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Policy lessons from assessing computer-use in secondary schools in a provincial capital, Polokwane.

Ebrahim Ghoord

A research report submitted to the Faculty of Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Management in ICT Policy and Regulation

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Abstract

This study examined different elements within the classroom, school and environment in order to establish their influence on technology implementation in schools. A review of the literature suggests that the integration of computers in schools is influenced by a number of separate but inter-related factors. If technology implementations in schools are to achieve the desired objectives as outlined in the e-Education White Paper, it is important that such efforts are cognizant of the unique characteristics of each school setting. Eight schools in Polokwane (Limpopo, South Africa) were chosen for this study, which was intended to evaluate current technology integration efforts against existing policy; and to see what policy lessons may be drawn from this.

Declaration

I declare that this report is my own, unaided work. It is submitted in partial fulfilment of the requirements for the degree of Master of Management (in the field of ICT Policy and Regulation) in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

_____
Ebrahim Ghoord
25 March 2013

Dedication

This work is dedicated to the memory of my family and friends who have taken-up abode in the universal realm of timelessness…

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List of Abbreviations

ASGISA	Accelerated Shared Growth Initiative for South Africa
CAQ	Computer Attitudes Questionnaire
CAT	Computer Applications Technology
CBD	Central Business District
CBI	Computer Based Instruction
CMC	Computer Mediated Communication
DoE	Department of Education
ESKOM	Electricity Supply Commission
FOSS	Free and Open Source Software
GEAR	Growth Employment and Redistribution Programme
ICT	Information and Communications Technology
IDRC	International Development Research Centre
ILS	Integrated Learning Systems
infoDev	Information for Development Programme (World Bank)
IT	Information Technology
JIPSA	Joint Initiative on Priority Skills Acquisition
M&E	Monitoring and Evaluation
NEPAD	New Partnership for Africa's Development
NGO	Non Government Organisation
NPO	Non Profit Organisation
PGDS	Provincial Growth and Development Strategy
PNC (ISAD)	Presidential National Commission (Information Society & Development
RDP	Reconstruction and Development Programme
SARB	South African Reserve Bank
SGB	School Governing Body
SITA	State Information Technology Agency
SITES	Second Information Technology in Education Study
SMS	Short Message Service
TAC	Teacher Attitudes Towards Computers
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization

Chapter One

1. Setting The Scene : Provincial e-Education

1.1 Background

Governments throughout the world face formidable challenges in designing education systems appropriate to meeting the needs of a modern, knowledge-based economy. The increasingly dominant role that information and communications technology (ICT) play in today's shrinking world demand that policymakers respond to this challenge.

During the World Summit on the Information Society (WSIS) in Tunis in 2005, the Head of the United Nations (UN), Kofi Annan, remarked that "we are living in a world of rapid change where technologies play a multitude of roles. How we tap this technology's potential will shape our future together. We cannot remain indifferent to this enormous metamorphosis." (Annan, 2005). In his address, at the same event, President Thabo Mbeki of South Africa stated that "[…there is a need for us all to do everything possible to promote the use of modern information and communication technologies to help extricate the poor of Africa and the world from their condition of underdevelopment, marginalisation and social exclusion" (Mbeki, 2005).

The introduction of computers into schools is one initiative that countries worldwide have embarked upon in order to leverage the benefits that modern information and communications technologies (ICT's) provide. Many countries have introduced computers into schools in order to equip their populations with the knowledge and skills for technology-rich environments of the future, while some developing countries have introduced ICT's in schools in order to address multiple challenges related to the shortage of educational and teaching resources and for the overall enhancement in the teaching experience for both educators and learners. A number of such programmes have been undertaken in South Africa and this study will evaluate the extent of computer-use in eight schools in Polokwane, South Africa, in order to determine those factors that promote or impede the effective use of technology in the school environment; and to see what policy lessons can be taken from this.

1.2 Context

South Africa held its first democratic elections in 1994. Prior to this, the country functioned along racially segregated lines in all aspects of life. This included strict rules about where and with whom people could live, learn, work, play and trade. The apartheid system of education was biased towards serving the socio-economic and political needs of a minority “white” group and failed to lay a foundation for the development of vital human capital required for sustained social and economic development in South Africa through inclusive education and training (Evoh, 2007).

The current dearth of human capital in the South African economy, coupled with low productivity levels may result in the country not being able to achieve its socio-economic goals. Labour productivity is defined by the OECD as "output per unit of labour input". In South Africa, output is measured by looking at the recorded value of all goods and services produced in South Africa during a 12 month period. For labour input, the South African Reserve Bank (SARB) uses the number of employees producing that output. Since 1967, output per worker per unit of capital has fallen from R7 297 to R4 924 a year – a decline of 32,5%. From the peak in 1993, this measure of labour productivity has fallen by 41,2%.

The apartheid policies of the past that denied the majority of South African’s access to quality education rendered them unprepared for employment in vital sectors of the economy such as science and technology, engineering and mining. In addition to being highly specialized, these sectors command good salaries and favourable opportunities for growth; and the exclusion of large numbers of the population from these sectors due to a skills deficit, has contributed towards gross income inequality in South Africa.

A report released by the World Bank in July 2012[1] states that although great strides have been made in South Africa in terms of providing basic education and sanitation, this did not equate to a level playing field for everyone. South Africa is one of the most unequal countries in the world, with a Gini coefficient of 0.7 in 2008, the bank noted. The Gini coefficient is an internationally used measure of income inequality. Named after its developer, Italian statistician Corrado Gini, the coefficient varies

[1] World Bank (2012). Press Release : Circumstances at Birth are Important Drivers of Inequality in South Africa.

between 0, which reflects complete equality and 1, which indicates complete inequality (one person has all the income or consumption, all others have none).

"This inequality of opportunity, particularly in the labour market, is the highest for the youngest age group," Ambar Narayan, World Bank lead economist on poverty reduction told reporters in Johannesburg at the release of the *South Africa Economic Update: Inequality of Opportunity* report.[2]

In short, the present shortage of skilled human resources puts South Africa at a disadvantage, as the country does not demonstrate the ability or agility to adapt to a rapidly evolving global economy. In addition, productivity levels need to be improved for the country to compete globally. Given that income growth in any economy depends on the productivity growth of its workers (i.e. the real output per worker), it is implied that investment in human capital or resource development defines the limits of income (Barro, 2002; Becker, 1975; 2002). As Goldin (2003) observes, "The 20th century became the human-capital century. No nation today — no matter how poor — can afford not to educate its youth at the secondary school level and beyond." (cf. Evoh, 2007).

In 2001, the then President of South Africa, Thabo Mbeki announced the establishment of the Presidential National Commission on the Information Society (PNC-ISAD). Comprising government, industry and civil society leaders, the role of this commission was to provide for a coordinated and consistent approach towards building an information society in South Africa (PNC-ISAD, 2006). Following the World Summit on Information Society (WSIS) phases held in Geneva and Tunis in 2003 and 2005 respectively, member countries resolved to develop national e-strategies and plans as a guide to building an information society within their respective countries. In South Africa, the national e-strategy identified five priority focus areas for ICT applications as the main drivers for building an inclusive information society (PNC-ISAD, 2006). These are:

[2] Nickolaus Bauer (Mail & Guardian, 2012). http://mg.co.za/article/2012-07-24-entrenched-inequality-of-opportunity-threatens-sas future).

1. Education, skills development and training
2. Health
3. Small medium and micro enterprises (SMME's)
4. Government service delivery
5. Local content development

For the purposes of this study, the emphasis will be on priority focus area one which relates to education, skills development and training.

1.3 e-Education Policy in South Africa

South Africa, like most countries across the globe, has adopted policies aimed at implementing information technology in schools. In its White Paper on e-Education, the South African Department of Education (DOE) defines the concept of e-Education as "... the use of ICT to accelerate the achievement of national education goals. e-Education is about connecting learners to other learners, teachers to professional support services and providing platforms for learning" (White Paper on e-Education – Transforming learning and teaching through Information and Communication Technology, DoE, 2004).

Broadly speaking, South Africa's policy environment in terms of recognising the value of ICT's in education can be described as favourable and enabling. The White Paper on e-Education (2004) recognises the value of ICT's in schools for learners, educators and administrators, while the White Paper on Science and Technology (1996) emphasises the need for the country to promote studies in the fields of mathematics and science in order to foster innovation[3].

Notably, the White Paper on e-Education specifically raises the issue of change management by stating explicitly that: *"Educational leaders do not yet fully appreciate the benefits of e-learning and administration for institutions and for provincial and district offices. It is important that educational leaders at all levels of the system are provided with the necessary support to enable them to manage the introduction of ICT's and the related change process"*[4]

[3] White Paper on Science and Technology, 1996, Chapter 10, Section 3.

[4] DoE. 2004. White Paper on e-Education – Transforming learning and teaching through Information and Communication Technology. Government Gazette, Vol470, No.26734. Pretoria: DoE, p.21

Two noteworthy state initiatives[5] aimed at hastening the pace of economic growth in South Africa are the Accelerated Shared Growth Initiative for South Africa (ASGISA) and the Joint Initiative for Priority Skills Acquisition (JIPSA). Asgisa was launched at the beginning of 2006 as a top-level government initiative to drive the economic growth of the country as a whole. JIPSA followed in March 2006 and was specifically aimed at addressing the pressing skills shortage situation in the short- to medium-term. Both these initiatives recognised the shortage of ICT skills as a challenge that must be addressed from within the educational sphere by encouraging learners to pursue studies in the field of ICT's both at school and in Further Education and Training (FET) Colleges.

The White Paper on e-Education also makes provision for interventions to address specific infrastructure challenges. For example, the establishment of refurbishment[6] centres with minimum refurbishment standards; arrangements with the Department of Minerals and Energy (DME) to prioritise the electrification of schools and FET colleges; and partnerships with the State Information Technology Agency (SITA) in order to ensure value for money in the procurement of technologies by leveraging economies of scale[7].

The importance of internet connectivity for schools has also not gone unnoticed in the White Paper on Education, and schools are expected to benefit from a special e-rate stipulated in the Electronic Communications Act, 36 of 2005. However, the policy does not specify the minimum bandwidth in relation to the e-rate, so it is difficult to determine whether schools will indeed benefit financially from this provision in the policy. It should be noted that for schools to fully benefit from ICT's, bandwidth demands are likely to be high as educational content generally feature rich multimedia components.

[5] www.thepresidency.gov.za/docs/asgisa.pdf; https://www.labour.gov.za/.../asgisa_economicgrowth.pdf

[6] DoE. 2004. White Paper on e-Education – Transforming learning and teaching through Information and Communication Technology. Government Gazette, Vol470, No.26734. Pretoria: DoE, p.30

[7] State Information Technology Agency (SITA) Act, 88 of 1998. 2005. Government GazetteNo. 28021, p. 16

Issues around research and sustainability[8] also feature in the White Paper on Education. In this regard, SITA is mandated to formulate a research agenda that informs future planning for ICT development and e-learning. The importance for provincial departments to budget for the appointment of ICT specialists is also emphasised.

Lastly, the Government has adopted a strategy for the implementation of Free and Open Source Software (FOSS)[9] as a way for promoting a spirit of sharing and collaboration in the field of software development and the production of educational content; and as a means of reducing the costs of licensing for conventional proprietary software.

A number of initiatives aimed at introducing information and communications technologies (ICT's) into schools have arisen out of these policies. Most of these have focused largely on equipping schools with hardware infrastructure (computers, printers, local area networks and internet connectivity). The most prominent of these projects, SchoolNet, has established partnerships with the private sector, government, non-governmental organizations (NGOs), and the donor community to install and promote the use of computers in schools.

Schools in South Africa differ widely with respect to the availability of resources, management skills and educator capacity. A UNICEF report titled "Child-Friendly Schools," states that "on the one hand, there is a mass of rural, peri-urban and township schools. These schools are cash-strapped, lack the basics such as water supply and sanitation and are often targets of crime and vandalism. On the other, are the well-resourced former Model "C" schools, with computer and science labs, sports fields, swimming pools and libraries and top teaching staffs" (UNICEF, 2008). Many of these differences are a legacy of the apartheid system under which 19 separate education departments existed – each organised on the basis of race, language and geography. The re-integration of former homeland governments under a central

[8] DoE. 2004. White Paper on e-Education – Transforming learning and teaching through Information and Communication Technology. Government Gazette, Vol470, No.26734. Pretoria: DoE, p.26

[9] DoE. February 2006. Guidelines for the use of open source software in schools. Pretoria, Department of Education

administration; and the realignment of provincial and municipal boundaries, has further complicated an already complex environment.

While there has been a general uptake in the diffusion of computers in South African schools, there are considerable differences in equity of access both in qualitative and quantitative terms. These disparities are particularly conspicuous between urban and rural schools, public and private schools; and perhaps more significantly, between former “white” and “non-white” schools. In the mid 1980’s, unequal access was to be expected since computers were coming largely into white schools and into the homes of those who could afford them. In the early 1990’s - with the impending liberation of South Africa from decades of apartheid rule - the proliferation of non-governmental organisations, donor agencies and multinationals in South Africa gave impetus to the drive for the introduction of computers in schools.

The birth of South Africa’s first democratic government, led by the pro-socialist African National Congress (ANC), ironically coincided with the demise of the Union of the Soviet Socialist Republics (USSR) and its various ramifications. The credibility of a socialist model having been undermined by the fall of the Berlin Wall, post-apartheid education policy in South Africa was faced with the challenge of having to ‘enable’ its population with the requisite skills to be able to effectively participate and compete in a rapidly emerging global economy; and to balance the sometimes conflicting need to address the economic inequalities of the past, on the one hand, and the “deracialisation” of South African society within an atmosphere of reconciliatory politics, on the other hand.

