to the school principals. Hand-delivery provides the participant an opportunity to read the letter in the presence of the researcher and be able to seek clarity immediately.

For follow-up interviews arrangements were made directly with the participants involved. The interview process was explained explicitly to the interviewees prior to the commencement of the interviews. The purpose was to obtain agreement with the interviewee on whatever was to be covered during interview process; which included the use of a tape recorder. Consent forms were then completed before the interview process by each participant (Appendix C). Transcripts were sent back to interviewee for member checking (Appendix D).

3.9 Data collection process

The tools mention in 3.6 were used to collect data, however the process of collecting data does not end there. There are also areas of great importance that not discussed under the tools of collecting data. These include piloting and debriefing.

3.9.1 Piloting

Before distributing the questionnaire to all the schools, a pilot study was undertaken at one FDET school. A pilot case study "serve[s] some of the functions as prior research, but [… focuses] more precisely on your own concerns" (Maxwell:2005: 56). In my case I used the pilot study to help me refine my data collection plans. I chose one of the FDET schools to pilot my study. The reason for the choice of the specific FDET school was made due to the assumption that there was regular usage of computers by teachers for both personal use and for teaching and learning. The piloting process started in May 2004 with a consent letter followed by questionnaires.

Table 3.3. Piloting process

School	Activity 1	Activity 2	Activity 3	Activity 4	Activity 5
FDET 3	Letter and questionnaire distribution	Collection of questionnaires & Debriefing	Re-distribution of questionnaires	Interviews	Member check
DATES	6 May 2004	May 2004	May 2004	9 June 2004	14 June 2004

3.9.2 Debriefing

Debriefing means sitting and trying to understand the information collected. Subsequent to the piloting phase was the debriefing phase which helped me to find out whether the questions posed

were suitable for achieving the goal of the study and also to ensure that the questions asked could be answered by teachers from the different categories of schools. Debriefing was also done after each and every return of questionnaires in preparation for follow–up face-to-face interviews. During each debriefing I examined the responses of participants to the questionnaires. I also used debriefing after interviews to keep interacting with my data which helped me to familiarise myself with the data in preparation for data analysis (Merriam 2002). Debriefing was also part of the activities that took place during data collection process. Data collection process proceeded as tabulated in Table 3.4 below.

Table 3.4 Activities

School	Questionnaire Distribution &collection	Debriefing	Interviews	Member check
FDET 1	18-28 June 2004	28 June -1 July 2004	4 November 2004	11 November 2004
FDET 2	No response	No response	No response	No response
FDET 3	See table 3.3	See table 3.3	See table 3.3	See table 3.3
FDET 4	18 June – 24 July 2004	25 – 28 July 2004	17 November 2004	19 November 2004
FDET 5	26 June – 31 July 2005	01 August 2005	22 February 2006	25 February 2006
FDET 6	20 – 22 June 2004	23 June 2004	14 March 2005	20 March 2004
FHOR	18 June–23 July 2004	26 July 2004	18 August 2004	25 August 2004
FMC 1	20 – 28 June 2004	June 2004	23 November 2004	28 January 2005
FMC 2	16 – 20 August 2004	10-12 September 2004	20 September 2004	24 September 2004
FMC 3	16 -22 August 2004	26 August 2004	21 September 2004	28 September 2004

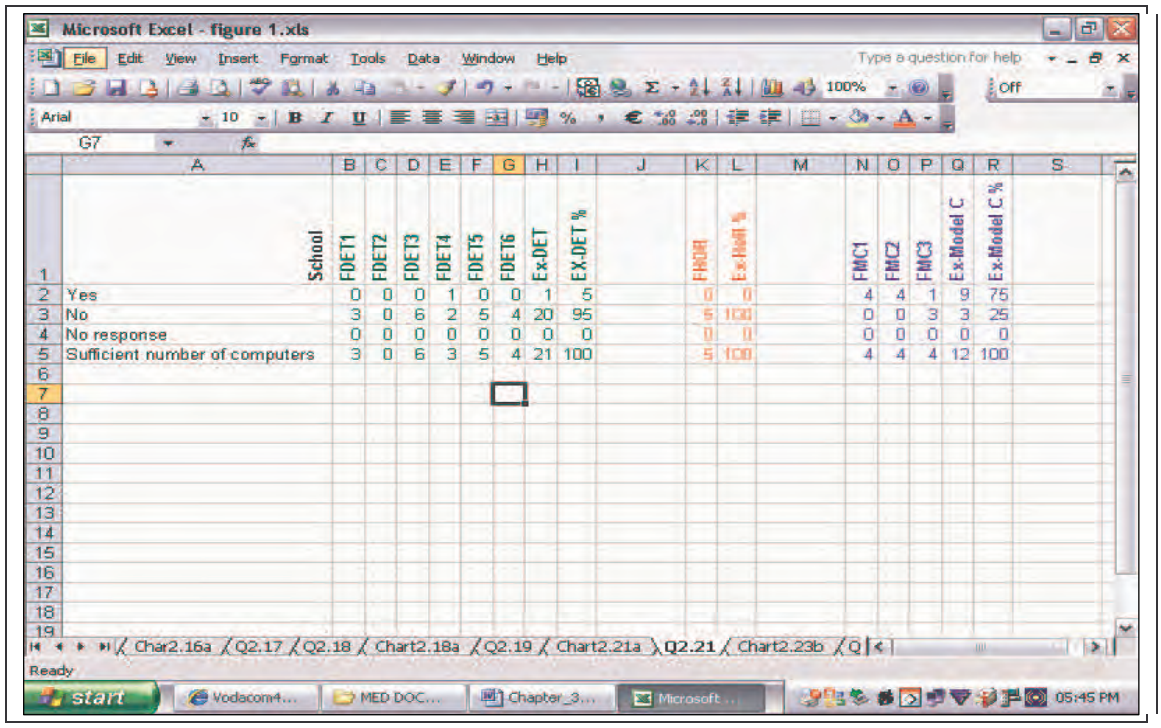
3.10 Data analysis

The different tools used to collect data informed my data analysis approach. Because I started collecting data using questionnaires, I analysed the questionnaire data before analysing the

interviews. Data analysis started by categorising and coding questionnaires. A quasi-statistical style was used for categorising and coding data. "Quasi-statistical style involves using predetermined categories and codes that are applied to the data in a mechanistic way to yield quantifiable indices" (Terre Blanche & Durrheim 1998: 140).

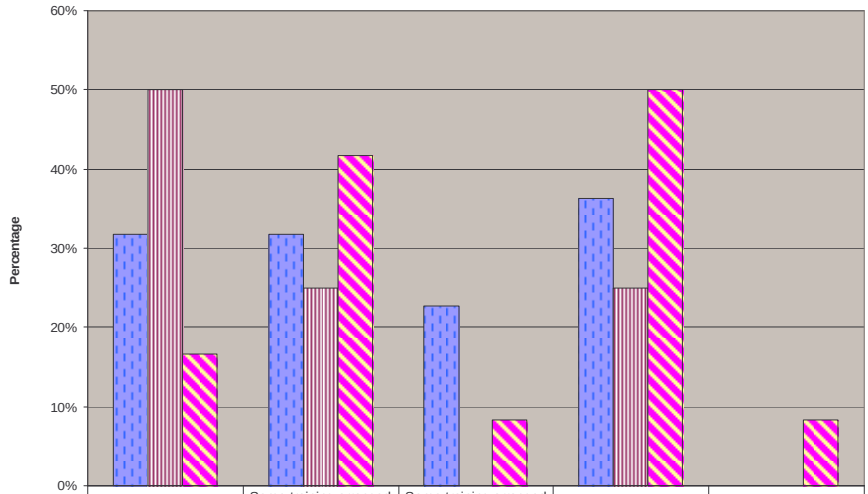
MS Excel was used to analyse data from the questionnaire and to plot graphs according to what transpired in the findings. This means that from *MS Excel* I used a worksheet to analyse data and a chart to plot graphs. Figure 3.1 shows how *MS Excel* was used.

Figure 3.1 Example of *Ms Excel* sheet used to analyse questionnaire data



When analysing the questionnaire data I was guided by the nature of the question. Closed questions usually yielded quantitative data so my interpretation of data was informed by the number of comments per school category, which in most cases I converted into percentages. I then consolidated the data from the three school categories by comparing and contrasting the findings. Most of these findings are presented in graphs such as the one in Figure 3.2.

Figure 3.2 Example of the final product of quantitative data



	Not at all	Some training arranged by the school	Some training arranged by DoE	Through my own studies	From family and friends
FDET	32%	32%	23%	36%	0%
FHOR	50%	25%	0%	25%	0%
FMC	17%	42%	8%	50%	8%

After the completion of the questionnaires I followed the inductive approach throughout the interview process. Because inductive analysis begins with specific observations and builds towards general patterns, I wrote down my observations during the interview period to analyse the situation. The observations that I made during interviews helped me to develop empathy and understanding of position of the interviewee. "Empathy develops from personal contact with people interviewed and observed during field work. Empathy involves being able to take and understand the stance, position, feelings, experiences, and worldview of others" (Patton 2001:52). As discussed in 3.6.2.3, I did not just listen to the interviewee, I observed him/her taking note of gestures and facial expressions. This exercise assisted me in interpreting what the interviewee could not express in words but rather displayed in gestures. I used a journal notebook to summarise and analyse every situation at each school immediately after the interviews, therefore I started the analyses process before transcribing the data captured during interviews. It is argued that "analysis should not be seen as a separate phase that starts only after all data has been collected; rather the different phase shade into each other" (Terre Blanche & Durrheim 1998:154).

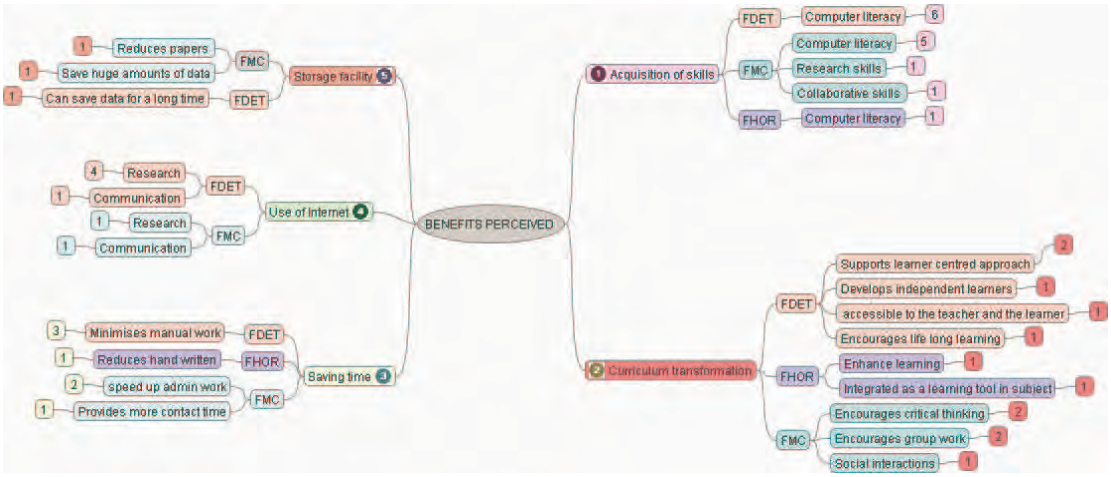
Open-ended questions were asked during interviews. After each and every interview I transcribed the tape. It was through listening to the tape, writing and later transferring what has

been hand written to word processing that I familiarised myself with my data I had to analyse. This then allowed me to understand patterns that existed in the phenomenon that I investigated (Terre Blanche & Durrheim 1998). When I started the analysis process I used *Freemind* mindmapping software (http://freemind.sourceforge.net/wiki/index.php/Main_Page). *Freemind* is a free mind mapping software package written in Java. I mainly used *Freemind* map to group my interview data into various emerging themes. I first analysed the data from each school using one *Freemind* map for each school category. Figure 3.3 below is an example of a *Freemind* map that was used for interpreting data from FDET schools.

Figure 3.3 Example of the freemind map

I then re-grouped the data from the three categories of schools; in doing so the themes emerged that helped me to consolidate my analyses. In some cases only two school categories would give response under the specified theme. In that situation the Freemind map would also reflect the school category with relevant response. Figure 3.4 illustrates the *Freemind* map with consolidated data.

Figure 3.4 Consolidated data from the three categories of schools



This exercise (inductive analysis) helped me to produce a thick description which is presented in the next chapter.

3.11 Summary

In summary, the study followed an interpretive paradigm within which I was able to use a case study method as a research approach. I opted for the use of a questionnaire survey and interviews as the key research tools to ensure design coherence within the study. A subsidiary tool was the research journal. The aim of the study was guided through following a set of subsidiary questions derived from the major question. The research sites ranged from the well resourced schools to poorly resourced schools. Participants were informed about the study through the letters written to school principals and direct communication made prior to the interviews.

Piloting of the study was done in one of FDET schools with the purpose of gaining insight to the questionnaire design and suitability for all school categories. Questionnaires were distributed concurrently to the other secondary schools after the pilot study. Debriefing was undertaken to start identifying gaps that arose from the completion of questionnaires and to prepare for follow-up interviews. Transcripts of the interviews were typed into *MS Word* and sent back to the interviewees for member checking. Quasi-statistical analysis was used to categorise quantitative data and *MS Excel* used for categorising data and the plotting of graphs.

Freemind mindmapping software was used to analyse qualitative data captured during interviews. Inductive analysis helped in producing a thick description of each site. Observations made during interviews and written up in the journal helped me to understand the situation from the position of the interviewee and I started getting closer to the data by writing journal notes after each and every interview.

The next chapter describes the findings of the study.

Chapter 4

Findings

4.1 Introduction

In this chapter I present the findings of teachers' perceptions of the use of ICT in the curriculum from the five FDET schools, the FHOR school and the three FMC schools. I explore the data collected under the following topics: teachers' access to computers; teachers' computer training; software used by teachers; teachers' use of computers; teachers' perceptions of the benefits of using computers; teachers' perceptions of challenges of using computers as guided by my research questions (from the survey and the semi-structured interviews).

Survey data was collected in the form of questionnaire; however question one of the subsidiary questions was answered through the use of data on teacher's access to computers that was collected in a separate survey conducted by Brandt (2006) who conducted her research in the same secondary schools during the same period (2004-2005). Semi-structured interviews were used to probe in depth what was not clear from the questionnaire.

The journal notes are used to clarify and interpret the information that could not be captured on tape during the interviews. This information will be presented as my observations during the semi-structured interviews. I elaborate upon the extent of the integration of ICT into the curriculum, deducing my discussion from the findings. Under each topic I compare and contrast the findings of the three categories of schools. It is important to note that the number of responses gathered during the questionnaire survey (38), exceeds the number of responses gathered during the semi-structured interviews (21). Table 4.1 illustrates the responses per school category for both the questionnaires and the semi-structured interviews.

Table 4.1: Response rate

Tool used	**FDET Schools**	**FHOR School**	**FMC Schools**	**TOTAL**
No of Questionnaires completed	22	4	12	38
No of teachers interviewed	13	1	7	21

4.2 Teachers' access to computers

In examining teachers' perceptions of the integration of ICT into the curriculum, it was necessary to first establish whether teachers have access to computers. This section assisted me with the interpretation of teachers' responses throughout the findings. Table 4.2 below illustrates the number of computers per school for FDET schools, FHOR school and FMC schools.

Table 4.2 Number of computers at each school

Number of computers	0-10	11-20	21-30	31-100	Physically Present	Working computers
FDET 1	x				5	5
FDET 3		x			36	16
FDET 4	x				14	9
FDET 5	x				5	1
FDET 6	x				1	1
FHOR	x					8
FMC 1				x		55
FMC 2				x		33
FMC 3				x		62

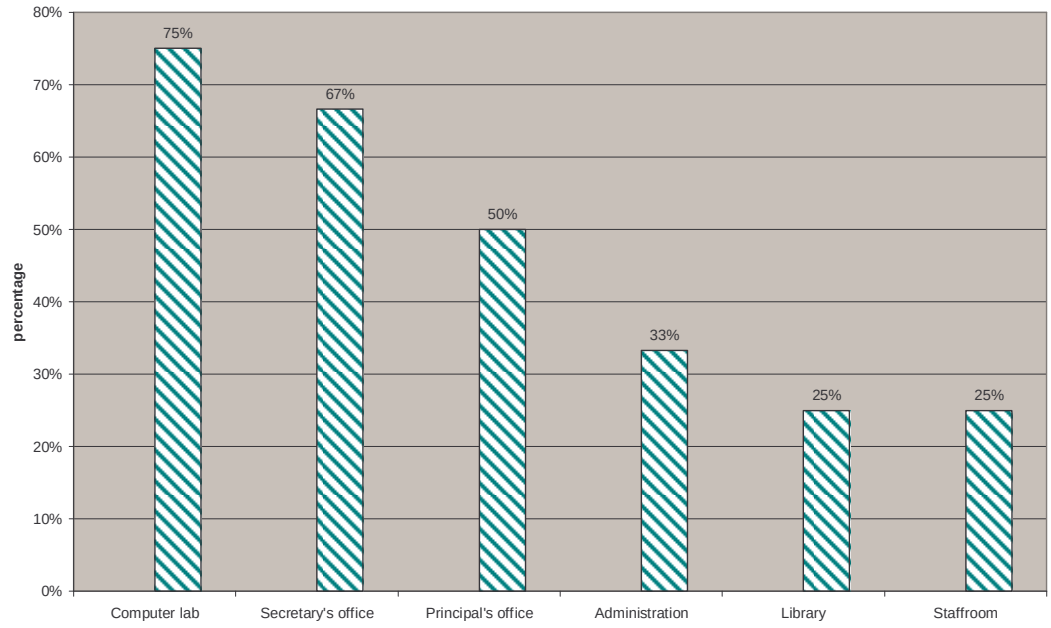
Adapted from Brandt (2006:75)

All FMC schools had above 30 computers with the highest number being 62 computers from FMC 3 school. The highest number of computers in the FDET schools is 16 (FDET 3) and two of the FDET (5&6) schools had only one computer each. FHOR had only eight computers at the

time of the survey. This means that teachers from the FMC schools had better access to computers than the teachers from all FDET schools or the FHOR school.

In establishing how these computers were distributed across all secondary schools, I used Brandt's overall illustration which captured the percentages of computers found in computer labs, secretarys' offices, principals' offices, administrative offices, libraries and staffrooms. Figure 4.1 below illustrates how these computers were distributed across the three school categories.

Figure 4.1 Distribution of computers across the three categories of school



(Adapted from Brandt 2006 :76)

The findings revealed that 75 % of the computers are placed in the computer labs. Sixty seven percent of the computers found in the three school categories are placed in the secretary's office. The findings highlighted that half of the principals' offices do not have computers while the other half (50%) have computers. Thirty three percent of the computers are placed in the administration offices, 25% in the libraries and an equivalent percentage (25%) of the computers are placed in the staffrooms.

4.3 Teachers' computer training

I have identified two forms of training mentioned by teachers that they need in order to integrate ICT into the curriculum: computer literacy training (responses to question 9 (Q9)) [see Appendix A]; and training to use computers within the curriculum (responses to question 10 (Q10)). Because I anticipated that there might be teachers who may not have undergone any kind of training, both questions included a "none at all" option for them to indicate the absence of training.

4.3.1 Computer literacy training

Q9 of the questionnaire required teachers to indicate whether they had received computer literacy training. The questionnaire provided categories of possible training that teachers might have undergone, including training arranged by the school, arranged by DoE, undertaken through their own studies and/or through family and friends. Table 4.3 provides the detailed illustration of the findings of computer literacy training received by the teachers from the three categories of schools. It is important to note that two teachers did not respond to the question even though it had different categories of possible training from which could choose. This means of the 38 participants 36 responded to Q9. As teachers were free to indicate more than one category of training received, the total value of percentages does not directly correlate with the number of questionnaires completed by teachers.