The euphoria of liberation also coincided with the anticipation of many foreign governments and businesses for significant economic opportunity in South Africa. Amongst the many social-responsibility interventions made by some of these agencies and businesses in attempting to “equalise” the South African education environment, one was to donate computers to schools. While the motivation for this intervention may have been well-intentioned, it was not always well-informed. This is borne out by the number of instances where computers were delivered to schools without due consideration being given to the schools preparedness to receive these devices - whether this related to availability of electricity, spatial requirements,

curriculum integration strategies, or the teachers capacity to be able to use these devices effectively. One extreme result of this 'box-dropping' was that a number of schools continue to have stacks of unused, now obsolete, computers tucked away in storerooms. A survey[10] undertaken by InfoDev suggests that the process of adoption and diffusion of ICT's in Africa is in transition and that there are the beginnings of a marked shift from experimentation in the form of donor-supported, NGO-led small-scale, pilot projects towards a new phase of systemic integration informed by national government policies and multi-stakeholder-led implementation processes. One particular feature of this new approach is the emphasis that governments in Africa are placing on policy development specifically aimed at ICT in education, thus laying down a framework and guidelines for partnerships and donor participation.

The post-apartheid transformation of South Africa's education system began with the country's first democratic election in 1994. This reform has touched all areas of the system, including governance and management; administrative processes,

curriculum development, and a shift towards learner-centred approaches through the introduction of outcomes-based education[11]. Figure 1 provides a snapshot of South African schools showing Grade 12 results for the years 2005-2008 and also reflects on poverty and unemployment statistics by province.

[10] Survey ICT and Education in Africa : A Summary Report Based on 53 Country Surveys

[11] www.info.gov.za/aboutsa/education.html

Province	Number of Schools (2009)	% of schools with Compu-ters (2009)	% of Schools with Labora-tories (2009)	% Passed (Senior Certificate Examination)				Unemploy -ment Rate (2007)	Average Household Income in Rands (2007)	% of Population living below the poverty line (2007)
				2005	2006	2007	2008			
Eastern Cape	5715	10%	9%	57%	59%	57%	51%	25.5%	47 930	29%
Free State	1643	21%	21%	78%	72%	70%	72%	26.4%	60 700	16%
Gauteng	1994	76%	40%	75%	78%	75%	76%	22.6%	111 079	7%
KwaZulu Natal	5835	17%	12%	71%	66%	64%	57%	29.2%	58 551	33%
Limpopo	3918	11%	6%	65%	56%	58%	55%	32.4%	36 386	34%
Mpumalanga	1540	16%	13%	59%	65%	61%	52%	26.3%	54 562	28%
North West	1740	22%	16%	63%	67%	67%	73%	32.0%	56 310	28%
Northern Cape	609	52%	30%	79%	77%	70%	68%	26.5%	49 697	24%
Western Cape	1466	60%	35%	84%	84%	81%	79%	17.2%	135 029	10%
South Africa	24974	23%	15%	68%	67%	65%	62.2	25.5%	74 589	23%

igure 1 South Africa, Provincial Statistics related to Schools, Unemployment, Income levels and Poverty
Source:

1. *South Africa Survey 2007/2008,* South African Institute of Race Relations (2008). (Pages 19, 31, 211, 229, 256, 364, 377-378).

2. Department of Education, South Africa. (Education Management Information System) http://www.education.gov.za/emis/emisweb/statistics.htm (Table 8, 2009).

1.4 The Limpopo Province

Situated in the northernmost part of South Africa, the Limpopo province of South Africa borders Zimbabwe in the north, Botswana in the west, Mozambique in the east, and Gauteng province in the south (see figure 2). The Province is divided into five district municipalities comprising a total of 26 local municipalities. The provincial government headquarters is based at the provincial capital, Polokwane, situated in the Capricorn district, which is the location of the eight schools selected for this study.

Limpopo has a population of 5.4 million, living predominantly in rural areas. (SA Survey (SAIRR), 2007/8). In his 2007 State of the Province Address, Limpopo premier Sello Moloto stated that while the province recorded an annual average growth of 4% between 1996 and 2005 (higher than the national average over that period) Limpopo remained one of South Africa's poorest provinces, with personal income per capita estimated at only 38% of the national average (Moloto, 2007). This anomaly can largely be attributed to the huge investments in mining operations in the province without any significant corresponding increase in employment

opportunities – a situation described by President Thabo Mbeki as “jobless growth”. Limpopo also records the largest rate of unemployment[12] in South Africa with 34% of the Province’s population living below the poverty line and the average household income is at levels lower than half the national average. (See figure 2).



igure 2 Map showing location of Limpopo within Southern Africa
Source: 2010, Limpopo Department of Economic Development, Environment and Tourism (LEDET), GIS Office

According to the Limpopo Provincial Growth and Development Strategy (PGDS) document, the province faces the challenge of ensuring that the benefits of economic growth flow to increasing numbers of its citizens. The PGDS further states that “the Province will also devise in the short term, a strategy as part of a national initiative that responds to the World Summit on Information Society (WSIS) resolutions to bridge the digital divide and thus build an information society in support of the provincial objectives in order to ensure sustainable socio-economic development in a global economy that is increasingly characterised by information and knowledge as the major factors of production” (PGDS, 2004).

Although significant progress has been made in rolling-out ICT initiatives in some schools across the country, the successes are overshadowed by vast differentiations both between provinces and within provinces themselves. The Eastern Cape and

[12] Source: Stats SA, *Labour Force Survey* March 2007, Statistical release P0210, 26 September 2007, p8. (cf. *South Africa Survey 2007/2008,* p211, South African Institute of Race Relations 2008, Johannesburg)

Limpopo provinces have the lowest number of schools with computers and access to telecommunications and internet facilities. The Gauteng province, for example records school computer penetration rates of 76% while its neighbouring province, Limpopo records only 11%. (See figure 1). In 2007, 58% of Limpopo learners passed the Senior Certificate examinations with 12% gaining university entrance compared to the South African average of 65% and 15% respectively (See Figure 1).

Limpopo is second only to the Eastern Cape in terms of computer facilities in schools and languishes at the bottom of the table when it comes to the availability of school science laboratories. The much publicised school textbook fiasco of 2011, which resulted in many schools not receiving textbooks until late into the school-year suggests that there are serious structural problems in Limpopo Education.

It is against the background of these rather grim education and employment statistics; and the recognition that ICT's has the potential to positively transform all areas of life, that this study will focus on the provincial capital of Limpopo province, Polokwane.

1.5 Problem Statement

Vast resources are being expended to install computers in schools and the goal of ensuring that every learner in South African primary and secondary schools is ICT-capable by 2013[13] suggests that the demand for resources in this area will increase. As the 1979 Nobel Laureate in Physics, Abdus Salam observed, "in the final analysis it is basically mastery and utilisation of modern science and technology that distinguishes the developing nations from the developed nations" (Lai, 1987). In a country where the multiple developmental challenges of poverty alleviation, unemployment, land and healthcare reform and education are competing for limited resources, it is imperative that any initiatives aimed at addressing these challenges are thoroughly researched and carefully analysed.

The dawn of democracy coincided with the rapid spread of globalisation. This has resulted in a relentless expansion in the scope and complexity of the activities that schools are expected to perform. At the same time, learner profiles have changed

[13] South Africa, Department of Education (2003). White Paper on e-Education

and schools are now serving the needs of an economically and socially diverse range of learners. While there has been a steady increase in the number of computers finding their way into Limpopo's schools, the full potential of these devices has not been leveraged. Most policymakers and parents assume that the mere availability of computers in schools will guarantee their use. Thanks to the involvement of the private sector, NGO's and well-meaning philanthropists, infrastructure roll-out in schools is advancing rapidly. Unfortunately, the complementary activities associated with exemplary computer use in schools, have not kept pace; thereby not achieving intended outcomes as espoused in the vision of the e-Education White Paper. A study of the e-Education White Paper and the reality of the situation in the school-setting suggests that there is a gap between the intention and the reality of technology integration in schools; and that the ways in which technology actually gains traction in school settings has not been adequately considered in the policy.

1.6 Purpose Statement and Research Questions

This study will attempt to make a small contribution to the already vast pool of available literature on the subject by attempting to determine those factors that promote the effective use of technology in schools in a provincial setting with low levels of economic development. By evaluating computer implementation in eight schools and reviewing existing e-Education policy, the study will endeavour to identify and establish the critical success factors for the successful integration of computers in schools in order to draw policy lessons for the realisation of intended outcomes and to derive maximum value from future implementations.

The research questions that emerge from the problem statements are as follows:

In which ways can policy interventions address the challenges facing computer-implementation programmes in Limpopo schools?

The following sub-questions will be asked:

1. To what extent are the perceptions, experiences and attitudes of individuals linked to their use of technology

2. What is the extent of availability and access to technology infrastructure for learners, educators and management?
3. What is the nature of challenges facing computer-implementations in Limpopo schools?

1.7 Chapter Outline

Chapter One presents a historical overview of the South African education landscape and describes the current status of technology implementation in South African schools. We also briefly reflect on government policy with respect to telecommunications and information and communications technologies (ICT's) in general and e-Education in particular. Lastly, this chapter will explain the rationale for this study and lay down the context for the entire report.

Chapter Two presents a comprehensive literature review on various technology integration programmes in both developing and developed countries. A description of key themes that emerge in the literature related to technology integration in schools, the impacts of technology on teachers and learners; and an assessment of current trends are provided so that the reader is able to gain a balanced perspective of the subject under consideration.

Chapter Three describes the research design and methodology that was employed in the course of undertaking the study. A description of the research process and the tools that have been used for data collection are provided. Sample questionnaires are included in the annexures.

Chapter Four provides a presentation of the findings and contains a brief description of the consolidated results of the questionnaire surveys.

Chapter Five contains an interpretation of the findings. A description of the data analysis process and the researcher's subjective interpretation of the qualitative data that was gathered is expanded upon.

Chapter Six contains a summation of the research and present multiple interpretations of the findings with recommendations and suggestions for further research.

Chapter Two

2. Taking A Position : Technology in Education

2.1 Rationale for implementing ICT's in Schools

Historically, technology and automation have been developed to help solve problems, enhance organisational and individual productivity and to improve the general living standards of society. It follows then that since its introduction, the computer has also been seen by many as the solution to many of education's problems. Yet, despite significant improvements in terms of accessibility, availability and affordability, the computer has not made its way into classrooms in ways that can be described as particularly ground-breaking or significant. "The picture of students sitting behind computer terminals for much of the day has not occurred in mainstream schools, and most would not like this to be realised" (Collis, 1988).

The reasons that governments' and development agencies most commonly advance for introducing computers into schools are described by Hawkridge, Jaworski and McMahon (1990) in their book "Computers in Third-World Schools." After studying the experience of African, Asian and Arabic-speaking countries, they suggest four rationales for computer deployment in schools across the developing world: the *social* rationale, the *vocational* rationale, the *pedagogical* rationale and the *catalytic* rationale. The first two are concerned with preparing learners for participation in a modern, knowledge economy and involves the 'demystifying of technology' and basic computer literacy that will prepare learners for employment in a computerised world. The latter two rationales are related to the implementation of computers in the classroom. The *pedagogical* rationale advocates the integration of computers into the curriculum so that the process of teaching and learning can be enhanced, while the *catalytic* rationale suggests the use of computers in schools to improve learning, teaching and administration processes and to make the learner independent of the teacher in the use of computers. (Hawkridge, Jaworsky, McMahon, 1990).

While these rationales point to certain distinct characteristics that differentiate them from each other; South Africa, as a developing country operating in a globalised economy, is faced with multiple challenges that requires all four rationales to be considered with equal emphasis. However, since this study is concentrated on the

impact of technology in schools, the focus will be on the pedagogic and catalytic rationales described above.

2.2 Traditional versus modern learning environments

There has been a significant paradigm shift in education across the world over the past two decades. Part of this shift has been in our understanding of the role of the teacher in the modern classroom environment. The traditional classroom setup places the teacher at the centre of the learning process - the “bringer of knowledge” - with the focus on leading, directing and control. The modern classroom environment places the child at the centre of the learning process, allowing them to direct the pace and direction of their learning, thereby instilling values of self-discipline, creativity and independence. The introduction of technology into the classroom, if harnessed effectively, will result in the teachers’ role shifting from “the sage on the stage to the guide on the side” (Turner, nd).

For the most part, traditional learning environments are characterised by teachers talking and children listening. In the past, schools served the needs of smaller, largely homogenous groups of learners. Globalisation, together with rapid urbanisation in developing countries, has resulted in the classroom now having to accommodate the needs of learners from diverse backgrounds, cultures, values and socio-economic status.

The blurring of lines between traditionally compartmentalised learning into strict subject disciplines is also not in tune with the increasing interconnectedness of human knowledge. Modern learning demands that we take a broader, holistic view of the world around us and to solve problems by seeking solutions through collaboration across disciplines.

The conventional mode of learning primarily through text and words is also being challenged by the concept of multimedia. Communication by means of sounds, pictures, video and graphics means that learners can be accommodated using a variety of learning styles and preferences.

A further challenge facing traditional learning environments is the requirement for rigid adherence to a centralised curriculum. While this may be necessary for

consistency and to allow for standardised assessment, the inherent inflexibility in this method has resulted in both teachers and learners aiming for the minimum. There is little incentive to go beyond the set requirements of the school curriculum and therefore any attempt by teachers or learners to indulge in innovation and creativity is constrained.

Assessment of performance in traditional learning environments is typically one-dimensional. Teachers generally rely on written tests and examinations to determine a learner's progress. Such tests tend to focus on low-level cognitive ability (eg. ability to remember facts), rather than allowing for the assessment of the learners higher order thinking skills (ability to conduct problem analysis, contextual thinking, etc.).

2.3 Impact of ICT's in schools

Various learning theories appear in technology literature offering different views regarding the use of computer technology in an educational setting. For instance, behaviourist theories propose that learning from technologies means using computers for drill and practice because learning, according to this view, is a matter of imitation and practice. Therefore, the behaviourist approach suggests that the role of adults (parents and teachers) in learning is important, as they provide a model by which children learn through imitation; the adults also encourage children to continue using computer technology by providing them with positive reinforcement (Gruender, 1996). In contrast, constructivist theory suggests that when the child learns with computer technology, the role of the computer is to enable, scaffold, and enhance learning in meaningful ways. When learning with technology, children should be given many opportunities to create, test, and reverse their hypotheses (Gruender, 1996).

The benefits associated with introducing computers into schools have been the subject of numerous studies worldwide, most notably the Apple Classrooms of Tomorrow (ACOT). Conducted in the United States of America (USA) over a period of 10 years during the 1970's, the research findings indicated that in addition to overall improvements in performance and attendance, student attitudes towards themselves and their work also improved (Rusten, 2003). Another study, conducted by Educational Testing Services (ETS), a non-profit organisation specialising in

educational research, demonstrated similar findings to the ACOT study. The ETS study found that “the use of computers to teach higher-order thinking skills was positively related to both academic achievement in mathematics and the social environment of the school” (ETS, 1998). This view is also supported by an examination of research studies that evaluated the impact of computers on student achievement which shows that computer-based instruction (CBI), computer-aided instruction (CAI) and integrated learning systems (ILS) can improve learners basic skills in such disciplines as mathematics (e.g., Koedinger, Anderson, Hadley, & Mark, 1997).

In yet another study, Sivin-Kachala and Bialo (2000) reviewed 311 research studies on the effectiveness of technology on student achievement. Commissioned by the Software and Information Industry Association, their study findings revealed positive and consistent patterns when students were engaged in technology-rich environments, including significant gains and achievement in all subject areas, increased achievement in preschool through high school for both regular and special needs students, and improved attitudes toward learning and increased self-esteem.

2.4 Epistemological and pedagogical considerations

In evaluating the literature related to the use of computers in schools it would be useful to consider the epistemological basis of our understanding of knowledge. Theories of epistemological beliefs focus on the individual’s perceptions about what knowledge is and where knowledge comes from. It also includes definitions of knowledge and how this knowledge is constructed and evaluated.

The idea that learners’ and educators’ beliefs about the nature of knowledge and learning may directly influence how they approach learning has been elaborated upon by Schommer (1994) and Hofer (2001). Epistemological beliefs are also particularly relevant for this study because they have been linked to a variety of behaviours associated with both academic performance and with various cognitive and motivational factors (Hofer & Pintrich, 1997).

Some studies (Cuban et al, 2001; Pelgrum, 2001) have suggested that technology can achieve systemic change in the schooling system only if

technology integration is informed by pedagogical theories. This means that successful technology implementation into schools requires a holistic approach that addresses all relevant issues, including educator development, educational approach, technology infrastructure management and curricular design.

After conducting an international study on the implementation of computers in schools across 26 countries (including 222 South African schools), the Second Technology in Education (SITES) identified the following as major barriers to technology integration: insufficient computers (70%), teachers' lack of computer knowledge (66%) and school's difficulty in integrating technology into instruction (58%), (cf. Law, Pelgrum & Plomp, 2008).

A number of studies also suggest that attitudes may be an important element in teaching children about computers. According to Todman and Dick (1993, cf. Christensen, 1998), "An important factor affecting the quality of the child's experience of computers at school may be the teacher's attitude towards computers." The increase in the use of computers at all levels of the education system has prompted some researches to investigate the link between an individual's self-belief in their ability to use computers and their actual use of computers in a classroom setting. Ropp (1999) uses the term "computer self-efficacy" to suggest that while many teachers have a positive attitude to the use of educational technologies, they do not necessarily believe in their own ability to use technology in a classroom with students (Ropp, 1999, cf. Jones, 2002). In another study, Delcourt and Kinzie (1993) reported that learning about computers is aided by high levels of self-efficacy and a positive attitude.

Some epistemological beliefs may also constrain the opportunities learners have in certain technology-based learning environments. The availability of large volumes of information and the increased number of choices are often put at the disposal of the learner and their decisions and beliefs are likely to shape how they utilise the technology. In one study, learners with simple epistemological beliefs had difficulty with the nonlinear nature of an ill-defined system (Hartley & Bendixen, 2001).

2.5 Integration of ICT's in schools

The integration of ICT's in schools is based on the assumption that computers should be an integral part of the learning process at all levels (Lockard, Abrams and Many, 1994). This means that technology should primarily be used to service curriculum needs and that the technology as a subject for study in itself must be secondary first and then be an object for study. However, the integration of computers into everyday classroom activity has proved to be more slow and difficult than many may have expected it to be (Collis, 1988), suggesting that there are incentives and barriers at work in enhancing the adoption of ICT's in some schools while effectively hindering wider acceptance in others.

Despite the growing support for computers as tools for learning, there continues to be a general unwillingness among teachers and schools to promote the use of computers across the curriculum. According to Collis (1988), the advocates of integration have failed to account for the reality of school life. The lack of appropriate teacher role models for those teachers implementing and managing computers in their classrooms is a fundamental cause of the problem. Complicating the situation is that those role-models who do exist, are generally computer-studies teachers using computers in laboratory situations. Wellington (1990) believes that the physical obstacle of computer rooms and the more subtle obstacle of computing being the domain of mathematics/computer studies inhibits the spread of computers across the curriculum.

The existence of subtle obstacles suggests that teacher beliefs or values play an important role in influencing the integration of computers in general teaching areas. In a review of the literature on teacher attitudes towards computers, Dupagne and Krendl (1992) identified twenty aspects related to teacher's perceptions of computers, the impact of computer use and the impact of personal and learning environment characteristics affecting a teacher's intention to use computers as teaching learning strategies.

Chandra, Bliss and Cox (1988) studied the implementation of computers in secondary schools in the United Kingdom and found organisational constraints within

schools were a significant impediment to the diffusion of computers across the curriculum. More recently, Schofield following a two year study of Whitmore High School, stated that "pre-existing attitudes and social structures shape the extent to which technology is used as well as the way it is used" (Schofield, 1995).

Becker and Riel's (1999) research found that the work of integrating instructional technology strategies into practice is a complex process and that teachers encounter either a bureaucratic culture or a professional culture in their school. Bureaucratic cultures tend to give teachers autonomy in their classrooms, but restrict their participation in curricular and organisational decisions. The bureaucratic culture hinders innovative practice and collaboration among teachers. In contrast, professional cultures support innovation and collaboration among teachers. In this culture, decisions are based on a guiding philosophy about teaching and learning and sensitivity to the learning needs of students. In previous research, Becker (1991) found that only 5 % of technology implementation programs succeed beyond a three-to-five-year period in schools. (cf. A Model for Pedagogical and Curricula Transformation with Technology. David R. Wetzel, Ph.D.)
A major challenge to educational innovation is assisting teachers in unlearning the beliefs, values, assumptions, and culture that underlie their school's standard operating procedures and practices (Dede,1999). To be successful beyond initial implementation, school systems need to assist teachers in learning, but also aiding them in unlearning their standard organisation's operating procedures. The goals of the innovation implementation must include organisational changes as teachers learn. A shift in organizational change will sustain change that can only be achieved when owned by teachers and not imposed or mandated (Dede,1999). (cf. A Model for Pedagogical and Curricula Transformation with Technology David R. Wetzel, Ph.D.)

Organisational constraints relate to the policies and practices (official and unofficial) that inhibit the implementation of ideas. In a survey of 26 American Principals, Hameyer (1989) noted that there was a degree of scepticism about whether or not computers would enhance learning. Hameyer (1989) also found that the financial resources that innovative technology might consume concerned many of the principals.

For some teachers, frequent and systematic use of computers for activities that involve higher order thinking is the norm. In a nationwide study of 608 teachers described as accomplished at integrating computing into their teaching by the Bank Street College of Education, it was found that exemplary practitioners devoted considerable time and effort to teaching with computers, using computers as multipurpose tools to present more complex material to students and to foster greater independence within the classroom. The study concluded that provided there is enough technology for teachers to have regular access, ample support and time for teachers to learn how to use and plan for computer use and there is a school climate which encourages an experimental approach to teaching, then it is possible for other teachers to gain the expertise and comfort levels demonstrated by exemplary teachers. (Sheingold & Hadley, 1990; Hadley & Sheingold, 1993).

In order to understand the impact of technology on education, it is important to consider the purposes for which the technology is being applied. One way of approaching this comes from Thomas Reeves (1998) who describes learning “from” computers as distinct from learning “with” computers. When learners are learning “from” computers, the computers are essentially tutors. In this capacity, the technology primarily serves the goal of increasing students’ basic skills and knowledge. In learning “with” computers, by contrast, learners use technology as a tool that can be applied to a variety of goals in the learning process, rather than serving simply as an instructional delivery system.

According to Schommer (1994), learners with simple epistemological beliefs view knowledge as absolute, black or white, handed down by authority, acquired quickly or not at all and that the ability to learn is fixed at birth. Sophisticated epistemological beliefs learners on the other hand, embrace knowledge as complex and tentative, and the source of knowledge shifts from the simple transfer of knowledge from authority to processes of rational thinking. (Schommer, 1994).

The important role of educators in ensuring successful technology integration into school classrooms is well documented (Cuban, 1999). This has led to a number of

computer-literacy initiatives aimed specifically at educators. The Intel Teach[14] programme is one such initiative. This program is aimed at enhancing the effectiveness of educators through a professional development programme focused on integrating technology into their lessons, promoting problem-solving, critical-thinking and collaboration skills among their students (Intel Teach, nd).

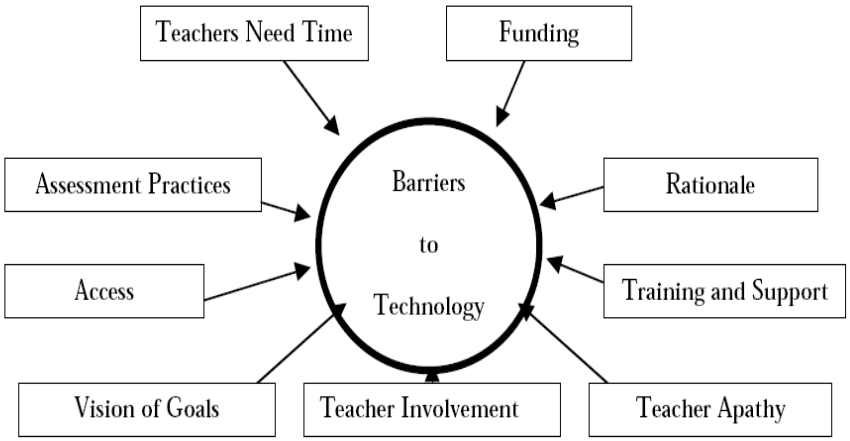
While the majority of literature reviewed reflects positively on the use of computers in schools (Kulik, 1994; Law, Pelgrum & Plomp, 2008), some authors have expressed a less optimistic view. In an article titled "The Computer Delusion" (1997), Oppenheimer says: 'there is no good evidence that most uses of computers significantly improve teaching and learning, yet school districts are cutting programs - music, art, physical education - that enrich children's lives to make room for this dubious nostrum, and the Clinton Administration has embraced the goal of "computers in every classroom" with credulous and costly enthusiasm.'

While this may represent an extreme point of view, some authors (Rusten, 2003) have cautioned that "computers and related technologies are not a panacea for the problems facing education in developed or developing countries." This is especially true for schools that lack the most basic infrastructure such as furniture, electricity and security. Cuban on the other hand, while not rejecting the merits of using technology in schools outright, suggests that they are "oversold and underused." Based on his study of Silicon Valley schools, Cuban suggests that if the current policies of technology promotion continue, universal access will be achieved but without any fundamental change in teaching practices (Cuban, 2001).

The common barriers identified as hampering the use of technology as an instructional tool are well documented in research. These barriers include time, funding, rationale for use, training and support, apathy, teacher involvement, vision, access to hardware and software, and adequate assessment practices. Research by the U.S. Congress, Office of Technology Assessment (1995) indicates that time is the greatest barrier to teacher's implementation and integration of instructional technology. (see figure 3).The time barrier is supported by the many demands on a

[14] Intel Teach programme, Internet Service Providers Association (ISPA) Teacher Training Working Group, SchoolNet SA

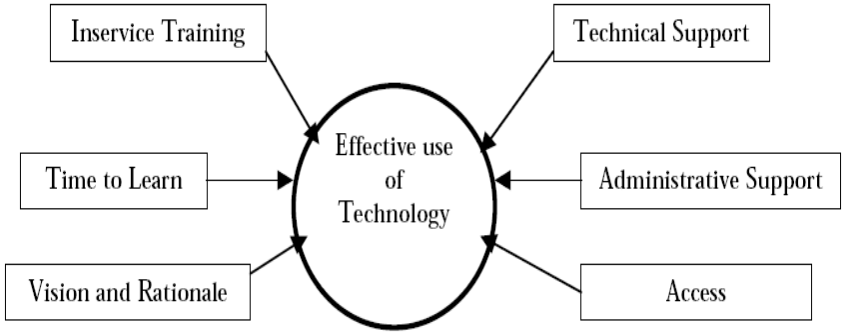
teacher during the course of a school day, with little or no time allotted to explore instructional technology, collaborate with other teachers about applications of this technology, and integration of the technology into their teaching strategies and techniques.



igure 3 Common barriers to teachers using instructional technology.
the U.S. Congress, Office of Technology Assessment, 1995.

Integrating instructional technology into schools extends beyond the provision of technology tools and IT training to educators. There is an equally important need to help them to learn to integrate the technology tool into their curriculum. To effectively integrate the use of this technology, several approaches are needed that will ease the concerns of teachers, increase the level of use, and provide examples of best practices for changes in teaching strategies. These approaches include training master teachers, providing expert resource-assistance, providing adequate staff development for teachers, providing staff development for administrators, and establishing technology training centers within the school districts (Becker, Ravitz & Wong, 1999).