Table 4.3 Computer literacy training

	School categories & Percentages					
	n =22		**n = 4**		**n =12**	
Types of training received	FDET Schools		FHOR School		FMC Schools	
	n	**%**	**n**	**%**	**n**	**%**
Through my own studies	10	45%	2	50%	9	75%
Through family and friends	2	9%	1	25%	3	25%
Some training arranged by the school	5	23%	0	0%	4	33%
Some training arranged by the DoE	3	14%	0	0%	1	8%
None at all	5	23%	1	25%	0	0%
No Response	1	5%	1	25%	0	0%

In terms of the findings on computer literacy training, I discuss the most frequently occurring response to the least frequently occurring response. According to the questionnaires 75% of the teachers from the FMC schools, 50% of the teachers from the FHOR school and 45 % of the teachers from the FDET schools indicated that they received training through their own studies. Twenty five percent of the teachers from the FHOR school, 25% of the teachers from the FMC schools and 9% of the teachers from the FDET schools indicated that they received informal training through family and friends. Thirty three percent of the teachers from the FMC schools and 23% of the teachers from the FDET schools indicated that they received training through some training arranged by the school. Seemingly the FHOR school did not hold internal computer training sessions, because none of the teachers from the FHOR schools indicated having received any training arranged by the school. Fourteen percent of the teachers from the FDET schools and 8% of the teachers from the FMC schools indicated that they received

computer literacy training arranged by the DoE. Again no teachers from the FHOR school indicated having received training from the DoE. There are teachers who indicated having received no training at all. Twenty five percent of these are from the FHOR school and 23% from the FDET schools. In addition to the above, 25% of the teachers from the FHOR school and 4% of the teachers from the FDET schools did not respond to Q9. It is difficult to understand why they did not respond, however I assume that they never received any computer literacy training.

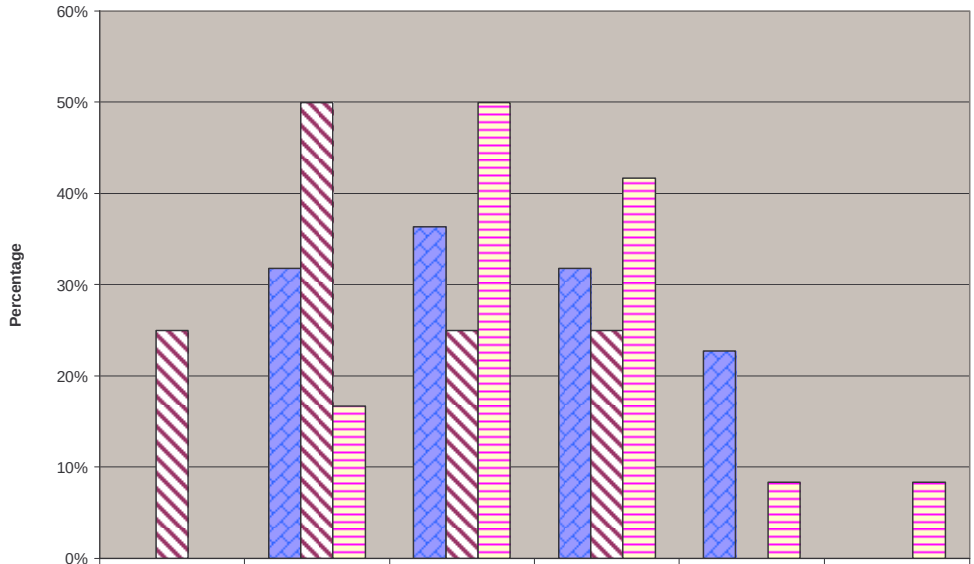
In summary, most of the training received by the teachers from all the three categories of schools was through their own studies, followed by the informal trainings received from family and friends. Only the FDET and the FMC school teachers indicated to have received training from their respective schools. This means the FHOR school did not have internal organised trainings for computer literacy. The least frequent response with the lowest percentage of training received by teachers is the training arranged by the DoE. Again the FHOR indicated nothing, which may mean that teachers from the FHOR were not part of the DoE training sessions.

What transpires from these findings is that all the FMC schools teachers who completed the questionnaires received computer literacy training. It is not easy to interpret the findings from the FDET schools and the FHOR schools because there are teachers who did not respond to the question. However it is evident that there are computer illiterate teachers in both categories due to “none at all” responses.

4.3.2 Training for using computer in the curriculum

Since the integration of ICT in the curriculum requires a special kind of training (Howell & Lundall 2000), I further enquired about the kind of training received by the teachers to support them to integrate ICT into the curriculum. In Q10 of the questionnaire I used the same criteria as in Q9 about computer literacy training. Figure 4.2 illustrates the data from the questionnaires which includes the nine teachers who claimed not to have received training for using computers in the curriculum.

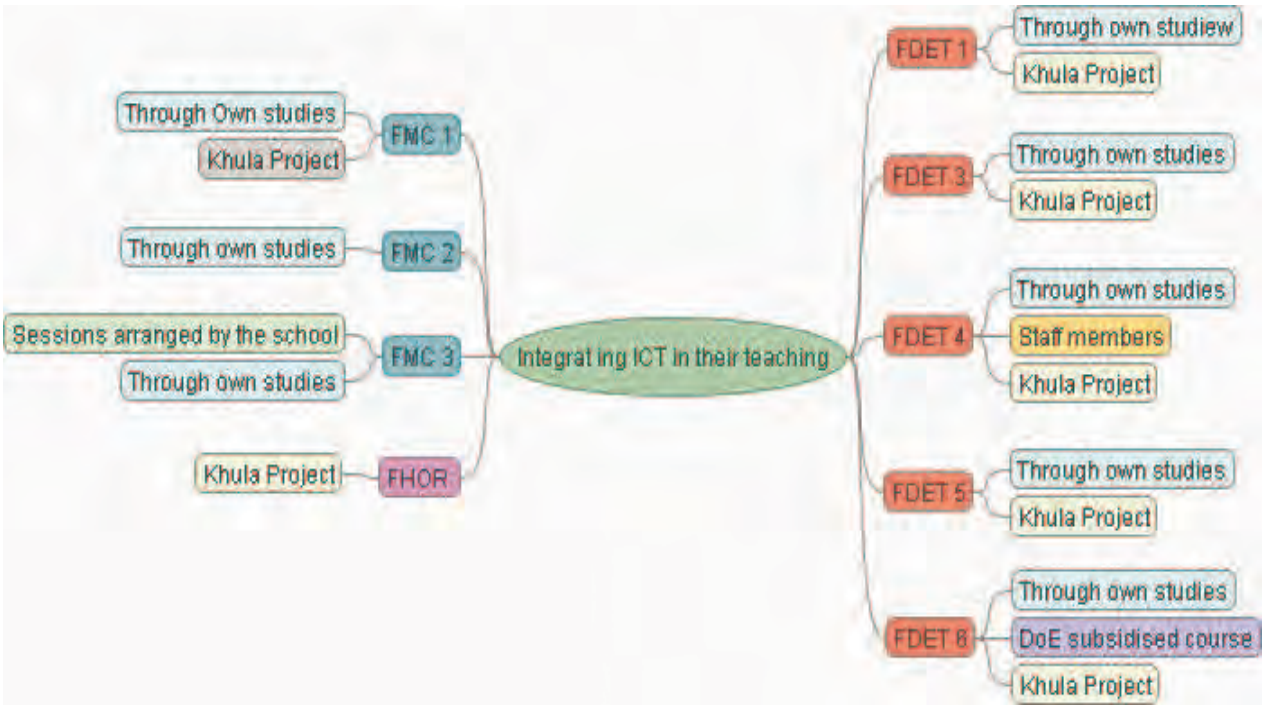
Figure 4.2: Questionnaire data: Training received by teachers to integrate ICT in their teaching



	No response	Not at all	Through my own studies	Some training arranged by the school	Some training arranged by DoE	From family and friends
FDET	0	32%	36%	32%	23%	0%
FHOR	25%	50%	25%	25%	0%	0%
FMC	0	17%	50%	42%	8%	8%

In order to relate the findings from the questionnaire to the teachers' responses to the interview question about training received to learn how to integrate ICTs in the curriculum, I first draw attention to the types of training that were mentioned during the interviews (Figure 4.3). Figure 4.3 illustrates data from the semi-structured interviews. During semi-structured interviews I selected some of the teachers who indicated having received training to use computers in the curriculum.

Figure 4.3: Interviews data: Training received by teachers to integrate ICT in their teaching



In my interpretation of the findings I link the questionnaire findings with the semi-structured interview findings. I used the categories provided in Q10 as subheadings of this section, but also include the training categories which were not in the questionnaire, but emerged from the teachers' responses during the semi-structured interviews.

No training received

In the FDET schools and the FHOR schools fewer teachers received specific training in the integration of ICTs into the curriculum than teachers who received computer literacy training. Fifty percent of the teachers from the FHOR school and 32 % of the teachers from the FDET schools indicated having received no training at all. In contrast to the computer literacy training where all the teachers from the FMC schools indicated having received some training, 17 % of the teachers from the FMC schools did not receive any training to use computers in the curriculum. Apart from the teachers who indicated that they did not receive training, 25% (one

teacher) of the teachers from the FHOR school did not respond to the question. I assume that this means that she may not have received formal training in integrating ICTs into the curriculum.

Training through own studies

The responses to the questionnaires indicate that 50% of the teachers from the FMC schools, 36% of the teachers from the FDET schools and 25% of teachers from the FHOR school received training to use computers in their teaching through their own studies. During the semi-structured interviews seven teachers from FDET schools reported that they have gone far beyond computer literacy to using computers in their teaching. They claim to have done this through their own studies at Rhodes University.

"*I started doing an ICT course with Rhodes University. There I have learnt a lot. How to use internet for more information in my subject. I could get something of which I was not quite aware in the years before. Yes I knew that there was Internet but I have not been aware of how informative it is. Today I know that from Internet you can get even lesson plans that can help you in your teaching. I think the ICT course has empowered me on how to use computers for teaching and how to get information for my subject and as such this year. I have started integrating ICT in my learning area"* (FDET 4 teacher).

Three teachers from the FMC schools indicated that they are able to integrate ICT in their Learning Areas (LAs). They claimed to have received training for integration of ICT through their own studies. For example:

"*I have taken a few computer courses at the Technikon [Further Education and Training] College here. What I mainly use computers for now, is the admin side of the school. I am a science teacher and I take the science class to the computer room to do a bit of science on the computers"* (FMC 1 teacher).

During the semi-structured interviews the one interviewed teacher from the FHOR made no mention of the training of teachers through private studies.

Training arranged by the school

Forty two percent of the teachers from the FMC schools, 32% of the teachers from the FDET schools and 25% of the teachers from the FHOR school received ICT integration training through some training arranged by the school. During the semi-structured interviews a question on training of teachers by the school was posed to the teachers from the FDET schools and the FMC schools and the responses given were as follows: "*We came back [from the Khula[i] Project] and teach other teachers so most of the teachers are able to use computers*" (FDET 4 Teacher).

While teachers from the FDET schools used training provided by an external educational project to act as a catalyst for teachers to teach each other, the FMC schools have internally arranged courses: "*Well, the courses are offered, but it is purely voluntary whether you want to go and learn how to use that programme*" (FMC 1 teacher).

Training arranged by DoE

The questionnaire data indicated that 23% percent of the teachers from the FDET schools and eight percent of the teachers from the FMC schools received training arranged by the DoE. However during the semi-structured interviews only one teacher from the FDET schools indicated having received training through a course subsidised by DoE:

"*when I started to teach here I was doing a course that didn't last, it was subsidised by the government we were doing Financial Accounting at Graham[stown] Tech but that course did not last so we had to drop out"* (FDET 6 teacher).

Other teachers' responses were *"no as of now there has been nothing from the DoE"* (FDET 5 teacher) and "*nothing*" (FMC 1 teacher).

Informal Training

In response to the questionnaire, only 8% of the teachers from FMC schools indicated learning about using computers in teaching on an informal basis. During semi-structured interviews no teacher indicated having received such training.

Training through educational projects

In response to Q2 9 of the questionnaire, one of the teachers from FDET schools and one teacher from FHOR school indicated that they received training from the Khula Project. Unfortunately there was no slot for such responses in my questionnaire and the two teachers ignored the "other" option given. Fortunately they decided to write their responses next to the question on the questionnaire.

During the semi-structured interviews I noted that eight teachers from the FDET schools claimed to have received training through the Khula Project workshop. This means that from each FDET school there is at least one teacher who claims to have received training through the Khula Project workshop. The purpose of the Khula Project workshop was to teach teachers computer skills that could be used in teaching Maths, Science or Biology (A. Stevens[3], personal comm.May 2007; Whitlow 1998). Seemingly the workshop gave teachers opportunity to develop their computer literacy since they also claim that this was the first time they had used computers.

"*The first time I touched the computer was during the Khula Project, when I was involved there in 2001. That was my first time otherwise the only thing that I knew was the key board because I used to type but the mouse and other things were new to me but the Khula Project helped me a lot because I began to be computer literate" (*FDET 6 teacher).

In the FHOR school the interviewed teacher indicated that three teachers from their school received training through the Khula Project workshop. *"The Khula Project stepped in with Maths and Science, three of our teachers participated in that workshop"* (FHOR teacher). One of the teachers from the FMC schools mentioned that teachers in his school were exposed to computer skills during the Khula Project , "*The other day we had a Khula Project scenario where you teach people with skills"* (FMC 3 teacher*).*

[3] A. Stevens: The co-ordinator of Khula Project at Rhodes University.

From this vague comment it is difficult to interpret whether the teacher concerned attended a Khula Project workshop or whether somebody else from his school attended the workshop. According to A. Stevens, the Khula Project workshop was designed for the under-served schools. Teachers from the FMC schools were not invited to attend the Khula Project workshop; however one teacher from FMC 3 school attended the workshop, but dropped out before the workshop came to an end (May 2007. Personal comm.).

In short, in comparison to the computer literacy training, the percentage of teachers who indicated having received no training in the integration of ICT into teaching increased for all the school categories. Even from the FMC schools there are teachers who indicated that they did not receive training for using computers in the curriculum. Likewise, the highest percentage of the teachers developed their skills to use computers in the curriculum through their own studies. The FMC schools have the highest percentage of teachers who received training through their own studies followed by teachers from FDET schools. The Khula Project training has emerged from two teachers' responses in the questionnaires and has been frequently mentioned by the teachers from FDET schools (see Figure 4.3). From the questionnaire there is an indication that all the three school categories schools provided some support in the training of their teachers to use computers in the curriculum.

It has emerged from the questionnaire that some of the FMC school teachers and the FDET school teachers have received some kind of training from the DoE, however during the semi-structured interviews only one teacher from FDET schools reported that she was part of a DoE subsidised course. I assume that this discrepancy is because not all teachers who completed the questionnaires were part of the semi-structured interviews. In evaluating these findings in relation to previous research it is evident that, like other teachers around the world, many of the teachers in this study may not be able to integrate ICT into the curriculum due to insufficient knowledge (Mooij & Smeets 2001) which may result in them lacking confidence of their own abilities to the use of ICT (Kennewell *et al* 2000). Like the Scottish teachers survey by Williams *et al.* (2000) it would seem that the teachers in the FDET, FHOR and FMC schools foresee the need for training which is relevant in terms of content and timing. However, Williams *et al*. caution that

"training alone is unlikely to be effective in the development of ICT skills and knowledge, and enhanced use of ICT in schools. A more holistic approach is required comprising appropriate training (appropriate in terms of skills, knowledge, relevance to educational goals and priorities and delivery): ready to access ICT resources …" (2000:319).

The study continues to reflect upon how the teachers were implementing the skills received during the training by finding out the relevant ICT resources (particularly the software) which teachers used in their teaching.

4.4 Software used by teachers

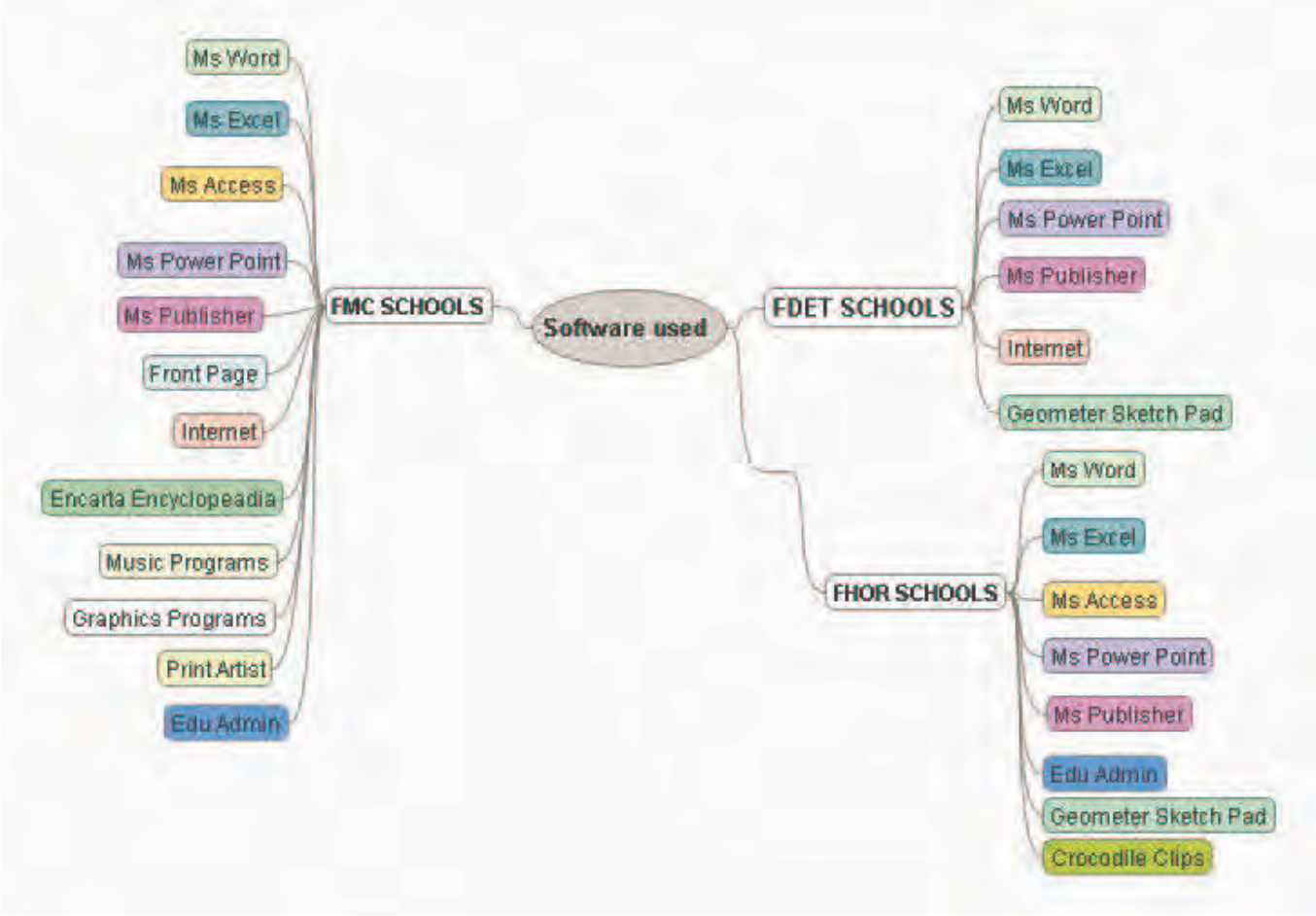
In response to question 7 (Q7) teachers identified the following software: Ms Word, Ms Excel, Ms Access, Ms Power Point, Ms Publisher, Ms Front Page, Ms Internet Explorer, various music programs, graphic programs, Encarta Encyclopedia, Geometer Sketch Pad , Windows XP, Windows 98. Unclear responses included "all accessories, Microsoft, and windows." There are teachers who indicated not using any software at all and also teachers who did not respond to the question. Table 4.4 illustrates the findings from the questionnaire data.