While the challenge of integrating instructional technology has attracted many suggested solutions, most appear to suggest “making time” for staff development and providing support for teachers. Instructional technology takes time to master. Modern technology, notwithstanding its focus on being “user-friendly," requires time to master. Like any other discipline, time must be invested in learning how to use an instructional technology tool before real integration in curricula can occur. Figure 4, adapted from U.S. Congress, Office of Technology Assessment (1995) illustrates the requirements for effective use of technology.



igure 4

Figure 2. Requirements for effective use of instructional technology.
Note. Adapted from the U.S. Congress, Office of Technology Assessment, 1995.

2.6 Variables Related to Technology Adoption

One possible explanation why technology may or may not be used effectively in a classroom setting may be related to an individual's inclination towards adopting innovations. There are a number of theoretical models which have been developed to explain this phenomenon and these are discussed in the ensuing paragraphs. There are also a number of variables that may influence the extent to which teachers are able to adopt and use technology. Kotrlik and Redmann (2009) describe five.

2.6.1 Technology Adoption Barriers

Teachers often fail to build on technology's instructional potential due to barriers such as institutional and administrative support, training and experience, attitudinal or personality factors, and resources. (Brinkerhoff, 2006). The British Educational Communications and Technology Agency (BECTA) reported that teacher-level barriers included lack of time, lack of necessary knowledge, and lack of self-confidence in using technology. Administrative-level barriers included access to equipment, technical support, availability of up-to-date software, and institutional support.

2.6.2 Technology Anxiety

Technology anxiety is the result of equipping teachers with technology without providing appropriate teacher training, or considering curricular issues (Budin, 1999). Technology anxiety has been found to explain variation in technology adoption by

career and technical education teachers. (Redmann and Kotrlik, 2004). They further concluded that technology adoption increased as technology anxiety decreased.

2.6.3 Technology Training and Availability

According to Vannatta and Fordham (2004), the amount of technology training was one of the best predictors of technology use. However, BECTA (2003) reported that training is generally focused on teaching basic skills rather than addressing the integration of technology in the classroom. Regarding technology availability, Mumtaz (2000) and BECTA (2003) found that a lack of access to technology was a key factor in constraining teachers from using technology in their instruction.

2.6.4 Gender

Anderson (1996) reported in his analysis of studies of computer anxiety and performance that several studies concluded gender was a significant factor in explaining differences in computer anxiety and attitudes toward computers, while other studies found that no relationships existed.

2.6.5 Age and Teaching Experience

Waugh (2004) concluded that technology adoption decreased as age increased. In regard to teaching experience, Mumtaz (2000) reported that a lack of teaching experience with technology was a factor that resulted in teachers avoiding the use of technology.

2.7 Models for Technology Adoption

There are a number of frameworks that describe the process of technology adoption by individuals. Three are listed in figure 5.

Stage	Rogers Innovation-Decision Process	Russell Learning to Use Technology	Miller Evolutionary Model
1	Knowledge	Awareness	Introduction
2	Persuasion	Learning	Entry
3	Decision	Application	Intermediate
4	Implementation	Familiarity	Penultimate
5	Confirmation	Adaptation (other context)	Creation
6	-	Creativity (new context)	-

igure 5 rameworks Describing Technology Adoption

Source: Developed from Van Russell, A. L. (1996). Six stages in learning new technology, Miller, P.A. (1997), Integration of Computers at Pinelands High School: A Case Study. Minithesis, MEd, University of Pretoria, South Africa, and Orr, G. (2003) A Review : Diffusion of Innovations by Everett Rogers (1995).

Roger s defines ***innovation*** as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption," and ***diffusion*** as "the process by which an innovation is communicated through certain channels over time among the members of a social system." (Rogers, 1995). According to Rogers, innovation goes through a period of slow, gradual growth before experiencing a period of dramatic growth. Following this the innovation's rate of adoption gradually stabilises and eventually goes into decline. The rate of adoption refers to the culmination of the decision-making processes by users in their implementation of the innovation. Rogers suggests that individuals can be categorised according to several innovation-adopter types: innovators, early adopters, early majority, late majority, and laggards. According to Roger's, early adopters are key in ensuring that a particular innovation reaches a point of self-sustainability. Rogers' rate of adoption model states that innovations are diffused over time in a pattern that resembles an S-shaped curve (Rogers, 1995).

Russell identified six stages that learners move through as they learn to use technology: awareness, learning the process, understanding the application of the

process, familiarity and confidence, adaptation to other contexts, and creative applications to new contexts (Russel, 1996).

Miller's (1997) Evolutionary Model is a synthesis of three models (Acot, CAMI Mathematics and Make It Happen!) into a single integrated model. According to this model, the *introduction* phase is when technology is introduced into the school. During this phase, time is spent checking that the equipment works and how it works. Teachers use computers for simple tasks (Miller, 1997).

The *entry* phase is when teachers start to use technology to support classroom instruction. The computer is used for drill-and-practice type instruction with little change in classroom layout and instruction continues to be largely text-based (Miller, 1997).

The *intermediate* phase is characterised by a move from text-based instruction to the use of wordprocessors, spreadsheets, databases and graphics. Learners are able to complete tasks more quickly and there is an improvement in the quality of work. The teacher's role begins to shift from that of instructor to facilitator. During this stage, the teacher also begins to experiment with different technologies and applications. The curriculum may also be modified to accommodate team teaching and peer-observation (Miller, 1997).

In the *penultimate* stage of Miller's model, many changes in instructional strategies occur. As a result of peer-observation, team teaching is consolidated. The curriculum is modified to make use of the different technologies and the learning and teaching process shifts from a behaviourist to a constructivist approach. The role of the teacher moves from facilitator to collaborator. During this phase, learners are actively involved in knowledge construction and collaborative learning projects (Miller, 1997).

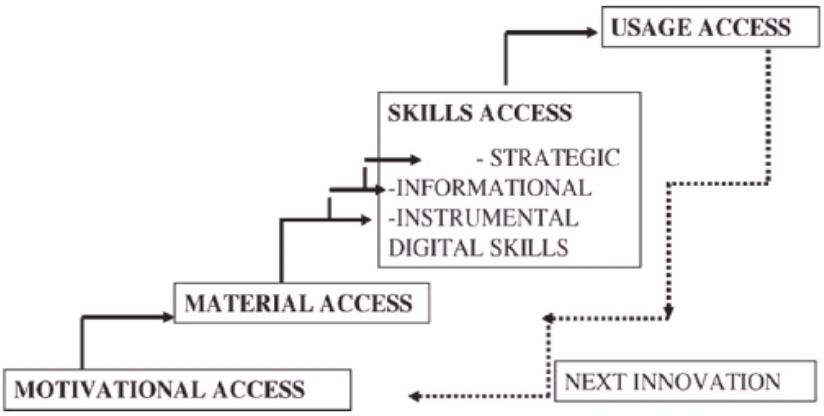
The *creation* stage in Miller's model is perpetual. As new technologies develop, schools have to decide which technology tools best suit their instructional needs and adapt accordingly. This phase is characterised by teachers working in collaborative teams and timetables are adjusted to allow team teaching and interdisciplinary, project-based, learning. Learners use ICT to create knowledge in the form of web

pages, multimedia documents and presentations. Lastly, learners and teachers demand frequent technology updates and training in new technologies during this stage (Miller, 1997).

2.8 Technology availability and access

The emphasis on the importance of ICT access for participation in the emerging global knowledge economy has led some authors to caution against another problem—the unequal social distribution of access to ICT's. The term "digital divide" is now broadly accepted to describe this phenomenon; and addressing issues around equitable availability and access to computers in schools should be considered within the context of wider debates related to the "digital divide." While there are a number of interpretations of what constitutes the "digital divide", there are four broad categories of discussion in the literature reviewed. The first category considers the divide to be a non-issue (Compaine, 2001). Another category (Antonelli, 2003), views the divide as a big-issue and considers it largely in economic and development terms. A third grouping considers the divide as largely political and social (Hacker and Mason, 2003; Colby, 2001), while the fourth category suggests that all efforts aimed at bridging the digital divide seem to benefit the more affluent sections of society rather than the poor (Yu, 2006).

Much of the early studies of the "digital divide" was concentrated on access to ICT's (Bertot, 2003), and was focussed on "the attached importance of the physical availability of computers and connectivity rather than to issues of content, language, education, literacy, or community and social resources (Warschauer, 2003, cf. Benhabrim, A, nd.). Some author's (Van Dijk, 2003, Gunkel, 2003) have refuted this position and have suggested that it promotes a form of technological determinism, i.e. the idea that physical access to a computer and a network would automatically solve all economic and social problems. Instead, Van Dijk suggests a multi-faceted concept of access that includes "mental access", "material access", "skills access" and "usage access" (Van Dijk, 2003), and goes even further by recognising disparities in access within these four elements by providing a cumulative and recursive model as a framework for interpreting the digital divide as described in figure 6.



igure 6 Van Di k's ramework for Interpreting the Digital Divide

Source: Van Dijk, J. (2003) A Framework for Digital Divide Research, Electronic Journal of Communication.

South Africa is faced with a number of challenges that could hamper efforts at bridging the digital divide; and in some cases, even present a threat in a competition for limited resources. These include high levels of inequality; a lack of ICT infrastructure, particularly in rural areas; and more pressing social development commitments.

2.9 Overview of ICT Policies in Education

The introduction of computers in schools is a costly exercise. This is particularly evident when one considers the number of complementary activities required for the sustainable and meaningful integration of technology in the classroom. In addition to the base cost required for the devices themselves, resources are needed for installation, regular maintenance, connectivity, software licensing and security.

While the need for training of teachers and technical support have been well documented, the costs in terms of time, money and school disruptions are difficult to adequately quantify; with the more fundamental issue of curriculum design to accommodate technology across the classroom, largely absent in policy.

Reflecting on a study undertaken by Tondeur, van Braak, and Valcke (2008), there is evidence to suggest that there is a gap between the proposed ICT curriculum at the macro-level and the actual use of ICT in the classroom settting. The study demonstrated that the intentions of national educational authorities to promote ICT

integration in schools have not always resulted in concrete changes in instructional practices at the classroom level. In this regard, Visscher and Coe (2003) point at the variability between schools, suggesting that generic, one-size-fits-all policies and reforms do not automatically lead to educational change at the classroom level. Schools differ widely with respect to performance levels, capacity for innovation, and contextual characteristics, such as location, community profile and socio-economic conditions. This implies that educational improvement or innovation efforts should consider to a larger extent the 'power of site or place'. Fullan (2001) concludes that large-scale change could be effective, but requires a degree of top–down initiative at the beginning, followed by larger attention paid to local conditions.

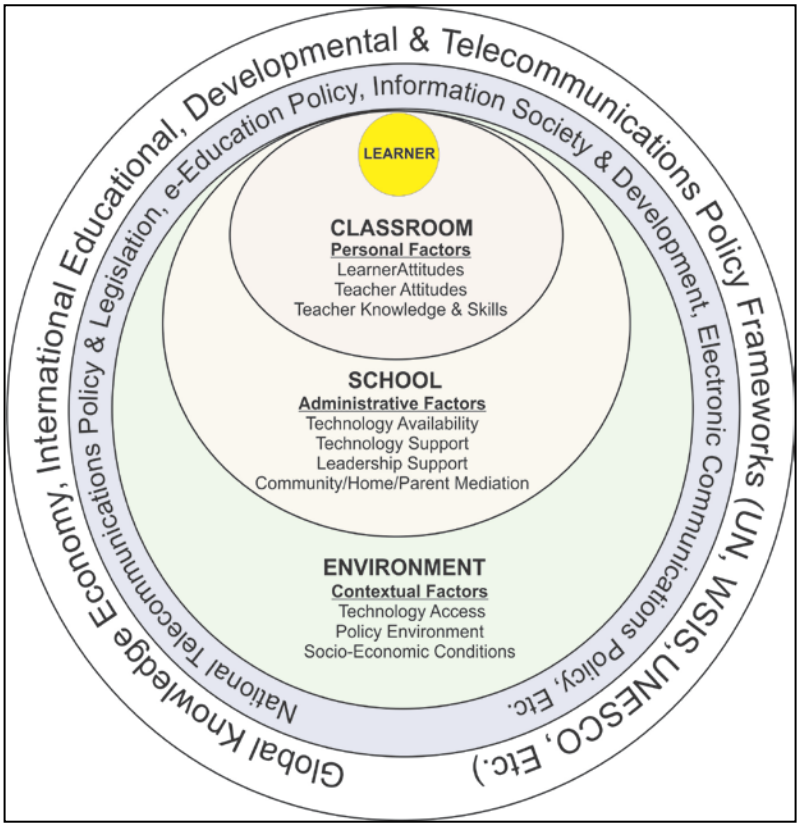
2.10 The Role of Monitoring and Evaluation in Educational Reform

Monitoring and evaluation (M&E) is a critical component of any planned ICT for education programme (Wagner, Day, James, Kozma, Miller, and Unwin, 2005). It can help in identifying gaps between the stated goals of a programme and the actual output in terms of tracking progress, measuring performance and documenting accomplishments. Systematic M&E is a useful tool that allows for early identification of both potential pitfalls and opportunities and allows for adjustments to be made in order to ensure successful implementation of the programme. James and Miller (2005) suggest that monitoring and evaluation should be factored into planning before a project starts and they provide an overview of the processes, tasks and outcomes that are needed to implement a successful M&E plan. This includes appropriate, realistic and measurable indicators which should be used to monitor outputs and outcomes. They advise that major stakeholders should be identified and involved in making M&E decisions to avoid possible problems with "buy-in" and commitment later in the process.

2.11 Conceptual ramework

There is general agreement in the literature reviewed, that the introduction of computers in schools is a positive development. The thrust of this research however, is less concerned with the merits of introducing technology into schools and more interested in assessing the extent of computer-use in the schools identified for the study and thereby determining the critical success factors for the effective integration of computers in schools.