Table 4.4: Questionnaire data: The most frequently used software

Types of software		**School categories**							
		FDET SCHOOLS n =22		**FHOR SCHOOL n =4**		**FMC SCHOOLS n =12**		**OVERALL USE n =38**	
		n	**%**	**n**	**%**	**N**	**%**	**n**	**%**
Application software	Microsoft tools	-	-	-	-	2	17%	2	5%
	Microsoft package	-	-	1	25%	-	-	1	3%
	Ms Word	10	45%	2	50%	8	67%	20	53%
	Ms Excel	5	22%	1	25%	7	58%	13	34%
	Ms Power Point	1	5%	-	-	1	8%	2	5%
	Ms Publisher	-	-	-	-	2	17%	2	5%
	Ms Access	-	-	-	-	1	8%	1	3%
	Front Page	-	-	-	-	1	8%	1	3%
Internet	Internet Explorer	4	18%	-	-	3	25%	7	18%
Operating systems	Windows	2	9%	-	-	-	-	2	5%
	Windows 98	-	-	1	25%	1	8%	2	5%
	Windows XP	-	-	-	-	1	8%	1	3%
Educational software	Encarta Encyclopaedia	-	-	-	-	1	8%	1	3%
	Geometer Sketch Pad	1	5%	-	-	-	-	1	3%
Miscellaneous software	Print Artist	-	-	-	-	1	8%	1	3%
	All accessories	-	-	-	-	1	8%	1	3%
	Music programs	-	-	-	-	1	8%	1	3%
None		3	14%	-	-	-	-	3	8 %
No response		7	32%	1	25%	1	8%	9	24%

The extent of their use of this software will be elaborated upon in the following section (4.4) in relation to the responses during the interviews. Figure 4.4 illustrates all the software identified by teachers as revealed in the semi-structured interviews.

Figure 4.4: Interview data: Software used



4.4.1 Application software

Teachers from the three categories of schools indicated that they use *Ms Office* software most frequently. Table 4.4 indicates that the most frequently used *Ms Office* tools are grouped together under one category "*Ms Office* suite". They are then split in terms of the different software in *Ms Office* suite indicated by the teachers. This includes the responses such as "*Ms Office* tool/package". The purpose of doing this is to provide an indication of the overall use of *Ms Office* suite. In terms of *Ms Office* suite, *Ms Word* was the most frequently mentioned software. Sixty seven percent of the teachers from the FMC schools, 50% of the teachers from the FHOR

school and 45% of the teachers from the FDET schools claimed to use *Ms Word* most frequently. The use of *Ms Word* was confirmed during the semi-structured interviews. When posing a question on the most commonly used software, a teacher from FDET schools responded "*Obviously Microsoft word because that is the basic one that we are using, now and again*" (FDET 6 teacher).

Following the use of *Ms Word,* teachers claim to use *Ms Excel* most frequently. Seemingly *Ms Excel* is not popular as *Ms Word*. The rate of using *Ms Excel* is less than the rate of using *Ms Word* across the categories. The data from the questionnaires indicates that 58% of the teachers from the FMC schools, 25 % of the teachers from the FHOR and 22 % of the teachers from the FDET schools claimed to use *Ms Excel* most frequently.

Only 17% of the teachers from the FMC schools use *Ms Publisher*. However during the semi-structured interviews one of the teachers from the FDET 6 reported that he sporadically uses *Ms Publisher*: "*I gained a lot because there's a programme that is called Power Point that is interesting and also the Publisher those are the programmes I found interesting although I did not get much training on them but I am trying to use them bit by bit*" (FDET 6 teacher).

Eight percent of teachers from the FMC schools and 5% of the teachers from the FDET schools reported using *Ms Power Point*. No one from the FHOR school made mention of the use of *Ms Power Point* from either the questionnaires or the semi-structured interviews.

According to the questionnaire data only 8% of the teachers from the FMC 3 school made mention of the frequent use of *Ms Access*. No teacher indicated use of *Ms Access* from the FDET schools or the FHOR school. Having found that the teachers from the FHOR school made no mention of software such as *Ms Publisher, Ms Power Point* and *Ms Access*, a question was posed during the interviews to find out whether they do use *Ms Publisher, Ms Power Point* and *Ms Access*. The response from the FHOR interviewed teacher revealed that they do use the mentioned application programs but not frequently: "*In fact something like Access you don't ever really need*" (FHOR teacher). This means the responses given on the questionnaire were deliberate.

It is interesting to note that 25% of the teachers from the FHOR schools claimed to use "Microsoft". This is rather confusing because "Microsoft" may refer to the operating system or to the Office suite. Even more perplexing is that during the semi-structured interviews I noted that one interviewed teacher use of the term "Microsoft" when referring to the Microsoft as Schools' Licensing Agreement. "*I'll do the hardware issues and organise the software from Microsoft. […] and the Microsoft thing, I saw it on the net and thought I would just apply [...]*" (FHOR teacher).

In short, both questionnaires and interviews authenticate the regular use of the *Ms Office* suite. Most of the teachers who use *Ms Office* packages are the teachers from the FMC school, followed by the teachers from the FHOR school and lastly the teachers from the FDET schools. The most frequently used software in *Ms Office* is *Ms Word*, with 53 % of the teachers from the three school categories having claimed to use it. Following *Ms Word* is *Ms Excel* with 34% usage. The use of all other *Ms Office* software is 5% or below. The use of the term "Microsoft" raised a concern as to whether teachers know the difference between *Ms Windows* and the *Ms Office* suite. No teacher referred to using Open Source software such as Open Office .org despite it being freely available.

4.4.2 Internet

Looking at the use of Internet in general, there are only a few teachers who indicated that they use Internet frequently. From the questionnaires 25% of the teachers who claim to use Internet are from the FMC schools and 18% of the teachers are from the FDET schools. This may be because of the five participating FDET schools only two of them (FDET 3 & FDET 4) were connected to the Internet. Surprisingly, during semi-structured interviews the teachers from the FDET 6 school also reported using the Internet. What was not initially clear was how they gain access to Internet since they are not connected to the Internet. Later in the interview it became clear that the teachers from the FDET 6 school access the Internet from the local tertiary institution, Rhodes University as they were registered students of Rhodes University: "*because right now we access Internet from Rhodes after school hours*" (FDET 6 teacher).

In short, there is little use of Internet mentioned by the teachers. The highest percentage of teachers using Internet is 25% of the teachers from the FMC schools. FHOR had the worst scenario with no Internet use at all even though the FHOR school is connected to the Internet. Further research would be needed to explain the lack of Internet use at a school where there is connectivity.

4.4.3 Operating system software

There were teachers who claimed to use various versions of *Microsoft Windows*: 25% of the teachers from the FHOR school and eight percent of teachers from the FMC schools claimed to use *Windows* 98. Nine percent of the from the FDET schools claimed to use "*Windows*". This is rather confusing; in the sense that *Windows* is not a software package that one could claim to be using most often since it is an operating system used to run the other software. Such responses may portray the insufficient knowledge possessed by teachers (Mooij & Smeets: 2001). Eight percent of teachers from the FMC schools also indicated using *Windows XP*.

4.4.4 Educational software

Interestingly, only the teachers from two schools FDET 3 and FMC 3 made mention of using the educational software in the questionnaire responses. Five percent of teachers from the FDET schools indicated the use of *Geometer Sketch Pad*, while eight percent of teachers from the FMC schools indicated the use of the *Encarta Encyclopaedia*. Surprisingly, during the semi-structured interviews, the one interviewed teacher from the FHOR school indicated the use of *Geometer Sketch Pad* by the Maths teacher and the use of *Crocodile Clips* by the Science teacher. In contrast to the Scottish teachers (Williams *et al*. 2000), the Grahamstown circuit teachers have less access to externally produced educational software. This may be because of the cost implications that the Grahamstown schools are without or have limited access to educational software.

4.4.5 Miscellaneous software

Eight percent of the teachers from the FMC schools made mention of two other software programs that were often used; music programs (8%) and print artist (8%). One of the interviewed teachers from the FMC schools indicated that he uses graphic programs for his camera. He made mention of this as he regularly used the software package *Photoshop*.

Additional software mentioned by the FMC teacher and FHOR teacher during semi-structured interviews is *Edu Admin*. In addition to the specific software already mentioned, somewhat vague responses were provided by the FMC school teacher who said that s/he uses *all Accessories* (8%). Even though I suppose this may indicate the use of *Ms* "*Accessories*" it would be improper for me to categorise this response under the *Ms Office* suite because of the uncertainty of what it may mean. In my view this means the teacher concerned knows very little about computer software. S/he might think computer software is limited to *Ms Office* tools.

With regard to the questionnaire 14 % (3) of the teachers from the FDET schools indicated not using any software, while 32% (7) of teachers from the FDET schools, 25% (1) of the teachers from the FHOR school and 8% (1) of the teachers from the FMC schools did not respond to the question.

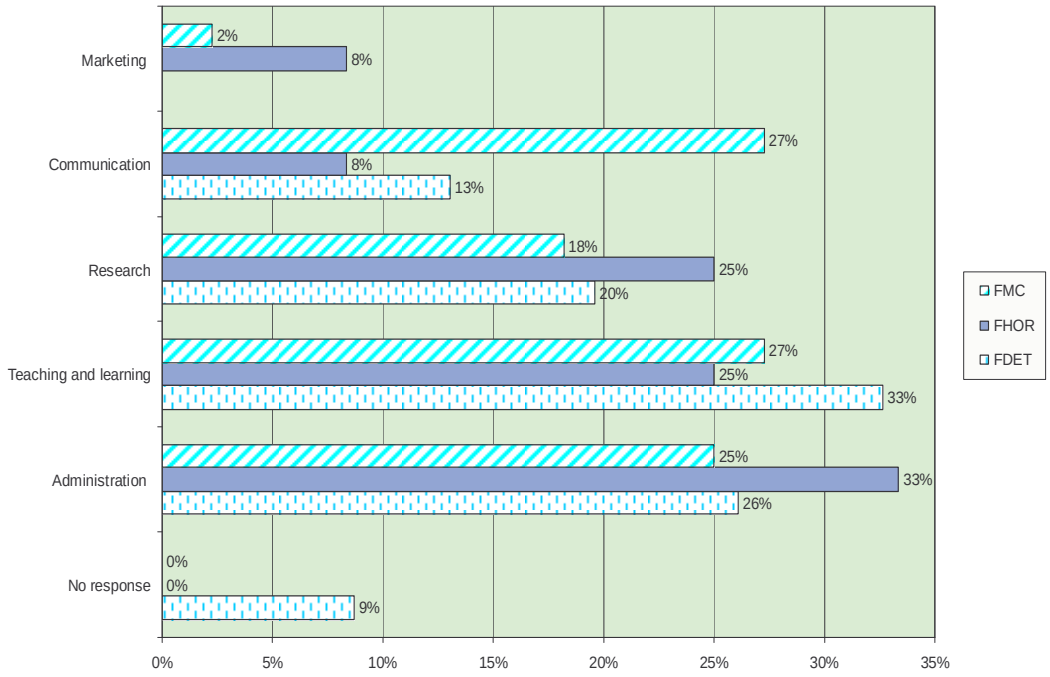
What transpired from these findings is that *Ms Word* is the most frequently used application software. In the light of previous research (Williams *et al*. 2000) it is unsurprising that teachers use word processing more than other software. The Internet was used less often by teachers than I anticipated considering that all FMC schools, the one FHOR school and the two FDET schools have Internet access. There is a subtle indication that not all of the teachers understand or know about the software they are using. The responses that indicated the frequent use of "Windows", "Microsoft" and "all accessories" bears testimony to this claim. The teachers made mention of the three educational software programs only: *Geometer Sketch Pad*, *Encarta Encyclopaedia* and *Crocodile Clips*. They also mentioned one educational administration package, *Edu Admin*. In the light of these findings I conclude that FMC teachers have access to and use a wider range of software than the teachers from the other two schools categories. However, the minimal use of educational software at all three types of schools raises a concern about how they integrate ICT in the curriculum.

4.5. Teachers' use of computers

What I regard as of great importance in my study are the purposes for which the teachers are using the indicated software. Q8 from the questionnaire probed for which purposes the teachers

are using computers. This means the teachers had to give more in-depth responses on the use of software they had mentioned in Q7. In Q8 teachers were given possible answers to choose their purposes of using computers (see Appendix A). The possible answers provided included: Administration; Communication; Research; Teaching and learning; and Marketing. The questionnaire gave a clear indication of what each of the provided answers meant. The following discussion flows from the findings from the questionnaire survey, as illustrated in Figure 4.5, and from what transpired during semi-structured interviews, and extended by the journal notes made during the course of the semi-structured interview.

Figure 4.5: Purposes of using computers (Q8)



4.5.1 Using computers for administration purposes

The questionnaire data indicates that teachers across the three schools categories often used computers for administration purposes. The highest percentage of administrative use of computers is 36% (4 comments) of the teachers from the FHOR school followed by 26 % (12 comments) of the teachers from the FDET schools and lastly 25% (11 comments) of the teachers from the FMC schools. Understandably the FHOR school leads in administrative use, because

the one interviewed teacher mentioned that two of the five computers they had were in the administration office and were used for school administration and only three computers were in the staff room. *"The school acquired two office machines for school admin, one for the principal and one for the secretary. The other three Sarisons computers are mainly for the staffroom, for the teachers and they must all queue around there"* (FHOR teacher). It is therefore unlikely to find 33 teachers using three computers for any other purposes other than administration. During the semi-structured interviews one teacher from the FDET schools made mention of the use of the software for administrative purposes such as creating mark lists on the computer: *"Excel, I use it when doing mark list"* (FDET 1 teacher). FDET 5 reported not using computers for any other purpose other than administration: "*We do not use computers; the only one working is in the administration and it is used for administrative purposes only"* (FDET 5 teacher 1). They added that even when they had working computers, they were used for administration purposes: "*When the other three were working we used to type […] and to do mark sheets*" (FDET 5 teacher). The teachers from the FMC schools confirmed their use of computers for administration purposes: "*we are mostly using Ms Word and Ms Excel for mark sheets"* (FMC 2 teacher). One teacher from the FMC 3 school reported that they use one central database system to do assessment and reports:

"*We've changed the way we do reports, we're using once central data base system […] yes. It's more global than that. The Edu-Admin system that we work on, which I think could be an incredible database, not that I've used too many of the others, it really does the job from my point of view, which is the assessment"* (FMC 3 teacher).

Edu Admin was also mentioned by the FHOR teacher who claimed that: "*Um after a while they bought a 486 which they used for admin purposes and they bought an admin programme that ran the schedules and the mark sheets, etc. I think its school admin, Edu Admin; ja I think that is it*" (FHOR teacher).

As has been noted, the teachers from all the school categories claim to use computers for administrative purposes. The FHOR teachers (36%) used computers for administration at a higher rate (33%) than the other two categories of schools. The teachers from the FDET schools

were using *Ms Word* and *Ms Excel*, while the teachers from the FHOR and the FMC schools were exploring *Edu Admin*; a special system for designing schedules and for assessment sheets.

4.5.2 Using computers for teaching and learning

According to Q8, the teachers from the FDET schools used computers for teaching and learning more often (32%) than the other two school categories. Following the FDET schools are the FMC schools with the rate of 27%. The school least likely to use computers for teaching and learning is the FHOR school with only 21% of teachers reporting the use of ICTs in the curriculum. The interview data revealed what teachers meant when they said they could use computers for teaching and learning. One teacher from the FDET schools claimed to have used different Mathematics programs:

"*Ok, I have tried when I teach quadratic equations because I have got special programme that I purchased and they offer tutorials to my learners and they are such that the learner goes through the tutorial it marks it and it allocates the marks. So when I've gone through a particular topic it could be factorisation, eh, it could be factorisation of differences of two squares it could be factorisation of trinomials and so on and so on and so children are able to go and to do tutorials and that's it"* (FDET 3 teacher).

In addition to this he used *Geometer Sketch Pad* to plot graphs: "*Ja I also use Geometer Sketch Pad for Maths as well [...]. It is a very interesting program, learners like it*" (FDET 3 teacher).

One teacher from the FDET 1 school claimed that she used *Ms Excel* for teaching Maths:
"in Excel I use it when doing mark list sometimes for my own benefit like doing my own assignment. I also use it for Grade 8 – plotting of graphs. I print out the graphs and take it to the class to show learners how to plot graphs" (FDET 1 teacher).

One teacher from the FMC schools reported using *Ms Excel* to plot graphs during Science lessons:

"I teach the physical science, so what we do sometimes is use Microsoft Excel spreadsheets to draw graphs for science experiments, What we do is, we do the experiments physically, take the readings and put the readings on a spreadsheet and get the computer draw the graphs" (FMC 1 teacher).

The Science teacher from the FDET 4 school reported the use of computers to teach science:

"*There is a programme in the computer whereby learners get information for science. There are elements that you can find from some of the computers. The learners can see the elements you are talking about and their shapes. If you are talking about sodium you can show them sodium in the computer so that they know more about the elements you are talking about"* (FDET 4 teacher).

Unfortunately he did not know the name of the program hence he said *"there are elements you can find in some of the computers*" (FDET 4 teacher). In my view this shows the teachers' lack of software knowledge because in working with computers one has to click the icon representing the programme s/he wants to access. One interviewed teacher from the FHOR indicated the use of *Crocodile Clips* by the teacher who attended Khula Project in his school. *"They* (teachers who attended the Khula Project workshop) *have some programs on, […] and then a science one too, Crocodile Clips and then some others that I cannot remember now*" (FHOR teacher).

The Geography teacher from the FDET 4 school reported that he downloads weather charts from the Internet and takes them to the classroom for interpretation: "*Basically I print weather charts from the weather sites and photocopy. The learners have to get the skill of looking on the weather map. They should be able to analyse and predict weather"* (FDET 4 teacher).

Equally important was the use of computers to teach Computyping (what is now called Computer Applications Technology (CAT)). Computyping is an optional subject selected by learners from Grade 10 – 12. It focuses on teaching typing skills including the speed: *"I am teaching Computyping Grade 10-12, but this year we only have Grade 12. Computyping is replacing typing. They are using Microsoft Word for Computyping. They type documents like business*

letters, balance sheet, notices of meetings and agenda" (FDET 4 teacher). From the questionnaire one of the teachers from the FMC 3 school indicated that he uses computers to teach Computyping.

To sum up, it is evident that most of the teachers who used computers for teaching and learning were from the FDET schools. The FDET teachers highlighted the use of computers to teach Maths, Science, Geography as well as Computyping. The teachers from the FMC schools seemed not to focus much on using computers for teaching and learning. This may be because the FMC teachers claim not to have programs in place to use in their subjects and only use *Ms Excel* to type work sheets and tests. The one interviewed teacher from the FHOR school indicated the use of computers for teaching and learning by the Maths and the Science teachers.

4.5.3 Using computers for research

The third highest purpose of using computers is the research purpose with 21% of teachers from FHOR school teachers, 19% of teachers from the FDET schools teachers and 18% of teachers from the FMC schools teachers. This contradicts the responses given by FHOR school in Q7 where the FHOR teachers made no mention of using Internet or any CD ROM as one of the most frequently used software.