From a traditional education perspective, the reasons for introducing technology into schools may be synthesised into three key objectives: the first relates to the organisational efficiency of schools and focuses on using technology to improve the schools' productivity by streamlining administrative functions. The other two are concerned with learners in the form of technology literacy and learning support – which may also include enabling teachers to be able to use technology effectively. This study suggests that the integration of technology into schools to effect positive change is dependent on a number of distinct variables.



igure 7 Conceptual ramework developed by the researcher for describing the elements that influence the integration of ICT in schools.

Chapter 3

3. Rationale for Mixed-Methods Research Design

Deciding on which method is the most suitable to use when undertaking a study of complex phenomena within diverse contexts is a difficult decision. According to

Creswell (2007), mixed methods research design is informed by a pragmatic and transformative-emancipatory theoretical position. This allows for multiple characteristics to be observed from within their own unique contexts In this particular study, a mixed-methods research design was most appropriate because it allowed for the use of both quantitative and qualitative data collection techniques. The data collection process consisted of a combination of structured and semi-structured components. Two separate pairs of survey questionnaires were administered in order to draw the desired data. One questionnaire contained elements designed to extract quantitative data, while the second questionnaire and interview were designed to draw responses that could be evaluated qualitatively.

3.1 Introduction

A number of programmes and projects by government, non-government organisations (NGO's), business and private donors have resulted in the introduction of computers into schools. While many of these projects form part of wider, coordinated initiatives (eg. Nepad e-Schools, Gauteng on-line and Khanya), and may be supplemented by educator training programmes and infrastructure maintenance and support, the vast majority of ICT implementations in South African schools occur on an ad-hoc, one-shot basis. Since the responsibility for implementing the goals of the e-Education White Paper rests with provincial departments of education, there have been widely varying levels of success across provinces with some recording school computer-penetration rates of up to 97%, while others languish at rates below 25%. More important however, within the context of this particular study, are the significant differences in the rates-of-use of computers for learning and teaching across provinces. In Gauteng and Western Cape, computer integration within the classroom is measured at 78% and 76% respectively, while Limpopo and Eastern Cape measure 9% and 8% respectively (Isaacs, 2007). In order to realise the goal of an inclusive information society, it is essential that we understand why the proliferation of computers in schools have what appear to be widely differing levels of success both in terms of improved learner performance and learner/educator experience. While some schools appear to benefit from the availability of computers, others have lagged behind. This study will attempt to investigate why this is so and

make recommendations based on the findings of this study so that future technology implementations into schools are able to realise intended outcomes.

3.2 Research Goal

The goal of this study is to assess the efficacy of computer-use in eight secondary schools in Polokwane, South Africa, in order to establish the extent to which the level of integration of computers in these schools is influenced by the attitudinal factors of school management, educators and learners. In this regard, the study will assess the school's technology vision, evaluate the respondent's exposure to technology outside the school environment and consider the historical context of the school.

Acknowledging that the learner's interest is at the heart of educational reform, this inquiry will explore environmental (i.e. socio-economic conditions, policy provisions and technology access), structural (i.e. infrastructure, planning and support) and cultural (i.e. leadership, goal orientation and innovativeness) characteristics at the school and classroom level in an attempt to understand how they contribute to ICT adoption and integration in the classroom.

3.3 Research Methodology

This research will take the form of a qualitative multiple case-study with a descriptive and evaluative focus. Data will be gathered using interviews, survey questionnaires and document analysis. According to Peshkin (1988), qualitative research studies are typically undertaken for one or more of following reasons: (1) *Description:* To reveal the nature of certain situations, relationships, systems or people, (2) *Interpretation:* To gain new insights or discover problems that exist about a particular phenomenon, (3) *Verification:* To test the validity of certain assumptions/theories, and (4) *Evaluation:* To provide a means to judge the effectiveness of particular policies, practices or innovations.

A case study is a story about something unique, special, or interesting—stories can be about individuals, organizations, processes, programs, neighborhoods, institutions, and even events. (Yin, 2003). Through these stories the participants are

able to describe their views of reality and this enables the researcher to better understand the participants' actions (Lather, 1992; Robottom & Hart, 1993).

The qualitative case study also allows for the exploration of a phenomenon within the boundaries of its own context using a variety of data sources. This allows for the subject to be explored from multiple perspectives. Myers (1997) suggests that a good piece of interpretive research should represent multiple viewpoints and alternative perspectives. According to Stake (1995) and Yin (2003) the case study approach to research is based on a constructivist paradigm. This paradigm holds the view that 'truth' is relative and that it is dependent on a particular individual's perspective. Constructivism also "recognizes the importance of the subjective human creation of meaning, but doesn't reject outright some notion of objectivity. Pluralism, not relativism, is stressed with focus on the circular dynamic tension of subject and object" (Crabtree & Miller, 1999). Constructivism is built upon the premise of a social construction of reality (Searle, 1995). One of the advantages of this approach is the close collaboration between the researcher and the participant, while enabling participants to tell their stories (Crabtree & Miller, 1999).

According to Yin, a case study design should be considered when: (a) the focus of the study is to answer "how" and "why" questions; (b) you cannot manipulate the behaviour of those involved in the study; (c) you want to cover contextual conditions because you believe they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context. (Yin, 2003).

One feature of interpretive research is to seek meaning in context. The use of an interpretive perspective can help researchers to understand human thought and action in social and organisational contexts.

In the context of this particular research, the case study method was chosen because it allowed the researcher to ask questions that would reveal technology adoption patterns while recognising demonstrable contextual factors, eg. education policy, teacher and learner attitudes towards technology, the school setting, etc. It would be difficult to determine the enablers and or barriers for technology adoption in

the selected schools without gaining an insight into the contextual factors that may be at play.

The single vs multiple case study

According to (McKinney 1966, Smith 1988 and Yin 1989), single case study research is applicable when the case is:

- critical or unique or where the researcher is able to access a previously remote phenomenon;
- critical for testing a well formulated theory;
- an exploratory study or pilot study; shown to be representative of a large population

Multiple case studies provide a purposive sample and the potential for generalizability of findings (Miles & Huberman 1994, Patton 1990). Additionally, including multiple sites increases the scope of the investigation and the degrees of freedom (Bonoma 1985; Eisenhardt 1989). Finally, multiple case studies are appropriate as they provide for a rigorous methodology for replication logic (Parkhe 1993; Tsoukas 1989; Yin 1993). Multiple case studies provide for theory confirmation through literal and theoretical replication (Anderson 1986; Bonoma 1985).

The final data will be analysed from a phenomenological viewpoint – the analysis of qualitative data that will provide an understanding of a concept from the participants' perspective, experience and view of social reality. The data collected from the interviews, survey questionnaires and document review will be mapped to a set of themes based on the conceptual framework designed by the researcher as described in Figure 7).

This study has primarily employed a qualitative research approach in order to gain an insight into the respondents' perceptions, but some tools of quantitative research have also been used for measurement, for example, the degree of technology access, usage and training. Miles and Huberman (1994) point out that approaches to sampling are deeply influenced, not so much by whether one conducts quantitative or qualitative research, but rather whether one seeks an understanding of a limited range of controlled variables or whether one seeks an understanding of a

wide array of interactional variables that are active in a complex system (cf. Thomas & Cronje, 2007).

A Survey Questionnaire was used as the main instrument for data collection in this project. This tool is used by many researchers because it provides for an effective and inexpensive data collection tool. It can also be easily managed when well-structured. According to Wilkinson and Birmingham (2003), the major advantages associated with the survey instrument are that it is generally inexpensive to develop, very little training is required to implement; and results are easy to analyse once completed. Six key reasons why many researchers favour the survey questionnaire are highlighted by Wilkinson and Birmingham as follows:

- Vast amounts of data can be collected with minimal effort.
- Once data has been collected, the instrument can facilitate the identification of relationships among quantifiable data.
- Respondents' anonymity is easily protected as data can be collected without having to identify respondents.
- Survey instruments can be used several times for different research endeavours or with modifications.
- Once appropriately coded, they can facilitate extremely quick analysis of data with minimal rates of error.
- It is easy for the researcher to maintain control over the direction of topic and issues for discussion. (Wilkinson & Birmingham, 2003).

3.4 Participants in the study

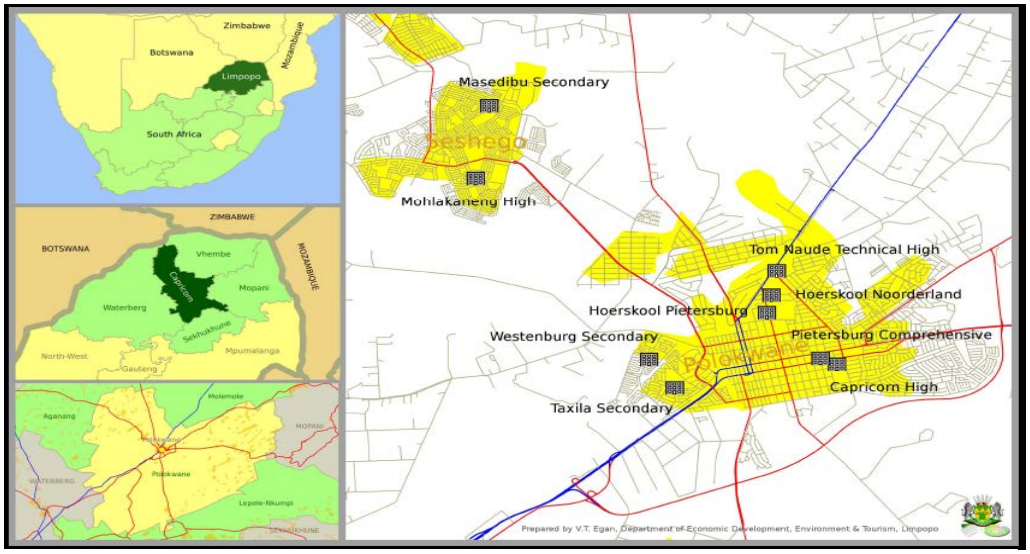
Eight schools had been identified for the study. All of the schools are located within the Capricorn municipal district of the city of Polokwane, Limpopo, South Africa. The schools were chosen because they are representative of Limpopo's diversity in terms of location, language and culture; and which continue, to a large extent, to demonstrate a profile consistent with that which existed under apartheid. The selected schools are listed in figure 7 and their mapped locations appear in figure 8.

School	Language*	Location

Capricorn High School	English/Afrikaans	Urban (former white area)
Hoërskool Landbou Kuschke	English/Afrikaans	Rural (farming community)
Pietersburg Hoërskool	Afrikaans/English	Urban (former white area)
Piet Joubert	Afrikaans/English	Urban (former white area)
Hoërskool Noordeland	Afrikaans/English	Urban (former white area)
Taxila Secondary	English/Afrikaans	Township (former indian area)
Westenburg High School	English/Afrikaans	Township (former coloured area)
Masedibu High School	N. Sotho/English	Township (former african area)

igure 8 Schools participating in the study

* English/Afrikaans denotes 1st Language/2nd Language respectively



igure 9 Mapped Locations of the Schools Identified for the Study

Source: Egan V.T. (2010), Limpopo Department of Economic Development, Environment and Tourism (LEDET), GIS Office.

The respondents (per school) identified for the study are as follows:

1. School Administrator/Headmaster (General Survey Questionnaire)
2. 3 X Subject Teachers (Mathematics/English/Computer Studies)
3. 4 X Grade 10 learners (2 x male & 2 x female)
4. 4 X Grade 11 learners (2 x male & 2 x female)

3.5 Data collection method and instruments

The data collection process consisted of a combination of structured and semi-structured components. Two separate pairs of survey questionnaires were administered to draw data from learners and teachers respectively. The first questionnaire in each pair was developed by the researcher to attract data that

allowed respondent's to describe themselves using a number of dichotomous questions that required respondents' to identify themselves as either male or female; their age category, the qualifications they had attained and the number of years they have taught (teachers). A number of questions designed to assess exposure to technology outside of the school environment were also contained in the survey questionnaire. These included questions related to the respondents' use of mobile technologies, internet banking, gaming and exposure to mainstream social media.

The second survey in each pair consisted of two questionnaires developed by Rhonda Christensen and Gerald Knezek as part of the Matthews Chair for Research in Education project of the College of Education, University of North Texas, USA. (Christensen, R., & Knezek, G.;1996); and are described below.

1. The Computer Attitude Questionnaire (CAQ v5.22) is an 85-item, 5-point Likert-type questionnaire designed for learners in the ninth through twelfth grades. The CAQ is designed to measure attitudes (feelings toward a person, or thing) and prevailing attitudes (dispositions), rather than achievement. Students recorded their own perceptions by circling the option that matched the extent to which they agreed or disagreed with each item. The CAQ includes separate subscales for evaluating:
    - Computer Importance
    - Computer Enjoyment
    - Study Habits
    - Attitude towards School and School work
    - Motivation/Persistence
    - Creative Tendencies
    - Email Use

2. The Teachers Attitudes Toward Computers Questionnaire (TAC ver3.2b) is composed of well-validated portions of several attitudinal surveys that have been used with teachers in the past. The TAC is a Likert/Semantic Differential Instrument for measuring teachers' attitudes toward computers using 105 items to gather data on seven factors:

- Enthusiasm
- Anxiety
- Avoidance
- E-mail for Classroom Learning
- Impact on Society
- Productivity
- Semantic Perception of Computers

All the questionnaires were administered by the researcher who was present throughout the exercise. The semi-structured component of the instrument consisted of a single open-ended question asking respondent's to comment on their "general impressions of technology and of its use in schools". A set of standard questions was used during the informal discussions. These questions were designed to probe for specific responses related to mobile technologies and technology policy in education (teachers); and mobile technologies and general technology experience in the school (learners).

The researcher prepared a cover letter addressed to the participants together with the survey instrument that explained the purpose of the survey. A copy of the approval letter to conduct the survey (written by Mr. Benny Boshielo, the MEC for Education in Limpopo) was provided to the headmaster. While the questionnaire provided a field for the respondent to fill-in a name, the researcher emphasised that this was optional and assured the participants' of strict confidentiality.