During the interviews one of the FDET school teachers confirmed their use of computers for research purposes: "*From the Internet I explore on the different websites and get information"* (FDET 4 teacher). In responding to the use of Internet for research purposes one teacher from the FMC schools reported the challenge of sharing a bandwidth with four other schools, "We share a band with [school 1, school 2, school 3, and school 4]. In my own analyses this may be the reason why FMC school teachers indicated less use of computers for research purposes.

In short, the teachers from the three school categories indicated limited use of computers for research purposes. The FMC school teachers use the Internet and the Encarta Encyclopedia for research purposes. Even though the Internet is used frequently by teachers from the FMC schools, it is not used for research purposes due to insufficient access to the Internet.

4.5.4 Using computers for communication

The data revealed that 27% of the teachers at the FMC schools use computers for communication purposes, with 25% of the teachers using the Internet in Q7. One interviewed teacher from a FMC school responded confidently when he was asked to elaborate upon the use of computers for communication: *"Communication is an awesome one, [...] I started playing around sending poems to grade 8 and 9's which was an amazing experience because some of the kids you never hear from in the class, are writing this awesome response to a poem"* (FMC 3 teacher).

From the FDET schools one interviewed teacher indicated that they use computers for communication. It is noted that when teachers refer to the use of computers for communication there is usually learner involvement. One of the interviewed teachers from the FDET schools confirmed this: *"Things like email. They can get friends because now we are engaged in a teenage project, so they get e friends e overseas … they talk to them and share experiences"* (FDET 3 teacher).

There were only seven percent of the teachers from the FHOR school who indicated the use of computers for communication. It is difficult to discuss this further because there is no evidence provided to elaborate upon their claim.

Contrary to the use of computers for research purposes the FMC school teachers had a highest percentage of using computers for communication. In short, the indication of using the Internet most frequently by the teachers from the FMC schools is confirmed by the highest percentage of using computers for communication (see Table 4.4). Teachers from the FMC schools and FDET schools offered supporting comments during semi-structured interviews.

4.5.5 Using computers for marketing

During the questionnaire survey 14 % of the teachers from the FHOR school indicated that they used computers for marketing. Figure 4.5 shows that only two percent of the teachers from both the FDET and the FMC schools claimed to use computers for marketing purposes. The use of computers for marketing did not arise during the semi-structured interviews.

4.5.6 No response

Nine percent of the teachers from the FDET schools did not respond to the question. This might be due to no use of computers at all in schools such as FDET 5 and FDET 6 where teachers do not have access to the school computer.

4.5.7 Summary of the purposes of using computers

On the whole teachers indicated that they were using computers for the different purposes as provided from the questionnaire. According to the questionnaire, the most frequent use of computers at all the schools was for administrative purposes. The teachers from the FMC and the FHOR schools used *Edu Admin* to do assessment and reports. The teachers from the FDET schools used *Ms Word* and *Ms Excel* to create mark lists and reports. All the actions performed in administration work are recording actions which according to Hokanson and Hooper (2000) are representational.

With regards to teaching and learning, 32 % of teachers from the FDET schools, use of computers is reported by teachers from the FDET schools. Most of the interviewed teachers from the FDET schools indicated that they used computers to teach their subjects/LAs. *Geometer Sketch Pad* and *Ms Excel* were used to teach Maths; a Science program (name unknown) was used for science experiments; and the Internet was used to download weather charts. From the FMC schools teachers used *Ms Excel* to plot Science graphs and *Ms Word* to type tests and work sheets. There is evidence that the Maths and the Science teachers from the FHOR school were using computers to teach the two LA's. *Crocodile Clips* was used to teach Science and *Geometer Sketch Pad* was used to teach Maths. Only two schools indicated the use of computers to teach Computyping; one teacher is from a FDET school and the other one is from a FMC school. The use of *Geometer Sketch Pad* and *Ms Excel* to plot graphs and the use of *Crocodile Clips* for teaching Science shows how computers can be used to generate thought in manipulating symbols. Hokanson and Hooper (2000) refer to this as a generative approach of using computers. The typing of tests and work sheet is representational since it is also a recording action.

The teachers from all the three categories of schools indicated that they use computers for research. In using computers for research purposes the schools should have software such as the

Encarta Encyclopaedia and ideally access to the Internet. It is not clear how the teachers from the FHOR school could indicate using computers for research purposes since there was no indication of using such software in Q7.

In using computers for communication purposes the FMC school teachers seemed to be the Internet for communication purpose more than research purposes. There was a strong claim of learner involvement in the use of computers for communication which is viewed as beneficial to both teaching and learning. The involvement of learners in communicating through email also emerged from the FDET teachers' responses. In this venture (using computers for communication purposes) computers were used as mediating tools (Romiszowski & Mason 1996) which they argue to be developing higher order learning objectives. Computers are used as media to socialise with capable others or with knowledgeable others from peers other school. According to Hartley (2007) this kind of interaction encourages thinking about writing by default. Therefore in this exercise ICT is underpinned by social constructivist theory (Bannon 1997; Palinscar 1998; Ravenscroft 2001). In my analysis of the finding regarding research and communication I observed that the highest number of teachers who use computers for research and communication are those with Internet connections. Table 4.5 provides detailed findings from questionnaire data.

Table 4.5 Detailed findings of using computers for research and communication

School category	Research	Communication	Total	Internet connection	No Internet connection
FDET 1 n =4	**x**	**x**	**2**		**x**
FDET 3 n =6	**x x**	**x x x**	**5**	**x**	
FDET 4 n =4	**x x x**	**x x**	**5**	**x**	
FDET 5 n= 4	**x x**		**2**		**x**
FDET 6 n =4	**x**		**1**		**x**
FHOR n =4	**x**	**x x**	**3**	**x**	
FMC 1 n =4	**x x x**	**x x x x**	**7**	**x**	
FMC2 n= 4	**x x**	**x x x x**	**6**	**x**	
FMC3 n=4	**x x x**	**x x x x**	**7**	**x**	

Internet connection adapted from Brandt (2006).

The teachers from FHOR indicated using computers for marketing (14%). Only 2% of teachers from both the FDET and the FMC schools indicated using computers for marketing.

There are teachers who did not respond to the question. This might mean they are not using computers at all.

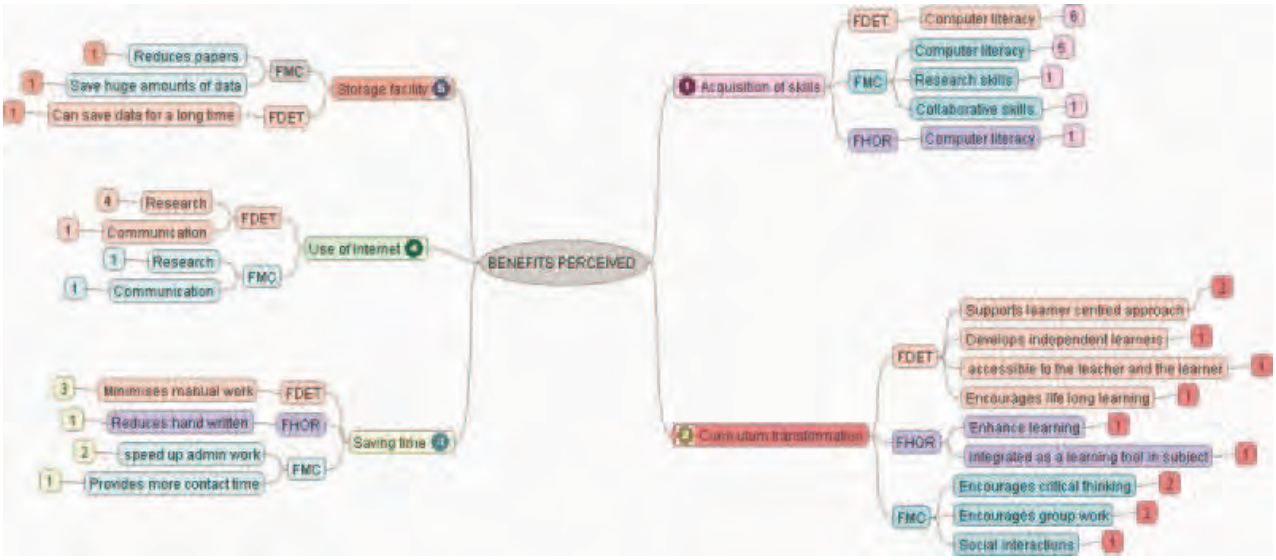
The three levels of ICT integration as mentioned by (Bialobrzeska and Cohen: 2005), have emerged from the responses made by teacher during both questionnaire survey and semi-structured interview; functional practice; integrative practice and transformational practice. Under functional practice teachers had highlighted the frequent use of computers to type documents that can be hand written such as work sheets and tests. Teachers provided some evidence on the use of computers for integrative practice, where they used computers to ensure that learners construct new knowledge in the process of learning. The use of weather charts to interpret charts from the web and the use of *Ms Excel* to plot graphs are examples of the integrative level. Teachers highlighted the transformational practice of the use of computers for communicating with learners from other countries; something that cannot be done without a computer and the Internet. The findings reveal that the most common level of integration is functional practice where teachers use computers to perform duties that can be performed without the computer, e.g. typing mark sheets and tests. An example of integrative practice (Biolobzerska & Cohen) was evident from a science teacher from FDET 4 who indicated that he or she used ICT to improve learners understanding of atoms. According to the teacher ICT provides better presentations of Science experiments, which concurs with Scrimshaw and McCormicks' view that "ICT allows the experiments to be carried out more efficiently than before". (2004:45).

4.6 Teachers' perceptions of the benefits of using computers

This section explores the benefits perceived by the teachers from the three categories of schools. Question 12 (Q12) asked what teachers perceive as benefits of using computers in the curriculum. This was an open–ended question and unfortunately it drew very few responses. Furthermore 12 teachers did not respond to the question at all; 10 from the FDET schools; one from the FHOR school; and two from the FMC schools. In addition, one teacher from the FMC schools commented on the questionnaire that s/he does not know what ICT stands for. Some comments

were vague therefore difficult to interpret. The semi-structured interviews filled in the gaps emanating from the questionnaire responses by probing in-depth what teachers meant in their responses. Because teachers used different wording to express their views; the responses are grouped together according to the commonalities and given a theme under which they will be discussed. The following are the themes formulated: development of skills, curriculum transformation; Internet; time management, and storage facility. The qualitative responses to both the questionnaire and the semi-structured interviews are illustrated in Figure 4.6.

Figure 4.6: Benefits perceived by teachers



4.6.1 Development of skills

In terms of skills, Table 4.6 illustrates how these skills were rated by showing the number of comments given to each skill.

Table 4.6: Skills developed through the use of computer

School category	Research skills		Collaborative skills		Computer literacy		Total	Percentage
FDET n=22	x	5%	-	-	x x x x x x	27%	7	32%
FHOR n=4	-	-	-	-	x	25%	1	25%
FMC n=12	x	8%	x	8%	x x x x x x	50%	8	67%
Total n=38	2		1		13		16	42%

Overall 42% of the teachers from all three types of schools commented on the use of computers to develop skills. Sixty seven percent of the comments were from the FMC schools; 32% of the comments were from the FDET schools and 25% of the comments were from the FHOR school.

The teachers from the FMC schools commented on the view that computers provide opportunity to develop skills such as computer literacy (50%), research skills (8%) and collaborative skills (8%). The computer skills were viewed as the most important skills that need to be developed for future benefit. One teacher from a FMC school responded to this during the semi-structured interviews:

"*We must understand that the money is not there for many of them* [learners], *they might not have applied themselves* [for university] *or have the ability necessarily, so you need to teach them skills that they will be able to use. I think that the technological skills will give them an edge over someone else and so, integrating technology into their work and into their daily lives and being comfortable with it, which I think is really important as well, is beneficial in the long run. It's one of those things you can get out of school that you can ultimately use*" (FMC 3 teacher).

In elaborating upon the research skills one teacher from the FMC schools said: "*because they do a lot of research using things like Encarta"* (FMC1 teacher). *This comment reveals that it is not only the Internet that provides opportunity to research, but also other programs such as the Encarta Encyclopaedia.*

From the FDET schools teachers indicated using computers for developing research skills (5%) and computer literacy (27%). The need for collaborative skills development emerged during interviews. The benefit of using computers collaboratively was reported indirectly when a teacher from a FDET school said:

"I think if we were having enough computers and internet. Learners would be able to communicate with other learners outside SA and even inside. They can socialise with other learners trying to find out what they need from other learners" (FDET 1 teacher).

From the FHOR school, 25% of teachers' comments were based on the development of computer literacy skills.
The comments made considered the benefit of communication as encouraging collaborative learning and development of collaborative skills as beneficial to learners. Collaborative learning can be viewed as improving teaching as teachers can work collaboratively with other teachers all over the world. Hence Webb and Cox (2004) and Lagos, Nussbaum and Capponi (2005) argue that computers encourage life long learning.

Again there is a contradiction of views with teachers from FHOR school. In Q8 FHOR teachers mention the use of computers for research purposes. However, when citing the benefit of developing skills, they only focused on computer literacy computer skills (see Figure 4.5 and Table 4.4).

In short teachers perceive computers as providing learners opportunity to primarily develop computer skills that they will use in the future and to a much less extent providing them with research skills and collaborative skills to help them during learning. This means computers are viewed as providing an opportunity for learners to develop skills that are needed in the work place or for further study. With reference to what teachers said about computer skills for future use, it is evident that teachers tacitly believe that the vocational rationale by Hawkridge (1990) should be considered in the use of computers in teaching.

4.6.2 Transformation of the curriculum: From positivism to constructivism

The second group of comments that emerged from the three school categories concerns the changes that take place in the process of teaching and learning. I therefore refer to these as the benefits of transforming the curriculum. From the comments made by teachers I deduced that they believe that computers can

- Enhance learning
- Be integrated across the learning areas
- Develop learner independence
- Afford access to information
- Promote learner centred approach
- Encourage life long learning
- Promote visualisation of concepts

I use Table 4.7 to illustrate how these comments were mentioned by each school category. I also present the schools' overall responses by calculating the overall percentage for each theme and then calculating the total overall percentage to help analyse the level of integration of ICT to transform the curriculum in these schools.

Table 4.7 Transforming the curriculum with ICT

School category	**FDET n=22**		**FHOR n=4**		**FMC n=12**		**Overall Percentage n=38**	
Teachers believe that computers can …	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Enhance learning	x	5%	x	25%	x	8%	3	8%
Be integrated across the learning areas	x	5%	x	25%			2	5%
Develop learner independence	x	5%	-	-	x	8%	2	5%
Afford access to information	x	5%	-	-	x	8%	2	5%
Promote learner centred approach	x x	9 %	-	-	-	-	2	5%
Encourage life long learning	-	-	-	-	x	8%	1	3%
Promote visualisation of concepts	x	5%	-	-	x	8%	1	3%
			Total				14	37%

Thirty seven percent (14) of teachers were able to identify some benefits related to curriculum transformation. Fifty percent (2) of the teachers from the FHOR school made the following comments: "*ICT enhance learning";* and *"ICT is integrated across the disciplines to support learning"* (FHOR teachers). Forty two percent (5) of the teachers from the FMC schools commented: "*Computers explain concepts with live action* [simulation] (FMC 3 teacher); *"computers give learners opportunity to work on their own"*, (2 FMC teachers) *"learners are able to work at their own pace", "with computers everyone learns something"* (FMC 1 teachers). Lastly 23% (5) of the teachers from the FDET schools commented, "*computers provide opportunity for life long learning for both the teacher and the learner"* (2 FDET teachers)*;*

"learners get opportunity to visualise concepts" (FDET 3 teacher)*; "learners no longer depend to the teacher for information"* (FDET 1 teacher).
"To add more OBE is child centred, it is the child who has to do most of the work. Using computers will enrich them. They have to search for information on their own. The teacher will guide them there and there. But they have to search it on their own and analyse it or discuss it in group or in the class and come up with a final decision on what they think is valid information" (FDET4 teacher).

In interpreting what the teachers said, I would argue that they view computers as tools to learn "with" not to learn "from" (Jonassen 1996). Teachers also view computers as providing opportunity to encourage learners to work on their own. This means that teachers are using computers to move from the traditional approach (teacher-centred approach) to the constructivist approach (learner-centred approach). The comments may indicate that teachers view computers as catalysts in transforming the curriculum, which corresponds to the catalytic rationale (Hawkridge 1990). In my observation, teachers view computers as being beneficial to teaching and learning when they are comfortable enough with the tool to move away from the traditional approach of teaching and learning to a constructivist approach.

4.6.3 Internet

The third set of comments concerned the use of Internet for accessing information and for communication, and was raised by the teachers from the FDET schools and the FMC schools only. Teachers overtly indicated why they perceive Internet as beneficial to teaching and learning in response to Q12 in the questionnaire survey.

Table 4.8: Questionnaire data: Internet as beneficial in teaching

School categories	**FDET schools n-= 22**		**FHOR n = 4**		**FMC 1 n = 12**		**Over-all % n = 38**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Research	4	18%	-	-	2	17 %	6	15%
Communication	2	9%	-	-	1	8%	3	8%
Total Number of comments	6	27%	-	-	3	25%	9	21%

Twenty one percent of teachers from the three categories of schools perceive Internet as beneficial in the teaching and learning process for the following reasons:

- It provides opportunity to do research, which corresponds with Granger *et al* (2002) research.
- It provides an opportunity for synchronous[4] communication, which corresponds directly with the research undertaken by Romiszowski & Mason (1996).

Fifteen percent of teachers (four from FDET schools and two from FMC schools) highlighted the benefit of using Internet for research. Eight percent highlighted the benefit of using the Internet for synchronous communications. Nine percent of the teachers from the FDET schools and eight percent of the teachers from the FMC schools highlighted the benefit of using Internet for communication. This again shows a discrepancy in the answering of questions by FHOR school teachers. Teachers from the FHOR school mentioned nothing in line with the benefit of using Internet for research in Q12.

During the semi-structured interviews the teachers from the FDET schools displayed enthusiasm and expressed their belief about what the Internet can do to support teaching and learning. Even

[4] Synchronous: Communication between two people that takes place in real time such as face to face discussion or online conversations.

the Xhosa teachers from FDET4 and FDET6 schools were of the view that the Internet is a useful resource that they use to access information in preparation for their lessons, despite the fact that most of the information online is in English. They did not feel disadvantaged by the fact that information is mostly presented in English:
"lets take a political topic; we take the history of Nelson Mandela from the computer and you find it in English and as a Xhosa teacher you have to translate it to Xhosa for your learners . This means as a teacher you cannot say there is no information that can help you to teach Xhosa from the internet." (FDET 6 teacher).

A teacher's response to the question posed around communication during semi-structured interviews was: "*I think if we were having enough computers and internet. learners would be able to communicate with other learners outside SA and even inside. They can socialise with other learners trying to find out what they need from other learners"* (FDET 1).

During the semi-structured interviews, one teacher from FMC 3 school alluded to the benefits of providing improved email systems to the school: "*One of the teachers is leaving and going to Australia, and I said , it's not impossible for [her] to teach from Australia if we have better bandwidth and that kind of opened some eyes*" (FMC 3 teacher). Similar to what Hartley (2007) suggested, this comment means teachers can provide distance teaching to their learners through the use of the Internet. However this depends to the amount of bandwidth that is available and what the school can afford. The said teacher also explained how he became aware of the value of using email in the teaching process:

"I really learnt the value of this at [Independent school] I started playing around and I remember telling you about it, sending poems to the grade 8 and 9's I was teaching, and having them comment on the poem by email, which was an amazing experience, because some of the kids you never hear from in the class, are writing this awesome response to a poem. The feedback that I got when I asked them how they felt about this process of emailing back and forth was it was really nice because in class they don't like to speak up. I would really have loved to try to see a lot more about the communication aspect" (FMC 3 teacher).

In conclusion, positive attitudes on the benefits of using Internet were revealed during the semi-structured interviews. Teachers were passionate about what the Internet provides to the teaching and learning process. It would seem that the interviewed teachers view the Internet as the provider of valuable material for teaching and learning. The idea of translating English to Xhosa was not viewed as a disadvantage but overlooked because of usefulness of the information. The interviewed teacher from the FMC 3 school displayed advanced ICT skill, which includes awareness of improved communication systems that can benefit teaching. The communication benefit is possibly the most important one to the teachers since it is not possible without access to computer networks.

The perceived benefits of using the Internet are related to curriculum transformation. The Internet allows learners to access information which they can analyse before they use it. Teachers argued that access to information by learners encourages a move from a traditional approach where learners are viewed as *tabula rasa* and therefore cannot manipulate and analyse information to a learner-centred approach which allows students to select and critique information from various sources. Communication allows learners and teachers to learn through socialising with other peers and knowledgeable others. In this way communication extends an "intellectual partnership" (Salomon, Perkins & Globerson 1991) even when the learner is away from the computer. It would seem that teachers believe that learners construct knowledge through active participation in a socialised environment.

Communication via – the Internet can promote distance learning. Distance learning was identified by a teacher from a FMC school who argued that the distance learning should be encouraged in schools in the event that a teacher is away from school. None of the FHOR teachers indicated their awareness of the benefits of using the Internet despite the fact that they claimed to be using computers for research.

4.6.4 Time management

In terms of time management, similar views were expressed through the questionnaires and the semi-structured interviews. The comments made focused on the use of computers for

administrative purposes. According to their comments, teachers seemed to have struggled with paper work which consequently had a negative impact on their teaching. The detailed report of the responses from the questionnaires is given in Table 4.9.

Table 4.9: Questionnaire data: Time management

School categories	**FDET n=22**		**FHOR n=4**		**FMC n=12**		**Overall n=38**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Minimise manual work	x x	9%			x	8%	3	8
Reduces time spent on admin work	x	5%	x	25%	x	8%	3	8
Increases contact time	x	5%	-	-	-	-	1	3%
Total	4	18%	1	25%	2	17%	7	18%

Overall 18% (7) of the teachers from the three categories of schools indicated that computers help them to manage time effectively. The seven teachers include one (25%) of four teachers from the FHOR school; four (18%) of 22 teachers from FDET schools and two (17%) of 12 teachers from FMC schools. The comments that were made during the questionnaire survey include *computers minimises manual work* (3 comments), *reduces time spent on hand written work by word processing work* and *speeds up admin work* (3 comments), *provides more contact time with learners through reduction of manual work* (1 comment).

In my view all these comments revolve around the time that teachers used to spend in doing manual work. According to their comments, they finish their administration work much quicker than when they had to do so by hand and are able to spend more time with their learners. This corresponds well with Selwood and Pilkingtons' findings that ICT releases time to teach (2005).

When the question on time management was posed during the semi-structured interviews, one of the responses given was:

"*You know it depends, there only thing I can say is that Ms Word and Ms Excel help with manual work for me and that saves a lot of my time. Like in Ms Excel you just need a formula and it can*

work out all your marks when you do your schedules and even put the names in alphabetical order" (FDET 5 teacher).

A teacher from the FMC schools also commented: *"We've changed the way we do reports, we're using central data base system […] I feel quite passionately about not wasting time on*" (FMC 3 teacher). Nothing was said by the interviewed teacher from the FHOR school during the semi-structured interviews.

In brief, there are teachers who indicated that computers save time in each school category. Like teachers in the UK (Becta 2005), the teachers in this study strongly emphasised the manner in which computers have helped them in reducing their work load and save time that was reinvested in other tasks such as lesson preparation and teaching.

4.6.5 Storage facility

The fewest comments made are related to the function of computers as storage facilities. In highlighting storing as the benefit of using computers the following themes emerged (Table 4.10):

- Period of storing
- Electronic devices used to store data.
- Being able to save data from one computer and take it to retrieve in another computer.

Table 4.10 Computers as storage facilities

School Category	**FDET n=22**		**FHOR n=4**		**FMC n=12**		**Overall Percentage n=38**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Period	**x**	**5%**	**-**	**-**	**-**	**-**	**1**	**3%**
Saving devices	**x**	**5%**	**-**	**-**	**x**	**8%**	**2**	**5%**
Saving and retrieving	**-**	**-**	**-**	**-**	**x**	**8%**	**1**	**3%**
Total	**2**	**9%**	**-**	**-**	**2**	**17%**	**4**	**10%**

Of 38 teachers only four (10%) highlighted the storing of information as the benefit of using computers. Of the four teachers, two teachers are from the FMC schools and two are from the FDET schools. Teachers from the FHOR school said nothing around the benefit of using computers as storage facilities. From the two of the FMC school teachers, one mentioned the electronic devices such as memory sticks and CDs that can be used to store data: "*then I use flash memory to move it across or I just burn it onto disc if it's too big"* (FMC 3 teacher), while the other one mentioned the use of electronic devices to store data at the same time he or she acknowledged the length of time for which data can be stored on the electronic devices: ""*It is good to use computer because one can save data in the computer or in the stiffy disk and keep it for years*" (FMC 1 teacher). One teacher from the FDET schools also made a comment about the length of time that data can be saved on the computer: *"Saved documents can be stored in the computer over a long period"* (FDET 3 teacher).

It has been noted that computers are good storage facilities that can keep data for years. Again the idea of storing information on a stiffy disk or memory flash stick helps teachers to move data from one machine to another. Therefore you can work on a computer at home and present what you have done on the computer at school. Similar to studies conducted by Becta (2005) and Selwood and Pilkington (2005) this reveals that ICT help teachers in managing and maintaining their work, thus reducing teacher workload. The benefits that teachers perceive are summarised in a tabular form in Table 4.11.

Table 4.11 Questionnaire and Interview data: Summary of the benefits perceived

School category		**FDET**					**FHOR**	**FMC**			**Categories commented**
Benefit perceived		1	3	4	5	6		1	2	3	
Development of skills	Computer literacy	x	x	x x	x	x	x	x x	x x	x x	13
	Research skills			x				x			2
	Collaborative skills									x	1
						Total number of developed skills					15
Curriculum transformation		x	x x	x x	x	x	x x	x	x x	xx	14
Internet		x	x x	x	x	x		x	x	x	9
Time management		x		x x	x		x	x		x	7
Storage facility			x			x				x x	4

On the whole, the teachers' response to the benefits of using computers in the curriculum revolved around development of skills, curriculum transformation, time management, use of the Internet and storage facilities. Of the three different skills that teachers perceive to be offered by

computers, computer literacy was the most recognized benefit. Teachers indicated that computers help them in transforming the method of teaching. The Internet was mentioned as providing access to information. The time management comments alluded to the experiences of having to produce hand written documents. Teachers perceived computers as providing better storage facilities that can store information over a long period of time.

4.7 Teachers' perceptions of the challenges

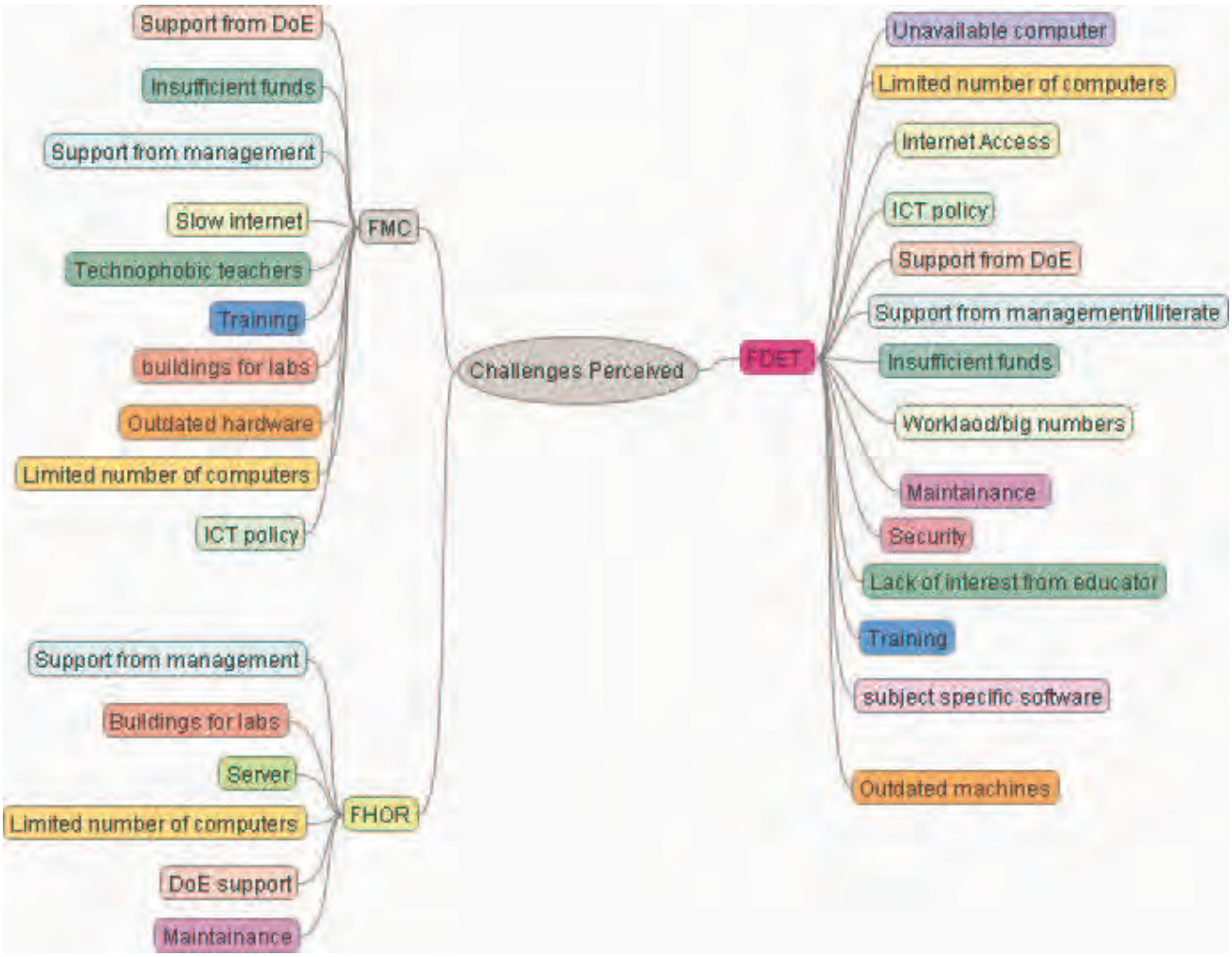
Teachers' perceptions of the challenges of using ICT in the curriculum were covered by question 13 (Q13). The questions from the semi-structured interviews also probed in-depth what teachers perceive as challenges in the integration of ICT into the curriculum. Before interpreting the findings I first present the data from the questionnaire in Table 4.12.

Table 4.12: Questionnaire data: Teachers' perceptions of the challenges

Challenges Perceived		**FDET : n=22**		**FHOR : n=4**		**FMC: n =12**		**OVERALL PERCENTAGE n=38**	
		n	**%**	**n**	**%**	**n**	**%**	**N**	**%**
INFRASTRUCTURE & NETWORK	Limited computer hardware	9	41%	2	50%	1	8%	12	32%
	Inadequate maintenance	4	18%	1	25%	2	8%	7	18%
	Insufficient buildings	0	0%	2	50%	1	8%	3	8%
	Lack of subject specific software	2	9%	0	0%	1	8%	3	8%
	Absence of Internet connectivity	0	0%	0	0%	2	17%	2	5%
	Percentage /category	**12**	**11%**	**4**	**20%**	**6**	**10%**	**27**	**71%**
Workload		4	18%	0	0%	1	8%	5	13%
Unavailable ICT policy		1	5%	0	0%	3	25%	4	10%
Insufficient training		2	9%	1	25%	0	0%	3	8%
Learners abilities		0	0%	0	0%	3	25%	3	8%
Inappropriate Information		1	5%	0	0%	0	0%	1	3%
No Response		7	32%	2	50%	5	42%	14	**36%**

From Table 4.12 it is clear that the key challenge, 32% overall, was the lack of hardware. This sentiment was echoed in the interviews (Figure 4.8). The discussions that follow will compare and contrast teachers' responses to Q13 and the interviews in the order of the themes that emerged most frequently from the responses to the questionnaire.

Figure 4.7: Interview data: Challenges perceived



The interpretation of findings begins with what the questionnaires revealed, links these ideas with what was said during the semi-structured interviews and lastly discusses the points that emerged during the semi-structured interviews.

4.7.1 Infrastructure and Networking

Both the questionnaire and the semi-structured interviews revealed that the most frequently mentioned perceived challenge revolves around the infrastructure. From the questionnaires, of the 38 teachers 27 teachers (71%) reported that the unavailability of infrastructure as the

hindering factor in the integration of ICT in the curriculum. Of the 27 teachers, 12 teachers reported the unavailability of computer hardware, 7 teachers reported the lack of maintenance, 3 teachers reported inadequate buildings and inappropriate subject specific software; and 2 teachers reported the lack of Internet connectivity as major challenges in the integration of ICT at their school.

Insufficient computer hardware

Under infrastructure, 50% of teachers from the FHOR school and 41% of teachers from the FDET schools reported the lack of computer hardware as the most inhibiting factor in their schools. Only 8% of teachers from the FMC schools reported the insufficiency of computer hardware as a hindering factor in the process of ICT integration in their school curriculum. This response was echoed by teachers from the three categories of school during semi-structured interviews: "*Basically, we have few computers and not all of these are working or are in good conditions*" (FDET 4 teacher).

Inadequate Maintenance

According to 18% of the teachers from the FDET schools and 25% of the teachers from the FHOR schools and 8% of the teachers from the FMC schools, inadequate maintenance was another factor that inhibits the integration of ICT into the curriculum. Maintaining the outdated computers was a problem encountered in their schools. One teacher from the FDET schools complained that the old computers in their school have a virus and some cannot save. This means the outdated computers cannot be included in an inventory of the computers that the school has since they are not in good working condition. In order to cope with this challenge a teacher from a FDET school reported that they receive support from the local university or make use of school funds:

"*In terms of technicians when computers are down-we are dependent solely on Rhodes University to assist us. They normally offer their services free of charge. This is what we are looking for because our school is very poor, we cannot afford to hire eh … technical support for us. It's very difficult to cope now we are looking forward to get some money from the school fund which money might be utilised to repair those that are down*" (FDET 3 teacher).

What transpired during the semi-structured interviews is that the FHOR school is always in predicament as far as the maintenance of computers is concerned. Sometimes they have hardware-related problems and at the other times software-related problems. "*And my problem now is that we have the software, but no machines to run them on*" (FHOR teacher). The presence of outdated machines was reported as the hindering factor of ICT integration by the FMC 3 teacher.

"*The problem at the moment, while I said that it was very nice that there are now some computers in classrooms, old machines, but it's kind of a self fulfilling prophecy in some ways. What happens is that they are using old machines with old software. What do they do once they have copied something, or they've put it onto a stiffy disk which they take up to the lab, which invariably doesn't work because it has a virus on, and so they start to become frustrated by it not working and so they say, gee, look, these machines actually don't help us at all"* (FMC 3 teacher).

This means that schools will continue to have problems even in the presence of new computers if the old computers are kept without being up-dated, as this hinders the ease with which teachers can transfer data between computers.

Insufficient buildings

The second point raised was the lack of sufficient space for computer labs. Two comments (50%) were made by the teachers from the FHOR school, three comments (8%) were made by the teachers from the FMC schools about the unsuitability of the buildings to be used as computer laboratories. In addition to this, a teacher from the FMC schools said: "*The biggest problem is that we do not get funds […] to maintain buildings*" (FMC 1 teacher). No comment was made by the teachers from the FDET schools.

Lack of subject specific software

From the questionnaire, two (9%) of the teachers from the FDET schools and one (8%) of teachers from the FMC schools commented on the lack of subject specific software as a hindering

factor in the integration of ICT into the curriculum. No comment was made by the FHOR teachers. In responding to this during semi-structured interviews, a teacher from a FDET school endorsed what was said during the questionnaire survey: "*Presently because of lack of appropriate software the integration of ICT into our curriculum is not effective*" (FDET 3 teacher). Lack of software can seriously limit teachers from implementing what they are able to do with ICT (Mumtaz 2000). One teacher from FDET 3 school was positive that with subject specific software, his school would be able to integrate ICT in the curriculum: "*Well it will be possible to get what ever software they [teachers] might need […] to assist them in the integration of ICT into the curriculum*" (FDET 3 teacher).

Absence of Internet connectivity

Only two (17%) teachers from the FMC schools reported the lack of access to the Internet as a problem during the questionnaire survey. This response remained obscure until semi-structured interviews were conducted. During the semi-structured interviews the FMC teachers commented: "*We share a band with [Independent school, FMC 1 and FMC 3] […], and the band that we get is negligible*" (FMC 3 teacher).

Despite the unavailability of the Internet at FDET 1, FDET 5 and FDET 6 the teachers from these schools did not report this as a challenge during questionnaire survey. However comments made informally during the visit for the semi-structured interviews indicated that the lack of Internet connectivity is a problem: "*There are few computers here and we do not have internet"* (FDET 1 teacher).

In short it is evident that the use of the Internet is limited to the two categories of schools. Even though the FMC schools are connected, limited bandwidth remains the problem. Three FDET schools were the worst off since they were not connected to the Internet at all.

4.7.2 Teacher workload

In terms of teacher workload 4 (14%) teachers from the FDET schools and one (8%) of the teachers from the FMC schools reported that the teacher workload is a stumbling block in the integration of ICT in the curriculum. The teachers view the large number of learners as matter

for concern. They are faced with large numbers in class and the other teacher-related demands: "*We cannot bring learners to the centre because of the number of learners in our classrooms. And because of work load we don't have time for them. If we can have more computers maybe we would be able to integrate ICT*" (FDET 1 teacher). Large numbers of pupils were also perceived as a problem because of the small number of computers available in schools and insufficient space in the computer labs: "*We cannot accommodate the whole class in the computer lab*" (FMC 1 teacher). "*To add more on that, we have quite big classes. It becomes difficult to take all learners to the lab. We take few of them and even those we take have to share the computers. But even then some are left in the classroom*" (FDET 4 teacher). There is no mention of workload concerns from the FHOR school teachers.

4.7.3 Lack of ICT policy

The questionnaire data reported that 25% of the teachers from the FMC schools and 5% of the teachers from the FDET schools claimed not to have a policy for the integration of ICT in place at their schools. These teachers reported that the lack of a school ICT policy was hindering the integration of ICT in the curriculum. Teachers recommended that in order for ICT to be integrated effectively, the manner in which teachers are to integrate ICT should be reflected on the school time-table. The semi-structured interviews revealed that it is not only the school ICT policy that is not available; all the teachers from the three school categories were unaware of the DoE White paper on e-education. When the question on the e-education policy was posed, one of the teachers from the FMC schools responded vigorously:

"*On ICT specifically, no, not really. Within school structure at the moment, I'm head of curriculum which means that all policy documents relating to curriculum and documents generally will often pass over my desk. I still haven't seen anything on ICT that would interest me as it would invariably be sent to me no matter what it's status was, and I haven't seen anything"* (FMC 3 teacher).

Teachers agree that they needed guidance to integrate ICT into the curriculum. They were of the view that ICT policies could provide the guidance Hodgkinson-Williams (2005) suggests.