After negotiating with the headmaster, appointments were scheduled and the school made available a free classroom and one hour for the survey questionnaire to be administered and a brief discussion to be conducted. Trial surveys undertaken by the researcher beforehand, placed the average time for completion of the questionnaires at between 18 and 25 minutes - this was consistent with the actual time of completion by the respondents during the actual survey. All the questionnaires were administered by the researcher in person. A 30 minute informal discussion followed the completion of the survey.

Once the data collection process was completed, survey responses were mapped to the descriptive indicator checklist for each dimension of the three identified factors namely:

1. Personal Factors (CLASSROOM)
2. Administrative Factors (SCHOOL)
3. Contextual Factors (ENVIRONMENT)

A detailed description of the above mentioned checklists appears in Figures 10, 11 and 12 below.

CLASSROOM (Personal actors)			
Dimension	**Instrument**	**Descriptive Indicator**	**Question Reference**
Learner Attitudes	Computer Attitude Questionnaire (CAQ)	Computer Enjoyment	1,2,5,9,10,12,13,14,15, 16,17,18
		Computer Importance	3,4,6,7,8,11
		Creative Tendencies	46,47,48,49,50,51,52,53, 54,55,56,57,58
		Attitude towards school and school work	73,74,75,76,77,78,79, 80,81,82,83
		Motivation and Persistence in Problem-solving	21,22,23,24,25,26,27,28, 29,30,31,32,33,34,35
		Email use	62,63,64,65,66,67, 68,69,70,71,72
Teacher Attitudes	Teacher Attitude Towards Computers Questionnaire (TAC)	Enthusiasm	1,5,8,9,10,12,13, 19,32,36,37,38,40, 41,42,45,53,55,57, 59,60,62,63,64,67,68, 75,76,80,84,86,97.
		Anxiety	14,15,16,18,34,35,54, 56,61,77,78,79,82,85, 87,89,90,91,92,93,94, 96.
		Avoidance	2,7,17,20,31,33,46,52, 65,66,81,95,98
		Technology Impact on Society	47,48,49,50,51,58,83,88
		Email Use	99,100,101,102,103,104, 105,106,107,108,109
		Productivity	3,4,6,11,39,43,44,69,70, 71,72,73,74
Teacher Knowledge & Skills	Teacher Questionnaires & Interview	Computer Course Attendance	All
		Teacher Qualifications	
		Access to Computer at School	
		Social Media use	
		Wordprocessor, Spreadsheet & Internet Proficiency	
		On-line Banking Use	

igure 10. Descriptive Indicator Checklist (CLASSROOM)

SC OOL (Administrative actors)			
Dimension	**Instrument**	**Indicator/Measure**	**Question Reference**
Technology Availability and Support	Schools General Questionnaire / Teacher Interview	Availability of Computers	All
		Internet Access	
		Technical Support	
		Computer Maintenance Plan	
		Anti-Virus Software	
		School ICT Policy	
Leadership Support and Community/Home/Parent Mediation	Schools General Questionnaire / Teacher Interview / Parent Interview	Computer Acquisition Model	All
		School Website	
		School-Parent Email/SMS Communication	

igure 11. Descriptive Indicator Checklist (SC OOL)

ENVIRONMENT (Contextual actors)			
Dimension	**Instrument**	**Indicator/Measure**	**Question Reference**
Socio-Economic Profile	Schools General Questionnaire / Teacher Interview / Document Analysis	Education Attainment	All
		Household Computer penetration	
		Household Internet penetration	
		Average Household Income	

igure 12. Descriptive Indicator Checklist (ENVIRONMENT)

A pilot survey of schools was conducted telephonically in order to broadly establish their suitability for the study. (See Figure 10).

Questions			Schools								
			Capricorn High	Hoërskool Noorderland	Hoërskool Pietersburg	Tom Naude Technical High	Pietersburg Comprehensive	Westenburg Secondary	Taxila Combined	Masedibu Secondary	Mohlakaneng High
1	a	Does your school have a computer lab?	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
	b	If yes, how many computers are there in the lab?	100	200	131		41	No	25	12 (32)	23
2		Do you have a computer teacher in the school?	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
3		Does your school have internet access?	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes
4		How many pupils are enrolled in the school?	1200	700	1377	950	1026	880	826	950	1117
5		What is your annual school fees per month?	570	670	836.36	530	310	77.27	163.64	No Fee	No Fee
6		Does your school offer computer studies as a subject?	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
7		Does the school principal have a computer in his office?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8		Does the school secretary have a computer in her office?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9		Does the school have a fax machine?	Yes	Yes	Yes	Yes	Yes	No	Yes tele	Yes	Yes
10		Does the school have a television?	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No Fee
11	a	Does the school have an overhead projector?	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
	b	Is it a data projector or OHP?	Both	Both	Yes	Data	OHP	No	OHP	OHP	No

igure 13 Pilot Survey of Identified Schools

Source: Pilot survey conducted by E. Ghoor (October 2009)

Chapter 4

4. Perspectives on e-Education : Learner, Classroom, School and Environment

4.1 Introduction

Each of the eight schools surveyed in this study has demonstrated its own unique characteristics in terms of how technology is used. These diverse approaches are reflected in the differences in perceptions about the nature of technology held by the teachers and learners in the different schools and within the individual schools themselves. Many of these differences were clearly discernible in the way technology-use was either being actively encouraged or ignored by teachers and school management.

The results of the School General Questionnaire (SGQ) is reported in Figure 14 as a summary; and a brief description of each of the schools covered in this survey is presented. A consolidated report of teacher responses from the interview sessions is provided in Figure 15.

The responses from all the questionnaires and interviews was consolidated and mapped to the descriptive indicators in the conceptual framework diagram in order to group the responses according to the various identified factors. The questions were themselves grouped according to the specific subscales for each attitudinal measure and the results consolidated accordingly.

What follows is a graphical representation of the results of the survey. The data collected from the results of each question was consolidated and mapped to the specific descriptive indicator for each dimension. A brief explanation of each result-set - Classroom, School and Environment - is also provided.

School	Taxila Secondary	Pietersburg Hoerskool	Noordeland	Capricorn High School	Westenburg High School	Masedibu Secondary	General Piet Joubert	Hoerskool Landbou Kuschke
Year Established	1927	1921	1965	1961	1985	1975	1976	1936
Number of enrolled learners	957	1349	875	1228	964	1007	675	517
Number of Educators	35	73	29	57	31	37	45	19
Number of Administration Staff	2	10	10	8	1	1	6	3
Total number of classrooms	-	63	29	56	35	23	43	18
Number of libraries/media centre	1	1	1	1	1	1	1	1
Number of auditoriums	1	1	0	1	0	0	0	0
Number of telephone extensions	4	99	4	16	1	1	42	3
Number of Internet Connections	3	1	2	5	0	0	1	4
Number of computer rooms	1	4	5	2	0	1	2	1
Number of computers available for school administration	1	20	40	12	5	2	5	5
Number of computers available for learning & teaching	26	160	180	90	0	25	50	53
Total Number of Computers	27	180	220	102	5	27	55	58
Are your computers networked	YES	YES	YES	Y	N	Y	YES	YES
Number of data-projectors	4	20	17	5	0	2	1	6
Number of printers	7	26	12	13	1	3	6	5
Number of television sets	4	5	1	3	0	1	2	2
Number of learners taking Computer studies as a subject	37	889	713	82	0	56	0	36
Number of Computer Teachers	1	4	34	3	0	1	2	2
Computer Acquisition	S-Fund	SGB	SGB	S-Fund	DON	DON	SGB	DON
Does your school have a computer technician (FT/PT)	PT	PT	FT	PT	NO	NO	NO	PT
Does your school have a computer maintenance plan	YES	YES	YES	YES	NO	YES	NO	YES
Are your computers installed with anti-virus software	YES	YES	YES	YES	NO	YES	YES	YES
Number of Computers linked to the internet	3	180	220	97	0	0	2	58
Name of Internet Service Provider	LANTIC	MWEB	RSAWEB	MWEB	NONE	NONE	IMAGINET	ITEX
Internet Connection Type	ADSL	ADSL	ADSL	ADSL	NONE	NONE	ADSL	ADSL
Do you have a school IT policy	YES	NO	YES	YES	NO	YES	NO	YES
Does your school have a website	NO	YES	YES	NO	NO	NO	NO	NO
Does your school have its own email address	YES	YES	YES	YES	NO	NO	YES	YES
Do you use sms to communicate with learners	NO	YES	NO	NO	NO	NO	NO	YES
Do you use sms to communicate with teachers	NO	YES	NO	YES	YES	NO	NO	YES
Do you use sms to communicate with parents	YES	YES	YES	YES	YES	YES	NO	YES
Do you use email to communicate with learners	NO	YES	NO	NO	NO	NO	NO	NO
Do you use email to communicate with teachers	NO	YES	YES	YES	NO	YES	NO	NO
Do you use email to communicate with parents	NO	YES	NO	YES	NO	NO	NO	NO

igure 14 Consolidated results from Schools General Questionnaire

4.2 Overview of Schools

4.2.1 Capricorn High School

Capricorn High School is located in the Polokwane CBD. The School was established in 1961 as an English medium high school. There are 1228 enrolled learners and a staff compliment of 65, comprising 57 teachers and eight administrative staff. The school also operates onsite boarding facilities and has historically attracted learners from all across South Africa. There are 56 classrooms including two computer laboratories. The school also has an auditorium and media centre. There are a total of 16 telephone extensions and 5 internet connections. There are 90 computers available for learning and teaching and 12 for administration use. The school has acquired the Saspac school management software to manage its administrative functions. The procurement of all computers have been financed by the school through its own budget.

The school also has three television sets and five data projectors. A total of 82 learners are enrolled for computer studies as part of the schools' formal curriculum. All computers are connected to the internet using an uncapped ADSL line. The school has contracted a part-time technician to perform maintenance on the computers once a week. The school has a public address (PA) system to communicate with teachers and learners; and a close circuit television (CCTV) system to monitor activity.

The school has an extensive sports infrastructure that includes football, rugby, hockey and swimming facilities; and a cricket oval. The school publishes an annual magazine. There is a strong emphasis on sporting and academic achievement and this is reflected in the prominently displayed trophy cabinet and roll-of-honour. The school reception area is comfortable and the gardens well-kept with paved parking available for teachers and visitors. The school has a strict "no cellphone during school hours" policy. Access to the school is controlled by a guard and visitors are required to sign a gate register upon entry.

4.2.2 Hoerskool Noordeland

Hoërskool Noordeland was established in 1965 as an Afrikaans-medium high school. The school is situated in the Polokwane CBD. There are a total of 875 learners; and a staff compliment of 39, comprising 29 teachers and 10 administrative staff. There

are 29 classrooms and five computer labs. A total of 180 computers are available for learning and teaching; and a further 40 are available for administrative use. The Saspac school administration software package is used for administrative functions. The school offers both Computer Application Technology (CAT) and Information Technology (IT) as formal school subjects. A total of 292 learners are enrolled for the former and 70 for the latter.

The school has 4 megabit ADSL line for connection to the internet. There is an unsecured wi-fi connection available for wireless connection to the internet - which the researcher was able to access. All computers in the school have been funded through initiatives driven by the School Governing Body (SGB). The school has employed a full-time IT technician to maintain the technology environment. The school has a public address (PA) system to communicate with teachers and learners; and a close circuit television (CCTV) system to monitor activity. The school has a strict "no cellphone during school hours" policy.

The school has its own website and also publishes an annual school magazine. The reception and waiting area is adorned with the photographs of previous headmasters and a roll-of-honour highlighting sporting and academic achievements of former pupils. There is a well-equipped staff room with refrigerator and microwave oven; and a leisure area for teachers with couches and soft chairs. The school uses school management software to manage administrative functions.

Access to the school is controlled by a guard and visitors are required to sign-in upon entry to the school premises.

4.2.3 Westenburg High School

The school is situated in the former "coloured" township of Westenburg, 7 kilometres from the Polokwane CBD, and was established in 1985. There are a total of 964 enrolled learners, 31 educators and one administrative staff member. There are a total of 35 classrooms including a media centre. The school has five computers and one printer available for administrative functions. The school does not offer computer studies as a subject and there are no computers available for learning and teaching. The available computers were acquired as part of a donation. The school grounds are neat, but playground and sports facilities are rudimentary. There is no access control and the researcher was able to enter the school premises without having to present identification. Mobile phones are not allowed in the school.

4.2.4 General Piet Joubert School

The school is situated in the Polokwane CBD and was established in 1976 as a "special school" catering for pupils with learning difficulties. There are a total of 675 enrolled learners and 45 teachers, supported by 6 administrative staff. The school continues to offer trade-oriented subjects such as carpentry, welding, fashion design, hairdressing and motor mechanic training. The school has well-established infrastructure to support the courses offered and there are hostel facilities for accommodating learners on the premises. There is also an impressive sports infrastructure. Access to the school is controlled by a guard and visitors are required to sign-in upon entry.

The school has a strict "no cellphone during school hours" policy. This school presents the highest learner-to-computer ratio of all the schools surveyed.

4.2.5 Pietersburg Hoërskool

Pietersburg Hoerskool (PHS) is the oldest Afrikaans-medium school in Polokwane. Established in 1921, the school maintains a strong Afrikaans cultural heritage which is evident in the art and cultural artifacts that adorn the walls of the administration block. There are a total of 1349 learners supported by 73 teachers and 10 administration staff. The school employs a full-time IT technician and has its own website and Facebook profile. The school has also invested in 2 interactive whiteboards and the headmaster indicated that some teachers were experimenting with motion sensing technology to administer multiple-choice tests.The school also has a well-established infrastructure and has an impressive array of sports facilities. The quality and appearance of the school buildings suggest regular upkeep; and the gardens are well maintained. Access to the school is controlled by a guard and visitors are required to sign-in upon entry. The school has a strict "no cellphones during school hours" policy.

4.2.6 Masedibu High School

The school is situated in the former "African" township of Seshego, 15 kilometres from Polokwane. The school was established in 1975 and has a total of 1007 learners supported by 37 teachers and one administrative staff member. There are 23 classrooms and one library. One classroom has been converted into a computer lab. There are 25 computers available for learning and teaching and two computers

are designated for performing administrative functions. 56 learners are enrolled for computer studies as a formal school subject. All the computers have been acquired as a donation from a private company. The computer lab is not well-maintained; evidenced by poor cable management and the generally haphazard arrangement of computer equipment. The school does not have an internet connection. While there is a computer maintenance plan, the school does not have the services of a computer technician and maintenance is carried out by the computer teacher on an ad-hoc basis. The school has a strict "no cellphone during school hours" policy. The school infrastructure is rudimentary and while the gardens are kept neat, there is no paving. Sports facilities are basic and sports fields are without grass. The school buildings are in need of maintenance. The school does not have any administration software because they cannot afford the annual license fee – the headmaster has designed a spreadsheet to use as a tool for managing enrolments and budgets. The electricity supply was interrupted twice while the researcher was on-site and the headmaster indicated that this was a common occurrence.

According to the headmaster, seventy percent of learners are from single-headed households. The headmaster indicated that "there is low level of motivation amongst learners, but computers appear to ignite the kids' interest." Communication with parents and guardians is by postal mail. There is a strict no-cellphone policy in operation at the school. The headmaster reported that there had previously been a few "unfortunate incidents involving cellphones" at the school. There is an access control point and the researcher was able to gain access to the school premises only upon presentation of identification.

4.2.7 Taxila Secondary School

The school was originally situated in Polokwane CBD and operated under the name of Pietersburg Indian and Colored School. The school was re-located to the former "indian" residential township of Nirvana in 1979 and renamed Taxila Secondary School. There are 957 enrolled learners and a staff compliment of 38. There has been a large exodus of pupils from Taxila to nearby private schools; and the majority of children now attending this school are non-residents of Nirvana – the residential suburb where this school is situated.

The school has a strict "no cellphone during school hours" policy. One classroom has been converted into a computer lab and Computer Applications Technology

(CAT) is offered as a subject. The school uses a school administration software package for managing daily operations. The school has well-established infrastructure and access to sports facilities nearby. Parking areas are paved and gardens are well-maintained. Access to the school is controlled by a guard and visitors are required to sign-in upon entry. The school publishes an annual school alumni magazine.

4.2.8 Hoërskool Landbou Kuschke

Hoerskool Landbou Kuschke was founded in 1936 as an agricultural school. Located in the farming area of Eerstegoud, on the outskirts of Polokwane, the school has well established infrastructure that includes extensive sporting facilities, hostels and agricultural farmland. There are a total of 517 learners supported by 19 teachers and 3 administration staff. The school grounds are kept neat and the gardens are immaculate. Access to the school is controlled by a guard and visitors are required to sign a register upon entry.

4.3 Consolidated Report of Teacher-interview responses

School 1				
No	Questions	T1	T2	T3
1	Are mobile technologies (cellphones/smartphones/tablets) useful instruments in the classroom?	No, They disrupt my class. Cellphones should be banned in schools.	It is useful if there is an emergency to get hold of parents	No, The children get upto mischief. The kids are always sms'ing and giggling in class
2	Is the internet a good source of information for supporting learning and teaching?	Yes, but sometimes the internet can be wrong. Children don't know how to tell right from wrong	Yes, sometimes if I come across a good video, I download it and show it to the class.	Yes, when I was at university we used to use the internet for research.
3	Do you use the internet as a resource?	Yes, to get pictures or diagrams to show the children	Yes, in my media class to get the latest news	Yes, to find information. Like encyclopedias wikipedias, etc.
4	Do you encourage your learners to use the internet as a resource?	Sometimes	Yes	No. Because sometimes learners don't know which information is reliable.
5	How active is the School SGB in terms of supporting extra-school initiatives	Used be to very active previously. Now most wealthy kids are in private schools	Help in fundraising	Active
6	Does Social Media add any value to Education?	No	No	No
7	How should technology be used in schools and what can authorities do to promote ICT in schools?	We must be given training. Only the computer teachers get training	More training is needed and new computers must be bought	It will be good if they can give all teachers a laptop. It will make it easier to prepare our notes.

School 2						
No	Questions	T1	T2	T3	T4	T5
1	Are mobile technologies (cellphones/smartphones/tablets) useful instruments in the classroom?	If they are controlled it is okay. We can't live without cellphones.	They should only be allowed in breaks.	They can be used for a good purpose if there are apps for learning	The risk is very high. We have had a lot of theft of cellphones. It is a problem	If we can teach children about the dangers of cellphones they will be more responsible
2	Is the internet a good source of information for supporting learning and teaching?	Yes	Yes	Yes	Yes	Yes
3	Do you use the internet as a resource?	Yes	Yes	Yes	Yes	Yes, to get charts and pictures.
4	Do you encourage your learners to use the internet as a resource?	Yes	Yes	No	Yes	Yes
5	How active is the School SGB in terms of supporting extra-school initiatives	SGB is okay. Most parents are from out of town.	They are very helpful	They are very good	They do fund-raise to buy equipment	They are supportive
6	Does Social Media add any value to Education?	Maybe if they develop more educational apps. I use Facebook to play chess, but kids use it to chat	No	Yes, most children use Mxit. It is a good way to communicate	No	No
7	How should technology be used in schools and what can authorities do to promote ICT in schools?	The department must make sure all teachers attend computer training courses	Computers are a good thing and must be taught to all children – not only to those doing IT subjects	Teachers must be given computers, because many children have computers at home and they moving faster than teachers.	All learners must be taught to use a computer because computers are used in all types of work	It will be easier if we had projectors. the old transparencies get damaged easily.

School 3					
No	Questions	T1	T2	T3	T4
1	Are mobile technologies (cellphones/smartphones/tablets) useful instruments in the classroom?	Yes, we don't have to worry about textbooks. We can load the books on the tablet. It will be cheaper	No. They are disruptive. How? They are always playing loud music outside my class while I am teaching	Yes, but only during breaks and after school	Yes, we use it to sms parents when kids are absent
2	Is the internet a good source of information for supporting learning and teaching?	Yes	Yes	Yes	Yes
3	Do you use the internet as a resource?	Yes	Yes	Sometimes. But the textbooks cover everything we need.	Yes
4	Do you encourage your learners to use the internet as a resource?	Yes	Yes	Yes	Yes
5	How active is the School SGB in terms of supporting extra-school initiatives	The SGB is very active in supporting the school when dealing with the Department	They have helped to raise sponsorships for tours	There are many influential people who sit on the SGB, but I think it is more about status	They are supportive
6	Does Social Media add any value to Education?	No	No	No	No
7	How should technology be used in schools and what can authorities do to promote ICT in schools?	Computers can make things run efficiently. It will be good if every teacher has a computer and a projector in class.	We must start teaching computers to children in primary school otherwise they will struggle when they get to high school.	Teachers must be trained to use computers properly.	Most of the computers we have are broken and we have to wait months for them to be fixed. If we buy computers for all the teachers, then we must get support to fix them

School 4					
No	Questions	T1	T2	T3	T4
1	Are mobile technologies (cellphones/smartphones/tablets) useful instruments in the classroom?	No	Yes, I use it to remind learners about their homework	No	Yes. Because there is so much information about new inventions in the world, and teachers can't know everything.
2	Is the internet a good source of information for supporting learning and teaching?	Yes	Yes	Yes	Yes
3	Do you use the internet as a resource?	Yes	Yes	Yes	Yes
4	Do you encourage your learners to use the internet as a resource?	Yes	Yes	No, a lot of information on the internet is false.	Yes
5	How active is the School SGB in terms of supporting extra-school initiatives	The SGB is very effective. They make sure the principal is supported	The SGB organized the donation for the computers	They are very good at getting things for us from the Department. Like books and furniture	They are very supportive
6	Does Social Media add any value to Education?	No	No	No	No
7	How should technology be used in schools and what can authorities do to promote ICT in schools?	All teachers must be given a computer or subsidized.	We must offer IT subjects for those learners who want to become computer scientists	We must have computers in our libraries, so that learners can search for information. The books in the library are very old and outdated.	Computers can be used to make teaching easier. If we have spreadsheets we can calculate marks and issue reports and assessments quickly.

School 5					
No	Questions	T1	T2	T3	T4
1	Are mobile technologies (cellphones/smartphones/tablets) useful instruments in the classroom?	No, they are banned in our school	No.	No, they cause too many problems. We had an incident where some children were taking rude videos.	They are not good in education
2	Is the internet a good source of information for supporting learning and teaching?	Yes	Yes	Yes	Yes
3	Do you use the internet as a resource?	Yes	Yes	Yes	Yes
4	Do you encourage your learners to use the internet as a resource?	No, There are bad influences on the internet	No	No	No
5	How active is the School SGB in terms of supporting extra-school initiatives	The SGB tries very hard, but they don't meet often because they are all working	The school is very poor and the SGB doesn't have power to raise money.	They are very good because they have negotiated with the Department for many things	They must meet more often. Sometimes they call us to a meeting but they don't come.
6	Does Social Media add any value to Education?	No	No	No	No
7	How should technology be used in schools and what can authorities do to promote ICT in schools?	Our computers were donated and now the company has left us with the old equipment.	The president talked about "one teacher, one laptop". I think that will be good.	The internet helps us to communicate better. If we have emails we can get upto date information from the department.	Teachers must be given computers and trained how to use them

School 6					
No	Questions	T1	T2	T3	T4
1	Are mobile technologies (cellphones/smartphones/tablets) useful instruments in the classroom?	We can't escape technology. It is everywhere even though it is a bad influence.	I use my own sms to send messages to learners to remind them about homework	No. It will do more harm than good	No. Theft is a big problem. We don't even have CCTV cameras in our school
2	Is the internet a good source of information for supporting learning and teaching?	Yes	Yes	Yes	Yes
3	Do you use the internet as a resource?	Yes	Yes	Yes	Yes
4	Do you encourage your learners to use the internet as a resource?	Yes	Yes	No	Yes
5	How active is the School SGB in terms of supporting extra-school initiatives	The SGB is very poor at our school	They always help at sports events and fund raising for the soccer and netball teams	The SGB is very weak. This is why the school is dying slowly. Se only have 1 computer in the whole school	The members are good, but they have no power to do anything good for the school.
6	Does Social Media add any value to Education?	No	No	No	No
7	How should technology be used in schools and what can authorities do to promote ICT in schools?	We must offer IT and CAT because our children are at a disadvantage without computers	Even if we have computers, we don't have teachers to teach IT.	The Department must provide computers for all teachers.	IT must be brought to the school. It is very important for the future of children

School 7					
No	Questions	T1	T2	T3	T4
1	Are mobile technologies (cellphones/smartphones/tablets) useful instruments in the classroom?	No	Yes, I have showed my class how to download a dictionary app and spelling has improved in my class	Yes, I send reminders to my kids about projects and homework	No, If they are regulated properly it's fine. But some kids bring very expensive phones to school and theft is a problem.
2	Is the internet a good source of information for supporting learning and teaching?	Yes	Yes	Yes	Yes
3	Do you use the internet as a resource?	Yes	Yes	Yes	Yes
4	Do you encourage your learners to use the internet as a resource?	Yes	Yes	No	Yes
5	How active is the School SGB in terms of supporting extra-school initiatives	They are very helpful and always available to help with fund-raising	All the computers were funded by the SGB. They also paid for the paving	The members are very involved and many people want to be on the SGB.	The SGB is active here.
6	Does Social Media add any value to Education?	No	Yes, if we teach our kids to use them responsibly	No	No
7	How should technology be used in schools and what can authorities do to promote ICT in schools?	If we had computers in our school we could offer IT subjects. Our learners are disadvantaged because we don't have computers in our school.	Computers will make it easy for us to prepare notes. At the moment all the teachers have to share only one computer.	We must be given computers otherwise our learners will not be able to use them.	If they put computers in our school they must first put security gates and burglar bars, otherwise they will get stolen

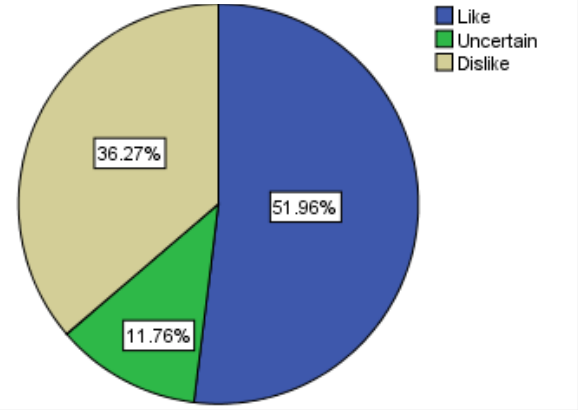
School 8					
No	Questions	T1	T2	T3	T4
1	Are mobile technologies (cellphones/smartphones/tablets) useful instruments in the classroom?	Cellphones must be accepted because they are everywhere, but they must be banned in school hours.	Yes, we use sms to communicate with parents and learners	They are expensive, but if we can provide them to all kids it will be fine	I use cellphones in my class to control the data projector. I also encourage learners to use all the cellphone features like the calculator and to take pictures of interesting things to share with the class.
2	Is the internet a good source of information for supporting learning and teaching?	Yes	Yes	Yes	Yes
3	Do you use the internet as a resource?	Yes	Yes	Yes	Yes
4	Do you encourage your learners to use the internet as a resource?	Yes	Yes	Yes	Yes
5	How active is the School SGB in terms of supporting extra-school initiatives	The SGB is organised and they make sure the school is well-supported by the Department	Very active. They are also very strict about enforcing school policies.	The SGB is very good. They keep the principal on his toes	Parents are very active in the activities of the school
6	Does Social Media add any value to Education?	Yes, children can share ideas about homework and can work together on projects	Yes, if we teach our kids to use them responsibly	No	Yes
7	How should technology be used in schools and what can authorities do to promote ICT in schools?	We are offering IT subjects and it helps learners to make a career in Computer Science.	Teachers must be given proper training. Some teachers are very good with computers and I feel hopeless when I see their work	They must make computer equipment available.	Computer studies must be made compulsory for all teachers. Internet speed is very slow

4.4 Classroom (Personal actors)

4.4.1 Learner Attitude Dimension

	Frequency	Percent	Valid Percent	Cumulative Percent
Like	53	52.0	52.0	52.0
Uncertain	12	11.8	11.8	63.7
Dislike	37	36.3	36.3	100.0
Total	102	100.0	100.0	

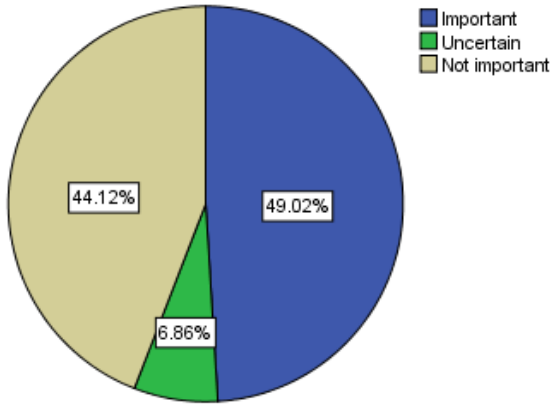
igure 15 Learner Computer En oyment



The "computer enjoyment" subscale was derived from consolidating the responses from twelve questions on the Computer Attitude Questionnaire (CAQ). Results revealed that the half of all learners surveyed enjoy using computers, while one-third reported discomfort with using computers.