4.7.4 Insufficient training

Two (25%) of the teachers from the FHOR school and two (9%) of teachers from the FDET schools reported insufficient training as a problem in their schools. In contrast to the low percentage of teachers who reported this challenge, the response of teachers during the semi-structured interviews indicated that there are many teachers who experience the same problem; they view the training of teachers as a significant constraint in the integration of ICT in their schools: "*Well they just need simple training if they can just undergo training like we have"* (FDET 3 teacher). However, the teachers who reported having received training still see the need for them to be trained further: "*We as teachers need to get training courses, intensive courses before we can think of adding it in our main stream*" (FDET 5 teacher). One of the reasons for raising training as a point for concern is that in some schools there are teachers who show less interest in using computers than others. In most cases teachers who showed interest are those who claimed to have received computer training for the integration of ICT in their LAs. The training might have stimulated their interest and resulted in improving their levels of ICT competence as Becta (2005) reported of UK teachers.

Despite the fact that none of the teachers from the FMC schools reported training of teachers as the challenge, a technophobic attitude was raised during the interview:
"*The "technophobia" among the staff is definitely holding the process back considerably, but you know, often people will say that the way to reverse that is to give them training*" (FMC 3 teacher).

In arguing this further, the said teacher from the FMC 3 school alluded to the view that technophobia or resistance to change cannot be eliminated merely through training of teachers as noted in Granger *et al.'s* (2002) study. According to the FMC 3 interviewed teacher, training is not the solution; according to him changing the teachers' perception is the key in addressing the technophobic attitude of teachers as Lee (2002) has proposed.

4.7.5 Limited abilities of learners

The limited learners' abilities were mentioned by three (25%) of the teachers from the FMC schools as inhibiting the use of ICTs in the curriculum. The teachers were concerned about the learners' computer literacy level at the senior grades (grade 10-grade 12). The concerned

teachers indicated that learners' computer literacy skills are not developed at the junior level, but they expected to select Computer Assisted Technology (CAT) as an optional subject at grade 10: "*Pupils also often lack the basic skills by the time they start Grade 10. Pupils do not have time to practice on a computer as many do not have them at home*" (FMC 3 teacher). The teachers from the FDET schools and the teachers from the FHOR school did not mention learners' abilities as a constraint in integrating ICT in their schools. This might be due to absence of CAT in their schools.

4.7.6 Inappropriate information

Some information on the Internet that was deemed inappropriate to learners was raised by five of the teachers from the FDET teachers during the questionnaire survey. In the questionnaires teachers state that through the process of researching information; the teachers would find information that has not been filtered: "*Information not thoroughly dealt with"* (FDET 3 teacher). Through personal communication with one FDET teacher it was reported that pornography was seen as unacceptable by the teachers and that they did not know how to deal with it (J.Turygyenda [5]Personal comm.2004). This result from the fact that the Web information is uncontrolled (Oppenheimer 1997).

4.7.7 No Response

Despite the fact that the number of challenges were mentioned by the teachers; 14 of teachers did not respond to the question (Q13). Two of the teachers are from the FHOR school; five of the teachers are from the FMC schools and seven of the teachers are from the FDET schools. It is not easy to interpret their lack of responses.

4.7.8 Lack of DoE support

The teachers interviewed from all three school categories reported that the integration of ICT in the curriculum is taking place without the involvement of Department of Education (DoE). Interestingly, a teacher from a FDET school raised this point without being asked:

"*But I also want to say that the department needs to help us with these computers because you find out that with the most of black schools we get computers through participating in*

[5] J. Turygyenda: ICT competent colleague actively involved in implementing ICT into teaching and learning

competitions sometimes by chance. The school, most of the black schools, maybe 90% of them cannot afford to buy computers for themselves, the department should. The Department needs to do something about it. Even when you do get computers maybe you won computers there are no teachers to teach them if there are teachers to teach them there is no money to maintain them as our case" (FDET 3 teacher).

This means the teachers are aware that the DoE may not have funds to support all the schools with ICT related resources, however at least part of the ICT should be supported by the DoE, for example; maintenance and security. This lack of support from the DoE officials may be due to insufficient ICT knowledge possessed by district officials as Carnoy (2004) suggests in his study.

4.7.9 Inadequate management support

The teachers interviewed from the three school categories alluded to the challenge of not receiving sufficient support from the school management. One teacher reported that even the school management team needs to be trained in order to be able to support the integration of ICT in their schools: "*The management also need to be trained in order to know what to do in their schools*" (FDET 6 teacher). The one interviewed teacher from the FMC 3 school found it difficult to lead the curriculum of his school since whenever he suggested something to be done on computers, he would be asked to do it himself:

"*I was surprised last year I went to a management meeting and said to them, we need new computers, and I knew that I would be told – go and find out, what do we need and get us some quotes, and within a school environment, that's beyond my preview, so that's usually a brush off to be told that, but I went and I got the stuff and I brought it to them and I told them that it was from a company in PE that they might want to look into, they offer IT solutions and we've got new computers*" (FMC 3 teacher).

One interviewed teacher from the FHOR school indirectly reported the lack of support from his school management. There seemed to be a number of disagreements between the IT teacher and the school management who according to the interviewed teacher were not in favour of the integration of ICT in the curriculum.

The interviews revealed that there were subtle tensions between the school principals and the teachers who, in my observations, showed a passion for using ICT within the curriculum. A teacher from the FHOR school and a teacher from a FMC school implicitly alluded to the ignorance of school principals when they asked for ICT related support. According to these teachers, principals are supposed to lead the integration of ICT in the school curriculum as suggested by Flanagan and Jacobson (2003).

4.7.10 Insufficient funds

Scarcity of funding was raised as the challenge by the teachers from the FDET schools, FHOR school and FMC schools. The schools are running without sufficient funds to purchase and maintain computers and in some cases to pay for the ICT specialist. One of the teachers from FMC 2 school reported that the school had to secure funds to pay the ICT coordinator since the person was employed by the School Governing Body (SGB) not by the DoE: "*The biggest problem is that we do not get funds from the government so we have to generate funds to maintain buildings and pay extra teachers*" (FMC 2 teacher). In some schools learners paid extra fees in order to attend computer classes. This matter on its own created a problem for the respective schools. They had to find a way of addressing it.

"*In this school computers are an extra mural activity for instance [the IT convener] after school she stays behind and teach the learners who have paid R50, 00 but as I've said there are few computers working at the moment, two in this lab and in the old lab I think there are five so she has to take few of them teach them and then after maybe a month teach other learners but [only learners] who have paid the R50,00 [are taken to the lab]*" (FDET 3 teacher).

The one interviewed teacher from the FHOR school alluded to his frustration of being unable to run the computer department at his school due to insufficient funds. In his comments, he referred to the registering of the school as Section 21[6] school as a possible strategy that could increase the problem of scarce funds instead of eliminating it.

[6] Section 21 schools are schools that have a responsibility of managing the finances deposited in their school bank account by the DoE. They remain public schools owned by and accountable to the South African state (DoE, KZN:2006)

4.7.11 Inadequate security

Although security was not mentioned during the questionnaire survey, during semi- structured interviews the teachers from the FDET 4, FDET 5 and FDET 6 schools alluded to the inadequate security as the hindering factor in the integration of ICT in the curriculum at their schools. Teachers from the FDET 4 schools and the teachers from the FDET 6 schools reported having lost computers through a school burglary that took place at their schools. The teachers from the FDET 5 school reported having forfeited the opportunity to get computers from the private company because of not having a secured classroom to use as the school computer laboratory.

4.7.12 Summary of the challenges perceived by teachers

In summary, the questionnaire and the semi-structured interview data revealed that the critical inhibitors that impede teachers from integrating ICT in the curriculum revolve around insufficient infrastructure, lack of teacher training, learners' limited abilities, unavailable ICT policy, high workloads and inappropriate information on the Internet. The most frequently mentioned inhibitor under infrastructure was computer hardware, followed by maintenance, buildings, subject specific software and Internet. In considering the number of comments made by the teachers from FDET schools and the FHOR schools under infrastructure; it is evident that there is a gap between the FMC schools and the two other categories that were previously under-served. This may mean in addressing the integration of ICT into the curriculum of the Grahamstown secondary schools, one has to address the digital divide as one of the issues that the White paper on e-education highlights. Following infrastructure was the need for the development of teachers, which included training of teachers and ongoing support. Limited learner ability was mention by teachers from the FMC schools where CAT forms part of the curriculum. Absence of ICT policy was viewed as a constraint which holds the key to the process of ICT integration since its presence would guide teachers in implementing ICTs into their teaching.

While previous authors reported on the reduction of teacher workload by ICTs, in contrast teachers from the three categories of school reported increased teacher workload as hindering the process. Teachers from a FDET school viewed the Web as providing inappropriate information to learners. There was lack of DoE support which could be the result of technology illiterate

district officials. The lack of support from the management was also raised as a matter of concern. Insufficient funds were identified as hindering the schools from the running of computer laboratories, from providing the school with computers, teacher development workshops and ongoing technical support.

Lack of security was reported as a problem by the school that lost computers through a burglary. The no response had a high percentage from all schools in the questionnaire.

Table 4.13: Summary of questionnaire & interview data: Number of comments on the challenges perceived per school (x stands for questionnaire comments and o stands for interview comments)

Challenges perceived		**FDET SCHOOLS**					**FHOR SCHOOL**	**FMC SHOOLS**			**NUMBER OF COMMENTS**
		1	**3**	**4**	**5**	**6**		**1**	**2**	**3**	**ALL**
Infrastructure	**Hardware**	X o	xx o	xx o	xx o	xx o	xx o	X o	o	x o	21 8 **29**
	Inadequate maintenance		x o	x x o	xx		x o		x	x o	7 4 **11**
	Internet	X o			x	x			x o	x o	5 3 **8**
	Buildings						xx o	X o			3 2 **5**
	Software		x o		x			X			3 1 **4**
Total		**4**	**7**	**6**	**6**	**4**	**8**	**5**	**4**	**6**	**50**
Lack of ICT policy		x o	x o	x o	x o	x o	x o	X o	x o	x o	9 9 =**18**
Lack of DoE support		O	o	o	o	o	o	O	o	o	9
Insufficient funds		O	o	o	o	o	o	O			7
Insufficient training		xo	xx o	o	x o	o	x	O		x o	6 7 =**13**
Limited learners' abilities										xxx o	3 1 **4**
Teacher workload		x		x				X			3
Inappropriate information			xx								2
Total		**9**	**11**	**8**	**8**	**7**	**7**	**6**	**5**	**10**	**71**

4.8 To what extent do secondary teachers of the Grahamstown Circuit integrate ICT into the curriculum?

In arguing the extent to which ICT is integrated in the Grahamstown secondary schools, I base my argument on the findings of this study in relation to the models of ICT integration as proposed by McCormick and Scrimshaw (2001). I make use of the most relevant findings which I can compare and contrast with McCormick and Scrimshaw's models of ICT integration in to the curriculum.

- training of teachers
- ICT policy within the school,
- access to computers,
- the most frequently used software, and
- the purposes of using computers.

I further make use of the levels of integrating ICT in schools' curriculum from the model I adapted from UNESCO to make my judgement on the level of integration of ICT into the secondary schools of the Grahamstown circuit. The levels of the adapted model consist of the emerging, applying, infusing, transforming and innovating levels.

The findings reveal that very few teachers were trained by the schools. Most teachers claimed having received training through their own studies and most of those received computer literacy training only. Even those who claimed having received training in order to integrate ICT in their teaching expressed the feeling of not being confident enough to integrate ICT in their teaching. The teachers concerned indicated the gap between trained teachers and the school policies. According to my analysis of the situation the "gap" was due to the fact that the training that teachers received was not informed by the needs of the school, it was informed by the teachers own interest. This was justified by answers given to the question asking about the availability of ICT policy in schools.

According to the responses given none of the schools had an ICT policy in place. This means that none of the schools had organized time-tables with defined strategies of ICT integration. However teachers from two FMC schools indicated having ICT training workshops at their

schools. In addition to this all teachers claimed not to be in possession of the national e-education policy. It is therefore clear that ICT integration in the Grahamstown circuit exposed teachers to a difficult situation of "wanting" to integrate ICT but being impeded by lack of guidance from the DoE. Likewise the lack of ICT policies in schools resulted in absence of guidance on how teachers could use computers in their teaching. Ideally an ICT policy would help teachers decide on whether to use computers to: *improve efficiency and effectiveness, extend the reach of teaching and learning, or transform the concept of the subject* (McCormick & Scrimshaw 2001).

Although the schools had no ICT policy, teachers indicated having access to computers, even though they were unable to take the whole class to the computer laboratory due to the big number of learners per class. The highest use of application software indicates that most teachers from the three school categories used the representational approach by Hokanson and Hooper (2000). This therefore means that the teachers used computers to improve efficiency and effectiveness by word processing their mark lists and tests.

The use of *Geometer Sketchpad*, *Crocodile Clips* and *Ms Excel* (educational software) for teaching graphs indicates that there are times when the generative (Hokanson & Hooper 2000) approach was used. However the minimal use of educational software indicates that not all teachers were able to adopt the generative approach. This means, there were very few teachers who were able to extend the reach of ICT and even those who were able to, could do so to a negligible extent because of insufficient computer hardware.

The inadequate internet connectivity also impeded the exposure of teachers to other teachers' work and to transforming their teaching into a collaborative type of teaching that could be done through communication with other teachers and learners from other places. With regards to the issues discussed above; insufficient training, absence of ICT policy inadequate use of educational software, and inadequate Internet connectivity, teachers of the secondary schools of the Grahamstown circuit appear to be at the emerging phase of integrating ICT in their teaching. Even the emerging phase is dependent upon the teachers' interest not to the schools' interest. According to the findings, the school management from only the FMC schools and one FDET school are supporting the integration of ICT in their schools. However even in these schools

there are no continuous programmes to monitor and support teachers as it is suggested in the application phase of ICT integration. Therefore teachers at the secondary schools of Grahamstown were still very far from integrating ICT at the transforming and the innovating phases.

4.9 Conclusion

Teacher's access to computers differs from school to school. There are schools with worse scenarios, i.e. where the teachers do not have access to computer at all. However, that does not mean teachers from these schools did not receive any kind of training. It is noted that teachers from the three categories of schools claim to have received some kind of training for both computer literacy and for using computers in their teaching. Most teachers claimed to have received training through their own studies. The highest percentage of training received is 75% for computer literary and 50% for using computers for teaching and learning both being from the FMC school teachers.

The most frequently used software is application software. This software is most commonly used for administration purposes even though some teachers claimed to have used various productivity tools for teaching and learning. *MsWord* is the most frequently used software across the three categories. Very few teachers reported the use of educational software; one teacher from the FHOR school reported the use of *Geometer Sketch Pad* and *Crocodile Clips*, one from the FDET schools reported the use of *Geometer Sketch Pad*, while one teacher from the FMC school reported the use of *Encarta Encyclopaedia*.

Administration seemed to be the most common purpose of using computers with FHOR school (36%) leading the other two school categories. Teaching and learning was the second most purpose of using computers with 32% of teachers from FDET schools claiming to use computers for teaching and learning. Communication, research and marketing were reported as other purposes of using computers.

According to the teachers from the secondary schools of the Grahamstown circuit one of the benefit of integration of ICT into the curriculum is that learners will be computer literate and be

easily marketed in the job world today. This is promoting the vocational rationale by Hawkridge (1990). Research and collaborative skills were reported as specific skills developed through the use of the Internet. The Internet is viewed as providing communication which allows teachers to communicate with other teachers and obtain more access to relevant information needed in their teaching. Teachers also view computers as supporting them in their attempts to transform the curriculum.

Chapter 5

Concluding discussions and Recommendations

5.1 Introduction

In Chapter 1 I provided an overview of the international context and the South African context of the study. In relation to this context provided, I established the goal of my study which then informed me of the questions that needed to be asked in order to accomplish my goal. In Chapter 2 I reviewed the underlying theories that inform the use of ICTS for teaching as well a review a selection of research on the use of ICTs for teaching. In Chapter 3 I explained the research design choices and in Chapter 4, I provided a synthesized analysis of data, pertaining to the subsidiary questions. I discussed the findings in relation to what is reflected in the literature review provided in Chapter 2 and focus particularly on the extent by which secondary teachers in the Grahamstown Circuit integrate ICT within their teaching. I deduced my themes from the findings in Chapter 4 which identified teachers' perceptions of the most pertinent issues in the integration of ICT into the curriculum. I started by discussing teachers' access to computers in order to establish which teachers had the necessary infrastructure to be able to integrate ICT into the curriculum, to what extent they integrated ICT in their LAs, what benefits they perceive, what challenges they face and how they cope with these challenges. With reference to the finding and my own analyses of the integration of ICT, I discussed the challenges that teachers faced and make some recommendations. The areas of weakness in the integration of ICT becomes the major focal point in the further studies, hence after recommendations I suggest the further research studies that can be made with reference to this study.

5.2 Summary of findings

5.2.1 Who could integrate ICT into the curriculum?

In my analysis of the findings I deduced that only the teachers who received some form of formal or informal training to integrate ICT into the curriculum claimed to be able to integrate ICT in their teaching. According to the findings the teachers claim having received training to integrate

ICT through their own studies (50% of FMC, 36% of FDET and 25 % of FHOR school teachers), through sponsored projects (e.g. the Khula Project) (8 FDET, 3 FHOR school teachers); through training arranged by the school (42% FMC, 32% FDET & 25% FHOR), through training arranged by the DoE (23% FDET & 8% FMC) and training or through informal support of family and friends (8% of the FMC school teachers). Having noted that some of the teachers who claimed to have receive training through their own studies are those who claimed to have received training through the other forms of training, I regard the percentages of teachers who have received training through their own studies as the percentage of teachers who have received training in order to integrate ICT into the curriculum (36% of FDET, 25% of FHOR and 50% of FMC school teachers) and this means the teachers were driven by their own interest or curiosity and as such they had to pay for their studies and to spend their holidays and weekends on their studies. The consequence of this it that very few teachers had the requisite training so only a limited number of teachers claimed to be integrating ICT into the curriculum. During the interviews I noted that the teachers' interest in pursuing private studies on the integration of ICT was aroused by their involvement in the Khula Project workshop which was funded by a special project run from Rutgers University in the USA in partnership with Rhodes University, the University of Fort Hare and the then University of Port Elizabeth (now the Nelson Mandela Metropolitan University). Even though these teachers claimed to having received training they highlighted that their integration of ICT in their subjects depended upon on their access to computers.

5.2.2 Teachers' access to computers

Obviously the integration of ICT is not feasible without access to computers. In integrating ICT into the curriculum the teachers as well as the learners need to have access to computers. What transpired in this study is that teachers who claim to integrate ICT in their teaching are doing so with minimum access to computers. Where computers are available, they are all in computer laboratories. No teachers from any of the schools reported having computers in their own classrooms. Most of the FDET schools did not take their learners to the computer laboratory as the number of learners in their classes far exceeded the number of computers available.

Despite the fact that the FMC schools had more access to computers than the FDET schools and the FHOR school, the FDET schools reported the most integration of ICTs into the curriculum. Interviews with the FDET teachers revealed their innovativeness in using computers within the curriculum, including the use of computers from the local university for special projects and the use of specialist software (e.g. Geometer Sketch Pad purchased for them by the Khula Project).

5.2.3 How do secondary school teachers of the Grahamstown circuit integrate ICT into the curriculum?

Teachers indicated that they use computers for administration, teaching and learning, research, communications and marketing. From these uses I identified teaching and learning, research and communication as relevant to the integration of ICT into the curriculum.

In answering the question how teachers integrate ICT into the curriculum, it is not enough to say that computers were used for teaching and learning, but to elaborate upon how they were using computers. The "how" part is partly evident from the type of software that teachers used for teaching and learning. This means my discussion in using computers for teaching and learning will be based on the software mentioned by teachers. These include:

- *Geometer Sketch Pad* , which was mentioned by one Maths teacher from FDET schools
- *Excel*, which was also used to plot graphs in Maths and in Science
- *Crocodile Clips* which were used by science teachers to help learners simulate the building of electric circuits
- *The Internet*, which was used to download weather charts by the Geography.

What transpired from the findings is that most of the teachers who reported using computers for teaching and learning are Maths and Science teachers. This is because of the software that was available in their schools. They were fortunate to have been involved in the Khula Project where they obtained the software such *Geometer Sketch Pad* and *Crocodile Clips* together with the *Microsoft package* which includes *Ms Excel*.

The Internet was also used for research and communication purposes. Teachers mostly searched for information for their learners and downloaded it to be analysed in class by learners. Even though communication was mentioned as one of the uses of computers, only one teacher reported using the Internet for herself and the learners. According to what the FDET teacher reported, collaborative learning was promoted by providing the learners with the opportunity to work with learners from other countries. The findings reveal that the teachers who were innovative in using the Internet were the FDET school teachers. So despite their relatively poor access to ICTs, it was the FDET teachers who seemed to be integrating ICTs into their subject area most meaningfully.

5.2.3 Challenges faced by teachers in integration ICT into the curriculum

Reflecting on how teachers claim to integrate ICT into the curriculum, it is evident that the secondary school teachers of the Grahamstown Circuit face a number of challenges. Insufficient number of computers makes it impossible for teacher to take all their learners to the computer laboratories. The limited range of software that was used for teaching and learning supports the teachers' claim that their integration of ICT is inhibited by the lack of subject specific software. What transpired during interviews is that schools were unable to purchase subject specific software due to the:

- Unavailability of funds from the schools
- Lack of support from the leadership (management)

Lack of support from the management showed that there are no indicators of the quality ICT leadership (Becta 2005) across the three categories of schools. With reference to the use of the Internet I noted that only two FDET schools had Internet connectivity. FMC schools were all connected to the Internet, however sharing the bandwidth was reported as a challenge by the FMC schools.

What might have been the key to the challenges faced by teachers is the fact that none of the school was in possession of the White Paper on e-Education and none of the school had its own policy on how the integration of ICT should take place in their schools. This then reflects on the lack of support from the DoE which was reported as the challenge by most of the teachers. The lack of support from the DoE becomes more evident when looking at the training provided by the

DoE. Only one teacher reported having obtained computer training from the training arranged by the DoE. This might be the reason why there were teachers who still possessed insufficient knowledge about the national policies on ICT in education as well as specific computer-related knowledge and skills.

5.2.4 Teacher's computer knowledge

Considering the fact that insufficient knowledge possessed by teachers hinders the integration of ICT (Mooij & Smeets 2001), I made use of my journal notes to examine the knowledge possessed by teachers as determined by their responses during the questionnaire survey and the semi-structured interviews. I realised that teachers still lack some knowledge in as far as the integration of ICT is concerned. There are teachers who did not respond to the numerous questions from the questionnaire. My assumption to the "no response" is that in closed questions the teachers were not sure of what the question was asking while in open ended question (benefits and challenges perceived) the "no response" might have meant teachers were not exposed to computers in a manner that would expose them see to the benefits and challenges they are facing in the use of computers.

Even those who regularly responded to the questions had areas where they could not provide enough evidence of being ICT knowledgeable. In reporting the use of computers for communication, only one teacher across all the schools provided evidence of using computers for communication to benefit her teaching. Teachers' failure to report on communication as providing links to share information and effective practice with other teachers indicates that teachers still lack appropriate ICT integration knowledge (Becta 2005).

In addition, teachers across the three school categories were unable to use ICT as a tool to reduce their workload instead they alluded to the teacher workload as inhibiting the integration of ICT. Becta (2005) argues that only those teachers who are competent and confident enough in using ICT use ICT as a tool for reduction of workload.

5.2.5 Teacher's areas of strength

Even though the teachers still possess insufficient appropriate knowledge for ICT integration they have displayed areas of strength which I identified during the semi-structured interviews which include:

- Teachers' effort to obtain ICT integration knowledge (obtaining training through their own studies).
- Teachers' belief in the role played by ICT in transforming the curriculum (even those who did not receive formal training).
- Teachers' effort and creativity to ensure that they integrate ICT into the curriculum (e.g. downloading information from other institutions).
- Willingness to support others (Teachers training other teachers).

What becomes more noticeable is the fact that teachers were able to use ICT across the three integration stages (functional, integrative and transformative) identified by Bialobzerska and Cohen (2005). However the use was at the minimal level for each stage.

Teachers were able to use computers for doing functional work such as plotting graphs. Plotting of graphs is usually done by hand, however the use of computer software makes it more accurate and much quicker. Teachers were able to use computers for doing functional work such plotting graphs. Plotting of graph is usually made by hand, however the use of computer software make it more accurate. They also made use of computers to produce refined work with fewer grammar and spelling mistakes, thus being an integrative practice. The use of computers to type assignments can help learners refine their work before submitting it to the teachers and by doing so learners learn some grammar and spelling. The transformative practice was then reflected in the use of computers for communication purposes. This form of teaching cannot be done without the use of computers and Internet connectivity. It is also the area where the FDET teacher who obtained training to integrate ICT into the curriculum demonstrated the transformative skills she obtained during the training sessions.

In short, teachers showed enthusiasm and commitment in integrating ICT despite the challenges they faced. Individual motivation might be a key to effective integration of ICT; however in my view it would be unfair to defer the responsibility of effective integration to the teachers alone.

In the next section I make recommendations that will hopefully help teachers improve the integration of ICT into the curriculum.

5.3 Recommendations

In reviewing the model I proposed in chapter 4 for the integration of ICT, I recommend that the following should be considered in helping the Grahamstown secondary teachers in the integration of ICT into the curriculum.

- The Eastern Cape(EC) DoE should consider taking the forefront role in the integration of ICT. This includes:
  - providing schools with the necessary hardware and software they need.
  - ensuring that the schools are secured enough to house the computer hardware;
  - hastening the development of ICT policy to ensure that what teachers practice in their schools is in line with what the ECDoE has proposed in its policy;
  - appointing qualified ICT education specialists at both school level and district level; and
  - conducting regular and differentiated teacher training.
- The involvement of School Governing Bodies (SGB) in the school ICT policy, to allow smooth running of ICT integration since the process requires funds from the school.
- The involvement of the school community in the ICT related programmes to ensure safety and security of all computer infrastructure.
- The training of School Management Team in order for the teachers and the principal to share the same view in as far as the integration of ICT is concerned. This will hopefully result in schools being able to:
  - develop their own ICT integration policies (including timetabling to ensure more equitable use of computer facilities) and
  - further integrate ICT usage in the school timetable to ensure more equitable use of computer facilities.

5.4 Suggestions for further research

Because this study focused on the integration of ICT in the secondary schools that are run or fully funded by the DoE, I suggest that the next study school be conducted on the Independent schools

that are also in the Grahamstown Circuit. This study should also investigate how teachers of the Independent schools are integrating ICT in their LA's or subjects. The purpose should be to extract ideas of how the FDET schools, FMC schools and FHOR schools can improve their integration of ICT into the curriculum. In addition to this I also suggest that further studies be carried focussing on one LA e.g. a study that will look at how teachers integrate ICT in "English", "Geography" or "Maths" lessons. These studies will help the ICT education specialist in the circuit in her or his attempt to understand what is lacking in the integration of ICT in each Learning Area.

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Appendix A Questionnaire: Teacher's views

Please would you fill your response to these questions as honestly as possible.
This questionnaire is confidential so please do NOT write you name on the questionnaire.

1. What is the name of your school?

2. Which grade/s do you teach?

3. Which learning area do you teach:

4. In which age bracket do you fall? *Please tick*

23-29	30-39	40-49	50-59	60

5. Gender

Male	Female

6. To what extent do you use computers?

Not at all	Sometimes	Frequently

7. If you use computers, which software do use most often?

8. For what purpose do you use computers

Administration (Mark sheets,report)	Communication (E-mail)	Research (Internet, CD ROM's)
Teaching and learning (Worksheets, tests, exams)	Marketing (Presentations about the school)	Other:specify

9. What training have you received to use computers

None at all	Some training arranged by the DoE	Through my own studies	Some training arranged by the school	From family & Friends

10.What specific training have you received to use computers in your curriculum?

None at all	Some training arranged by the DoE	Through my own studies	Some training arranged by theschool	From family & Friends

11.To what extent are you able to integrate Computers in your curriculum?

12. What, in your opinion, are the benefit (or potential benefits)of integrating ICT into the curriculum?

13. What challenges or difficulties have you Encountered in the process of integrating ICT in the curriculum?

14. How can these challenges or difficulties be addressed?

15.Does your school have computer policy?

We don't have one	In the process of Development	Well planned	Well planned & Implemented

16. Does the timetable include periods for using computers in your learning area

Yes	No

17. How often does it allow you to use computers for teaching your curriculum?

-----hour a week	----hours in a cycle	----hours in a term

18. Is there a computer specialist in your school?

Yes	No

19. To what extent is he/she able to support you in using computers in your curriculum?

Not at all	To some extent	To a great extent

20. How many learners do you have a period?

21. Are there sufficient computers for each learner?

Yes | No

22. If no, how do you manage your class?

23. What level of interest do your learners show in Using computers?

Little interest | Some interest | A great deal of interest

24. To what extent does their eagerness to use computer Help them in their learning?

25. Which grade do you find most eager to use computers

Grade 8 | Grade 9 | Grade 10 | Grade 11 | Grade 12

26. Which gender do you find more cooperative when using computers?

Boys | Girls

Appendix B: Invitation letter to school principals

[RHODES UNIVERISTY LETTERHEAD]

21 April 2004

Dear Mr

Permission to conduct research at your school

One MSc and two MEd students from Rhodes University, Nikiwe Maholwana-Sotashe, Ingrid Brandt and Nombeko Mbane, are involved in a research project partially funded by the National Research Foundation. The research is based upon investigating the integration of information communication technology (ICT) in the school curriculum of all 13 secondary schools in the Grahamstown circuit. The study hopes to find out what current computer infrastructure exists at each school and to what extent ICT is being used within the curriculum or, if the school does not yet have computers, how they would like to deploy them so that a possible model of computer networking can be suggested.

The research details are as follows:

Questions: There are three main questions that are divided amongst the three students:

- What models of networked computer technologies can support secondary schools in implementing their vision or need for integrating ICT in the curriculum? [Ingrid Brandt]
- To what extent do Grahamstown Secondary School teachers' integrate ICT in the curriculum? [Nikiwe Maholwana-Sotashe]
- How does the integration of ICT in the curriculum enhance secondary learners' learning? [Nombeko Mbane]

The data collected for these three questions will be used to answer the broader question of the project that seeks to identify strategies used in the Grahamstown Secondary Schools to integrate ICT in the curriculum. Professor C.Hodgkinson from Rhodes University Education Department will undertake the collation and interpretation of the collective data.

The research methods will be a survey that will be conducted as follows:

- Ingrid Brandt will need to interview the IT teacher or network specialist if any.
- Nikiwe Maholwana–Sotashe will need to interview the Principal and IT teacher.
- Nombeko Mbane will need 10 learners, two from each grade to answer a questionnaire that will be sent to you prior the visit of the three students. On the day of their visit

Nombeko will need to conduct focus interviews with a minimum of 5 learners (one from each grade).

Further negotiations on how the research could proceed will be done on their first visit to your school.

The research aims to

- Establish the infrastructure in the secondary schools of this circuit [Grahamstown].
- Identify benefits of integrating ICT in the curriculum.
- Identify the stumbling blocks in the process of integrating ICT in the curriculum.
- Make recommendations on the strategies to be used when integrating ICT in the curriculum.

The information will be sent to the Department of Education to provide them with a plan of what need to be done before ICT implementation and what needs to be done to ensure successful integration of ICT in the Grahamstown circuit.

Thanking you in anticipation of working together as a team in the process of improving quality of education in the Grahamstown circuit. If you have any further questions about the project, please feel free to e-mail or phone either of the two supervisors, Prof Cheryl Hodgkinson or Dr Alfredo Terzoli. A list of all our contact details is attached for your convenience.

Yours sincerely

Ingrid Brandt	Nikiwe Maholwana-Sotashe	Nombeko Mbane

Appendix C: Informed Consent

21 September 2004

Dear teacher

Voluntary focus group interview for teachers

What is this project about?
Thank you for agreeing to participant in this focus group interview. This focus group interview is a follow-up on the questionnaire that you so kindly completed. The questionnaire and this interview are hopefully going to help me establish what you perceive to be the benefits and potential drawbacks of using computers and the internet in the school curriculum. This research is being funded by the National Research Foundation and is part of the research I am doing for my MEd at Rhodes University.

What is expected of you?
You are requested to participate in the focus group interview by answering the questions put to you with regards to the use of computers and the Internet (also termed Information Communication Technology ICT). However, you may respond only when you want to, as a response is not compulsory.

What are your rights as a participant?
Your participation is completely voluntary and you can refuse to participate or walk out of the interview at any time without stating any reason.

Sources of additional information
If you have any questions regarding this study, please do not hesitate to approach my supervisor or myself:

Prof Cheryl Hodgkinson-Williams
Education Department
Rhodes University
Grahamstown
(046) 603 8383 (w)
(046) 622 9567 (h)
c.hodgkinson@ru.ac.za

Mrs Nikiwe Sotashe
MEd Research student
Education Department
Rhodes University
Grahamstown
g00S4108@campus.ru.ac.za

Confidentiality
All information retrieved during the course of this study / interview will be treated as strictly confidential. Data that may be reported on in the research report will not include information that identifies you as a participant in the study. Your informed consent form will be filed in a safe place and it will only be accessible to the research team.
I hereby confirm that the researcher, Mrs Nikiwe Sotashe has informed me of the nature of this study. I have received, read and understood the ***Voluntary focus group interview for learners.***

I understand that:

- My identity will remain anonymous during the analysis, processing of data and reporting of the study.
- I am free to withdraw from the interview at any point, without giving any reason for my termination of the interview.
- My verbal descriptions and interpretations of my experiences during the focus group interview will be analysed for this research.
- I will have sufficient opportunity to ask questions.

I, …….. declare myself prepared to
(Participant's name - PLEASE PRINT)

participate in the ***ICT for Education interview***

Participant's signature: ……..

Date: 21 September 2004

I, Mrs Nikiwe Sotashe, hereby confirm that the participant has been informed in full of the nature and the manner in which the focus group interview and study will be conducted.

Researcher's signature: ……..

Date: 21 September 2004

Appendix D: Interview transcript

28 February 2005

Interviewer: From what I remember and from what you've said in the questionnaire, it would seem that your use of computers in your instance is primarily your own use.

Interviewee: Completely. I have tried making ICT a lot more integrated into the courses I teach. It is ultimately there – we use the computer a lot and with the students hardly ever. It is not very integrated into my classroom practice, not through a lack of desire, but through other factors, logistics and the equipment we have and what it can and can't do. I use the computer a lot for myself, but the other girls don't use it at all.

Interviewer: That answers it really well. It would seem that is from what you have said before and it's just this frustration that we will look at in a minute. One of the things she may not have asked you is your access to computers. You mentioned this afternoon that you ran home to read your email. That's a very interesting one. Where are you using a computer?

Interviewee: I've got my laptop that I use and I'm very lucky to be able to.

Interviewer: Is it your own?

Interviewee: Yes. I saved up for a while and I see it as an investment in a laptop. Most people gasp when they find out how much I spent on it etc, but I really did see it as an investment and after having had it for about just over a year I consider it as the best investment I've ever made as a teacher. And basically, I had to do that because I had really enjoyed working at my previous school and having a computer in my class at all times. It made me a better teacher just in what I was able to do on it and so I wanted one in my classroom but the school wouldn't, because there is no alarm system, the insurance doesn't actually cover a computer in the classroom so I hope they work around that problem and ultimately I decided to solve it myself by getting the laptop. I have my laptop which is always with me. I have it in my class and then if I need to go print, I have to disconnect it and take it upstairs. I have set up a printer with a USB connection which means I can access it immediately and print straight from my machine. When I'm at home, I work on the laptop so that the use of computers is seamless, I don't have to move from one machine to the next, but where I also don't want to open my machine to outside influences. I don't use it to connect to the net. I have a desktop which I download from which I do fairly extensively and I do get a lot of materials from the web, but that would on my desktop and I would have a couple of machines for that.

Interviewer: Do you have a desktop at home as well?

Interviewee: Two desktops that are connected. They both now have writers. What used to be the case is that one would have the CD writer and with the other one I would download from and I'd run data between them to write to CD, but subsequently I've solved that with another writer. Ja, I download data on to it, any information and then I use flash memory to move it across or I just burn it onto disc if it's too big.

Interviewer: The flash stick / disc – you bought yourself?

Interviewee: Ja, I bought it when it first came out so I paid about R500.00 for about 64 megs and I bought a flash for Bernade at Christmas and it was R150.00 for 128, but that's technology. If you're going to get in when it's still young you're going to pay for it.

Interviewer: You know that, you're making an informed choice about that. It may not be other people's experience and they are very unhappy to be involved with technology that changes at such a pace. It gets them out of pocket very quickly.

Interviewee: I put a machine together as an exercise. My sister recently bought a desktop and she hadn't had one and she wanted to know what she needed and I put together this awesome machine but with certain proviso's. Like, you don't actually need this although they will try and sell it to you and this is what it will do. She found this really helpful because when she went to the computer shop, they had tried to sell her things that she didn't really need. She had established what she needed and she knew what she was getting into if she spent the extra money. So, ja, being informed about computers allows you to make informed choices.

Interviewer: Would it be fair to say that most of your colleagues at the school would not be able to make that informed choice?

Interviewee: I would say about 90% of them, even people who know a little bit about computers, they can't make that informed choice. I would say out of the whole staff, maybe one teacher and myself could, two are equipped to do it. You are 100% right, there are far too many who aren't knowledgeable in the display of ICT and way too many who refuse to take that step to become knowledgeable. They are real "technophobes" and so that is holding them back and the school.

Interviewer: So one of the things that maybe be hindering is that is it an area where people feel very vulnerable.

Interviewee: Oh, without a doubt. I think, we are busy doing this IQMS (Integrated Quality Management Systems), it is basically teacher evaluation, and to do that, I have had to kind of look at the last couple of years and what I've achieved and what I haven't as part of a personal growth plan and I've really been pleased with the amount of computer or ICT I've brought into the school. We've changed the way we do reports, we're using once central data base system – these aren't things that I'm not an expert in but I feel quite passionately about not wasting time on. Looking back it's been nice to say that because of me pushing it, these changes have happened and that's been quite a nice feeling. The negative side is that there has been no-one else picking up the slack and say whenever something goes wrong with a particular data base system, everyone comes to me and I'm not the expert. The "technophobia" among the staff is definitely holding the process back considerably, but you know, often people will say that the way to reverse that is to give them training, but I disagree with that as well because I don't think that by training these particular teachers that things are going to change. Their perception of computers doesn't change and changing perceptions is the important thing. I've had to show people how computers are going to save them time in the long run, and even though it's a bummer they don't always buy into it, I can prove that they will save 50% of the time they might have previously spent, at the end of the day, they are still not going to take that step to using computers more. It's a slow process.

Interviewer: So if training is not the solution, what is?

Interviewee: It's changing perceptions.

Interviewer: If changing perceptions is, how are we going to do that?

Interviewee: You've got to be able to show teachers how using a computer is not going to make their life more complicated. At the moment, it's the battling that I've been fighting, even though it might not be the case, the argument is being used that it never used to be this way, it used to be a whole lot simpler and often they don't actually know the whole story or the costs involved or whatever the case may be, so you've got to overcome that prejudice and you've got to show them how the computer is going to be useful and will save them time. Once you've got that happening, then you're going to see change start to happen. And I have seen it in one or two teachers who have taken a step forward and they are starting to use computers in their classroom because this year, as luck would have it, the old computer lab was changed because I insisted that we had to update some of the computers at the school so we changed the whole lab, we got updated machines and operating systems and then the old machines were sent out to where they might be needed. So in classrooms, if a teacher wanted a computer, he or she could get. There are computers now in classrooms, and the teachers to a degree, although I still see far too many of them in boxes, and the teachers are now saying that it's quite nice to put my marks on a spreadsheet or to write up notes while someone is doing a presentation, rather then scribble it down and then have to transcribe. So, if you can show them the practical value of computers and that it is going to ultimately benefit them in some way, either through time or through the fact that they can it's convenient, I think that is how you are going to change their minds. But it's really a changing hearts and minds policy first before the skill building. The other day we had a Khula project scenario where you teach people with skills and ultimately, unless they are really convinced that it's being beneficial, they are going to go away and loose all those skills within a short amount of time and the teachers from that project who I've met subsequently and spoken to about computers and said how's it going, many of them have said no, I'm not interested, they don't do very much with it, but one or two who were really passionate in the project have taken it further. Initially, the desire must be there to use computers extensively and the actions will follow, but if you don't have that mental change or the idea that computer that are helpful and good and beneficial, then you are not going to get any change happening.

Interviewer Lets go back to the questions I was asking about your access to computers. You mentioned that you had a USB connection. Printing is in the lab or where?

Interviewee: Printing is in the lab. In the beginning, before I had my own laptop, I would have to bring stuff from home and put it onto the computers here and the print from that machine. Since I have had my laptop, that makes me quite a special person because I had access to something that 99% of teachers don't have access to, I went and got a USB connector and set it up at one of the printers. I personally set it up because I couldn't have gone to the school and said that I need access to a machine or I need this. I didn't ask for permission, I just did it. I know it messes around with the network printing and sometimes they can't print because I've just printed or something, but I'm not going to tell them that. They just say they've been having such trouble, but ja, I had to go and set that up. I have half-

heartedly mentioned that I would like access to a network connection in my class, which would give me access to the internet although I don't know how much that would be worth considering how slow the school access is, and also I could print from here to a machine in the lab, a printer in the lab, but it was sort of laughed off as not a serious request, and I wouldn't imagine that, with the current system, to be taken seriously.

Interviewer Coming back to the point of convenience and time saving, if you think about the amount of time you have to spend just printing, to try and convince your colleague that this is a time saving process, it would be very difficult and that it didn't have another benefit, because there are hurdles to overcome.

Interviewer: The problem at the moment, while I said that it was very nice that there are now some computers in classrooms, old machines, but it's kind of a self fulfilling prophecy in some ways. What happens is that they are using old machines with old software. What do they do once they have copied something, or they've put it onto a stiffy disc which they take up to the lab, which invariably doesn't work because it has a virus on, and so they start to become frustrated by it not working and so they say, gee, look, these machines actually don't help us at all. And so it kind of puts them into their view and supports the anti technology stance. While it gladdens me that there are computers in the classrooms, I see it for what it's worth.

Interviewer: In many ways, you have to be quite an accomplished teacher to use a computer well. Why some of the schools are inheriting a lot of computers from industry or from universities, actually have to be jolly, jolly smart to use it well.

Interviewee: Unless you are aware of the limitations of the computer you are working on, it can open you to a number of pitfalls, disappointment being one of them. As I say, I think there is a big psychological component to teachers being sold on the idea of using computers, you sit down with your 486 with 4 megabytes of memory, you are going to be disappointed. So, you must also let the people who will be using these machines know those limitations and say to them, this is what you can do and be quite open about it's faults and what is capable of, it's capabilities because unless you are very clear on those, there is going to be disappointment. I'm kind of only thinking this for the first time.

Interviewer: I think that's a very active insight. As you mentioned earlier on, it's a mindset, a perception and if you get that immediate disappointment, to then try and get over that, it's going to be even harder. In fact, I'm quite sorry that we don't ask some of these questions more often. Quite frankly, if we asked teachers what the issues were, and rather let them talk about it, I think the patterns would emerge, where I'm coming from, I think the patterns do emerge. Rhodes was having policies where they would sit there and scratch their heads, what needs to be done – just ask the teachers, they know.

Interviewee: Without a doubt, and I think as well with ICT, just the frustration that we have with policy makers not thinking things through.

Interviewer: In terms of policy, are you aware of any national policy?

Interviewee: On ICT specifically, no, not really. Within school structure at the moment, I'm head of curriculum which means that all policy documents relating to curriculum and documents generally will often pass over my desk. I still haven't seen anything on ICT that would

interest me as it would invariably be sent to me no matter what it's status was, and I haven't seen anything. A lot has to do with our local department.

Interviewer: If I can clarify then, you are not aware of any national policy regarding ICT at all and that is despite of you being head of curriculum.

Interviewee: Yes

Interviewer: For how long?

Interviewee: This is my second year. I have picked up some other documents, the integrated approach, as well as the new FET policy documents which I have had to look at. But there is an integrated approach to ICT. To me it is this wonderful catch phrase that is meaningless because once again we come to how is it practically going to be implemented and it's a wonderful vision, but on the ground, that is not the reality.

Interviewer: Have you seen or heard anything about a provincial policy?

Interviewee: No, not at all.

Interviewer: And from a district level, is there anybody who asks?

Interviewee: No. The district office is terrible. Granted, I don't have anything to compare it with, but I have worked with other departments and other administrators, and these people are terrible. They actually don't know anything, and that is not only ICT, it's just generally. For example, if I were to go to them to talk to them about FET next year, they wouldn't have a clue. I would have to get all the information I know from an NUE programme, and before that, I was completely in the dark.

Interviewer: In your own school environment, I gathered from what your questionnaire said that you haven't got a school policy in place yet.

Interviewee: I have tried to raise it because I am head of curriculum I am on the school management team, I've raised it to a degree. At one point, when it was raised and I said that we need to come up with an ICT policy for the school, it was ja, we'll look into that. So just on a school level, we don't have a policy that's stipulated.

Interviewer: Some procedure must be being followed in order to get labs, equipment replaced, software, who is making those decisions and how are they made?

Interviewee: There is a teacher who is in charge of the labs, both labs, and she makes decisions about the changing of equipment, or not so much changing of equipment, because that's a fairly big decision to be made. I was surprised last year I went to a management meeting and said to them, we need new computers, and I knew that I would be told – go and find out, what do we need and get us some quotes, and within a school environment, that's beyond my preview, so that's usually a brush off to be told that, but I went and I got the stuff and

I brought it to them and I told them that it was from a company in PE that they might want to look into, they offer IT solutions and we've got new computers.

Interviewer: In other words, the procedures are that if you have a request for something, you would have to go to the school management team with that. The fact that there isn't a fully fledged policy, the procedure process is that.

Interviewee: It's not just ICT procedure, it's any procedure. Any request would need to go to the school management team and ultimately the principle and then our finances committee will make a decision and that's the school governing body.

Interviewer: So it's the school management team to the principle.

Interviewee: The principle is on the school management team, so he part of that process and then the finance committee of the school governing body.

Interviewer: Sometimes, at schools, there are procedures that are being followed, and if there is still a clear procedural process, things might still happen.

Interviewee: At least here, we know that there is a decision making body. The school management team will discuss issues that arise so the only questions that you mentioned that you would ask has to do with licencing. The Microsoft licencing agreement was something that was brought to my attention by the edu-admin people, that's the software that we run for our school data base. They said why aren't you guys doing this etc etc. That's when the wheels starting rolling for the new computers and also for the licencing agreement. But, you know, that is all that I'm going to say – the school management team is wiling to discuss these issues, but it's to get there. Unless I was really motivated to make those changes, it would never have got to that point, and unless I am confident enough not to worry about what the principal is going to say about us needing new computers, whereas the computer teacher, who thought the same thing as soon as she started teaching, hasn't gone and made that point. There are procedures, but a lot of stuff is informal and you need to crusade for it.

Interviewer: A sort of sponsor champion.

Interviewee: You need to champion causes and that in its own right brings about conflict in an environment, particularly in this one, where you've got a champion for integrated ICT and greater technology use, and you've got someone else saying no, we should become an art school, so you've got strong champions, but completely different causes and there's a butting of heads.

Interviewer: In terms of licencing agreements, have you been able to work it out with Microsoft?

Interviewee: This is where things fell apart because at this point it no longer becomes my ……. One thing that I've learnt of the last few years is that the school's happy if you are hardworking and you are willing to take stuff on, they are willing to give it to you. Basically, at the end of last year, we filled in an assessment for the principle and gave it to her and I was very honest about and I just said, you know, that's the case. If you have some hardworking staff, they just have stuff lumped on them and maybe that needs to be looked at and she took action and stuff was taken away from me but what I have learnt is that if you take on too much, then you are responsible for everything and you can't do it and things fell apart. As far as the licencing agreement goes, I downloaded the

information, I got a PDF, I gave it to the person in charge of the labs and I said, this is what you need to do, and she was supposed to have started the process. I knew she was going away on holiday, overseas, I went back to her a couple of weeks later and asked if she had sorted it out because we don't want to do it at the beginning of next year and she said yes, there were a couple of issues but she would sort them out… we still haven't sent it off, so ja, it's all very good to champion something and to take it to a certain point, but unless that is where they are, you've got to assume other peoples roles and responsibilities. I really want the licencing agreement to go ahead and for us to look at open source options, but I can't do everything. While I'm happy to run with it to a certain extent, I'm not going to go all the way unless it's in my particular area so if it was in academics or English or history then I'll take it further, but this unfortunately isn't in some ways. I think it's fallen into the lap of this individual, and yet, there has been too much on her plate so this has kind of taken a backseat and so as far as the licencing agreement goes, it hasn't come to pass yet.

Interviewer: You're painting a very comprehensive picture of the fact that this is a major part, it could be, a major part in the schools functioning, it's not just a bolt on. If it is just a bolt on, then that's where it's going to stay.

Interviewee: Without a doubt. I think that the potential is there to integrate but I do fear that it is never going to be the case. There are other reasons beyond just administrative ones or a word on the part of the school administration. So, ja, I think those come up with other questions.

Interviewer: You have an internet connection at home and you then download things onto your laptop. Do you use the school's internet connection?

Interviewee: No. I've got a dial up at home and it is literally about a thousand times faster then what the school offers so you can imagine how slow things are here. I have been fighting a battle about this as well, but you don't want to step on peoples toes, so I keep brining it up and saying that this is an issue, we need to look at it, but the people responsible aren't championing the cause. We share a band with St Andrews, DSG, Graeme, P J Olivier I think, and the band that we get is negligible, where as experiencing what SAC has to offer, I know that there were there those in my tutor group who were downloading a gigabyte of data over a weekend through an internet connection, here we would be lucky to download a gigabyte of data a year. I'm being dead serious. It's not worth it and I've broached the subject of DSL and improving it some way, but once again you are told, you go and find out about it, so you have just got to fit it into your time, and so far, that is something that hasn't fitted in with my time constraints. It's not good.

Interviewer: In essence, what you are saying to me is that you individually are sponsoring your own internet access to get stuff downloaded for school and you are paying the charges.

Interviewee: Yes. It's more global then that. The edu-admin system that we work on, which I think could be an incredible data base, not that I've used too many of the others, it really does the job from my point of view, which is the assessment. We can do some pretty good things with it, although it has got many other uses, we need to update the software. What they do is they release it and put it onto the ftp sight. We can't download from school because of our downloads, so what's been happening up to now is that I've been downloading from home. It's not a small file so we are looking at about a three hour

download. I may be told you need to claim but it's really hard to say this download took me this long and then I have to stop it, and then go on at a different time, so I just ignore that. I do the downloads and I bring them to school. It's been unsuccessful the last couple of times, we've had corrupted data so what I've convinced the school to do now is to just have a CD sent to us. I do quite a bit of school work on my internet connection.

Interviewer: Getting back to your point about trying to convince teachers that this is really time saving and inexpensive. Here we've got expensive and time consuming.

Interviewee: I don't see it as expensive because I use the internet all the time so whatever it costs, I'm going to pay it. It's something I've just resigned myself to, I'm going to pay for my internet time and I don't differentiate necessarily between school time and personal time. Last night I spent an hour looking for stuff to do with maps and I really enjoyed myself. It's school time, but I'm not going to say, gee, I shouldn't be spending this much time. I'm just using a personal resource, and most teachers do. It might not be internet time, it might be that they are using personal time to gain resources. I think that happens universally. It might not happen in a technological sense, but you do use your own time, whether it be finding about field trips or this, that and the next thing, so I don't differentiate between my time on the internet and the schools time, it just happens.

Interviewer: You mentioned about programmes you've used, Word, Excel, PowerPoint, Outlook, FrontPage, Photoshop, Encarta, Adobe, Acrobat… If you had to say, which programme is the one you use the most, if that had to suddenly crash, you would be lost, what is your core programme?

Interviewee: It is difficult to say, because the one that I use the most is probably word because I'm writing up a lot of documents, I do my tests and worksheets and lists on that programme, but it is not necessarily the one that saves me the most amount of time. Excel, for example, with all my comments and my marks, that's a fairly important programme as a teacher specifically. The one that I need perhaps the most, whereas I use word a lot more. I'd say those two, although I do use the others. Photoshop I use fairly regularly. FrontPage, but they have very particular uses, so I'm involved in the Photo-Journ club and I use those programmes in that capacity, whereas the other two I use basically in all the areas of my teaching.

Interviewer: This is software that you have access to and you are using. Is there software you would love access to but you don't have access to it?

Interviewee: If you could turn the tape off.

Interviewer: The question we had here was the most important purpose for which you use computers. What would you say, administration, communication, research, teaching, learning, marketing… Here again, if you didn't have access to a computer, what area would suffer the most?

Interviewee: Assessment is one. This is something that having a computer in my class taught me the value of the computer, and that is using excel. When I'm marking, I use it to put my marks on and I put a comment in. It is more work, because I write the comment on the child's work and then I type it in, so I have access to the comment at all times, so I don't have to look back to be able to see that so and so is struggling with time issues, and I am

able to give some pretty good feedback to parents and to the pupils at the end of the term when we do their comment slips etc. and to be able to say, these are areas which you can improve. That for me as a teacher is perhaps the most important because it improves the quality of assessment and quality of feedback that I can give because it kind of integrates the assessment and feedback as one aspect. Communication is an awesome one, but I can't use it. I really learnt the value of this at my previous school. I started playing around and I remember telling you about it, sending poems to the grade 8 and 9's I was teaching, and having them comment on the poem by email, which was an amazing experience, because some of the kids you never hear from in the class, are writing this awesome response to a poem that they've never had. The feedback that I got when I asked them how they felt about this process of emailing back and forth, was it was really nice because in class they don't like to speak up. I would really have loved to try to see a lot more about the communication aspect. I think the communication aspect is perhaps the most important part of a computer, but I can't use it the way the school is currently set up, not because my laptop isn't connected to the net, but rather for them to download the email is going to take forever and a day, and a lot of them just don't use the email to the same extent, so I can't just say to them you need to access your email on these days, because they may not be able to because of the quality of our network. I think that that is the most exciting area, and the one that…. I was in our management meeting last week. One of the teachers is leaving and going to Australia, and I said, it's not impossible for Debbie to teach from Australia if we had better band width and that kind of opened some eyes. It was like "wow", we are living in a global village and this is possible, she could actually teach, if she's not teaching there, teach some classes to girls this side. Times aren't a problem, because she was saying that at these time she was available, we could set up extra classes, but, the bottom line is we don't have the equipment necessary and if you don't have the will to buy the equipment that is necessary. Finances are one thing and will is another, on the part of school administration.

Interviewer: You mentioned that you had no specific training in terms of using computers as part of the curriculum.

Interviewee: No, other then the stuff in the HDE and then that … you know you mentioned running with the Kenton conference, an ICT parallel. I think that's the problem, that it shouldn't be parallel, it should be completely integrated. As soon as you run it parallel, it's not seen as part of something, for example, what would have been nice is within the English method course, for us to do something on computers. I remember actually teaching the year after my HDE, doing some teaching with the ESL people on how to use computers in ESL and that I think might have been valuable. How can I use this in my subject in my area, rather then saying, these are general possibilities, which is all well and good, but, practically, show me.

Interviewer: It's once again, as you mentioned earlier, without treading on toes, that if a teacher doesn't even know how to send an email, how can we teach.. We've gone some way towards that, last year, we took a backseat with that because computer literacy was relegated to one term, rather then a semester. This year I've said, no ways, especially with the terms this year, we've got a term of five weeks. So, in other words, you haven't had any …. and anything you've had has been self taught?

Interviewee: For example, list servs, I go onto the list serve, not for a computers purpose, but that sort of gives me some good ideas as to how other people are using computers and I might think of adapting some of the ideas. I think how nice it must be to put back some of the

ideas. I think here, the logistical problems are just too much to overcome, in a low resources school with better net options; perhaps some of the ideas are implementable.

Interviewer: The next question is linked to some of the other questions I've asked. The hurdles that you're having to overcome, the time tabling, the hardware, are you talking about the type of hardware as well as the number of computers?

Interviewee: When we go out, I'll show you what's happened to one of the labs, because a large number of the learners that are doing compu-typing had a large failure rate in grade 11, and there's a large number of learners doing compu-typing in that year, that we've actually had to have more machines brought in, and what was actually a really pleasant environment, has become this mess. You have arbitrary desks in with machines, and that's just so that you've got the hardware there. And that's one of the issues. I don't think for the most part that it's a major one, I think it's mostly the quality of the hardware that we've got. So, the school is really buying entrance level machines, which sounds wonderful, but when you look at the specs, the entry level machines are outdated within a year. Just in terms of people are going to notice the slowness of them etc. in a short amount of time. Rather then getting good quality machines with good quality hard drives and monitors, and then upgrading, say the CPU's. They went from getting good stuff to major component upgrades, which in my mind just makes a lot of sense, but that's not how it's done, so that's obviously another issue. A great problem is the issue of finances because every time you give up an idea, it's, ok, we are going to have to look at money.

Interviewer: Arts are not inexpensive either.

Interviewee: No, without a doubt, although, you don't have the big blow out of cash.

Interviewer: IT isn't inexpensive, no doubt. You mentioned briefly, some of the reasons why you think the value of … For the learners, why have you got such a passion that they should be using computers? What do you think it does for their learning?

Interviewee: I don't know if I'm wrong in a sense, but I do feel that school in a sense is a bit of a wasted exercise. I have said as much at some of our classes, I think you are wasting your time. The two things that school taught me were to read and write, and to do basically well and I was successful at university because of that. I think that the skills you can gain at school are really, really important. Reading and writing are two essential ones, but using technology is becoming so much more of the work place, particularly, a lot of our students are not going to go on to university, or success at university, to think that everyone is going to go on and do a degree is fooling ourselves. We must understand that the money is not there for many of them, they might not have applied themselves or have the ability necessarily, so you need to teach them skills that they will be able to use. I think that the technological skills will give them an edge over someone else and so, integrating technology into their work and into their daily lives and being comfortable with it, which I think is really important as well, is beneficial in the long run. It's one of those things you can get out of school that you can ultimately use.

Interviewer: It's like a social rationale – you separate the work approach where people are very competitive at jobs.

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