	Frequency	Percent	Valid Percent	Cumulative Percent
Important	50	49.0	49.0	49.0
Uncertain	7	6.9	6.9	55.9
Not important	45	44.1	44.1	100.0
Total	102	100.0	100.0	

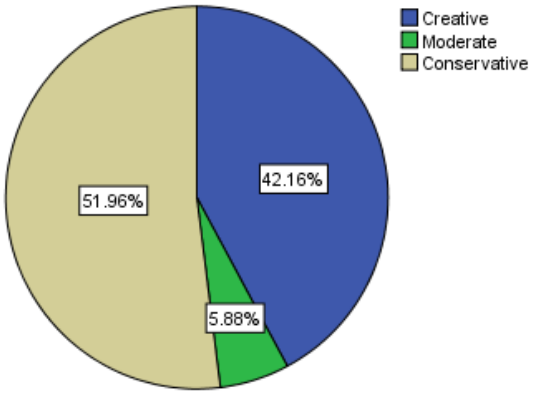
igure 16 Learner Computer Importance



The "computer importance" subscale was derived from consolidating the responses from six questions on the CAQ. The results revealed that there is an equal split between learners who consider computers important and those who do not.

	Frequency	Percent	Valid Percent	Cumulative Percent
Creative	43	42.2	42.2	42.2
Moderate	6	5.9	5.9	48.0
Conservative	53	52.0	52.0	100.0
Total	102	100.0	100.0	

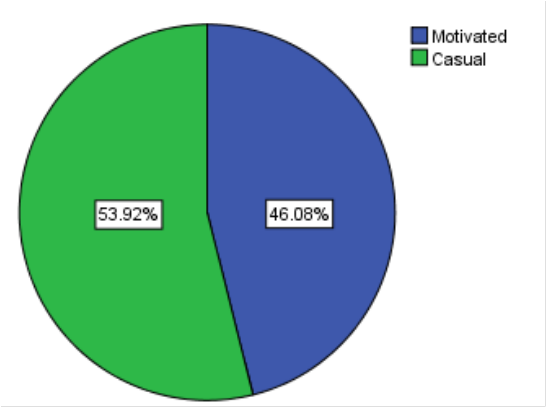
igure 17 Learner Creative Capacity



The learner's propensity for creativity and innovation was measured by consolidating the responses to thirteen questions derived from the "creative subscale" on the CAQ. More than half of the learner's participating in the survey demonstrated conservative creative tendencies.

	Frequency	Percent	Valid Percent	Cumulative Percent
Motivated	47	46.1	46.1	46.1
Casual	55	53.9	53.9	100.0
Total	102	100.0	100.0	

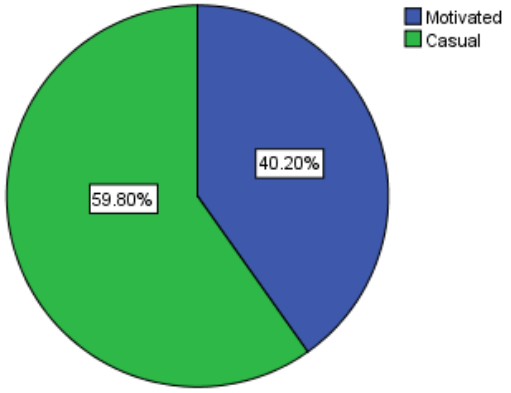
igure 18 Learner Attitude towards School Work



The learner's attitudes toward school and school-work was derived from the results of eleven questions on the CAQ "attitude subscale." Less than half the learner's demonstrated a motivated attitude.

	Frequency	Percent	Valid Percent	Cumulative Percent
Motivated	41	40.2	40.2	40.2
Casual	61	59.8	59.8	100.0
Total	102	100.0	100.0	

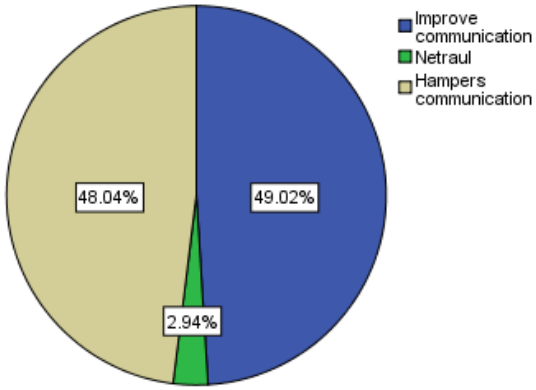
igure 19 Learner Persistence and Motivation in Problem-solving



Learner persistence and motivation was measured by consolidating the responses to fifteen questions on the CAQ "attitude subscale." Less than half the sample demonstrated persistence and motivation in problem-solving.

	Frequency	Percent	Valid Percent	Cumulative Percent
Improve communication	50	49.0	49.0	49.0
Neutral	3	2.9	2.9	52.0
Hampers communication	49	48.0	48.0	100.0
Total	102	100.0	100.0	

igure 20 Learner Attitude towards Email use

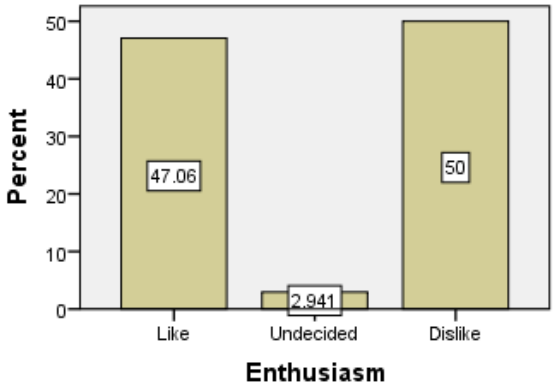


Learner's attitudes towards the use of email as a communication medium was derived from the results of eleven questions on the CAQ "email use" subscale. Half the learner's felt that email hampers communication.

4.4.2 Teacher Attitudes Dimension

	Frequency	Percent	Valid Percent	Cumulative Percent
Like	16	47.1	47.1	47.1
Undecided	1	2.9	2.9	50.0
Dislike	17	50.0	50.0	100.0
Total	34	100.0	100.0	

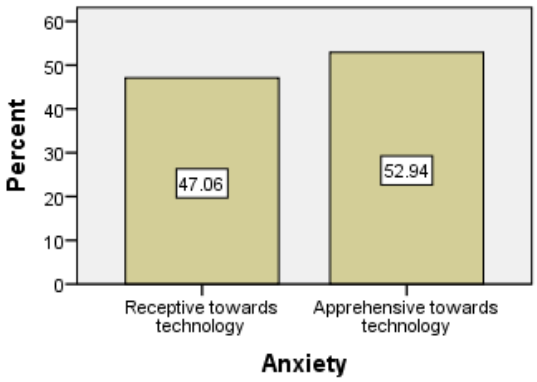
igure 21 Teacher Enthusiasm towards Computer Use



The enthusiasm of teachers in using computers was measured by consolidating the responses from thirty-two questions on the Teacher Attitude toward Computers (TAC). The results showed an equal split between teacher's who "like" and those who "dislike" using computers.

	Frequency	Percent	Valid Percent	Cumulative Percent
Receptive towards technology	16	47.1	47.1	47.1
Apprehensive towards technology	18	52.9	52.9	100.0
Total	34	100.0	100.0	

igure 22 Teacher Anxiety towards Computer Use

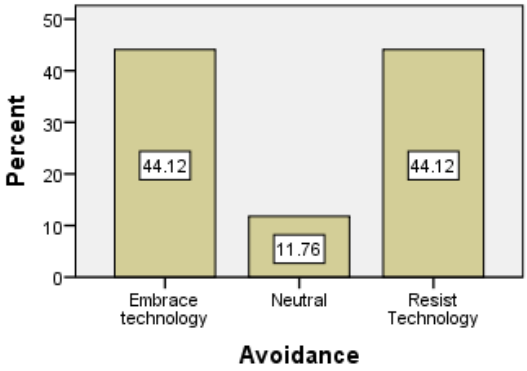


Anxiety by teachers in the use of computers was measured by consolidating the responses from twenty-two questions on the TAC questionnaire. The results reveal that more than half the teachers are apprehensive when exposed to technology.

Teacher Computer Avoidance

	Frequency	Percent	Valid Percent	Cumulative Percent
Embrace technology	15	44.1	44.1	44.1
Neutral	4	11.8	11.8	55.9
Resist Technology	15	44.1	44.1	100.0
Total	34	100.0	100.0	

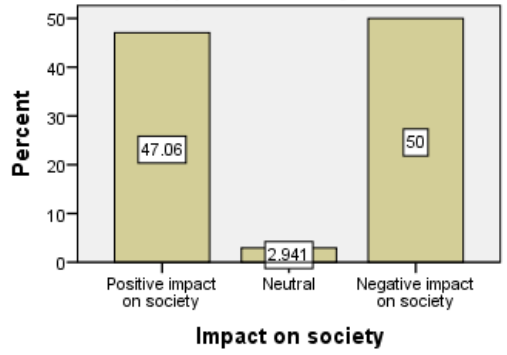
igure 23 Teacher Computer Avoidance



Technology avoidance by teachers was measured using the responses to eleven questions on the TAC questionnaire. The results show that 44% of teachers resist using technology.

	Frequency	Percent	Valid Percent	Cumulative Percent
Positive impact on society	16	47.1	47.1	47.1
Neutral	1	2.9	2.9	50.0
Negative impact on society	17	50.0	50.0	100.0
Total	34	100.0	100.0	

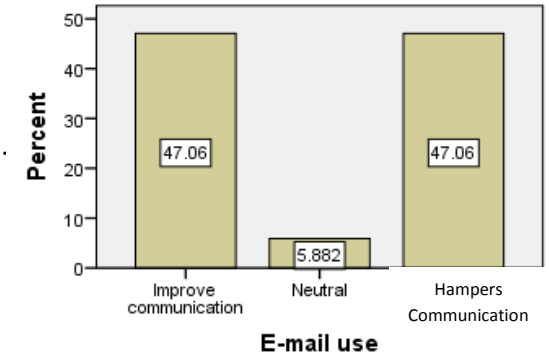
igure 24 Teacher Views on the Impact of Computers on Society



The views of teachers on the "impact of technology on society" was gathered by using the responses to eight questions on the TAC questionnaire. technology. 50% of teachers feel that technology has a negative impact on society.

	Frequency	Percent	Valid Percent	Cumulative Percent
Improves communication	16	47.1	47.1	47.1
Neutral	2	5.9	5.9	52.9
Hampers Communication	16	47.1	47.1	100.0
Total	34	100.0	100.0	

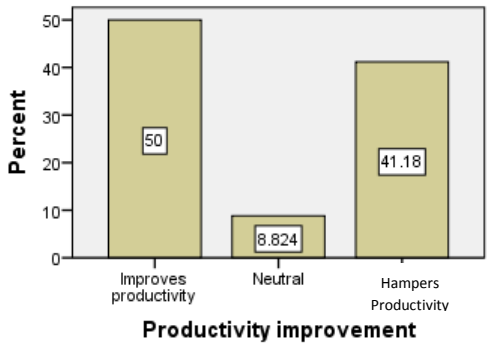
igure 25 Teacher Views on Email-use



Teacher attitudes towards the use of email as a communication medium was derived from the results of eleven questions on the TAC "email use" subscale. Half the teachers felt that email hampers communication.

	Frequency	Percent	Valid Percent	Cumulative Percent
Improves productivity	17	50.0	50.0	50.0
Neutral	3	8.8	8.8	58.8
Hampers Productivity	14	41.2	41.2	100.0
Total	34	100.0	100.0	

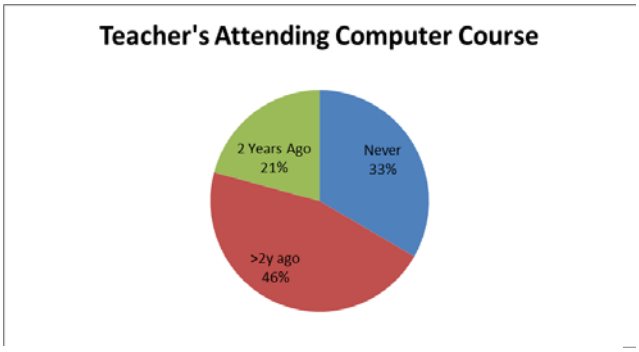
igure 26 Teacher Views on the Impact of Technology on Productivity



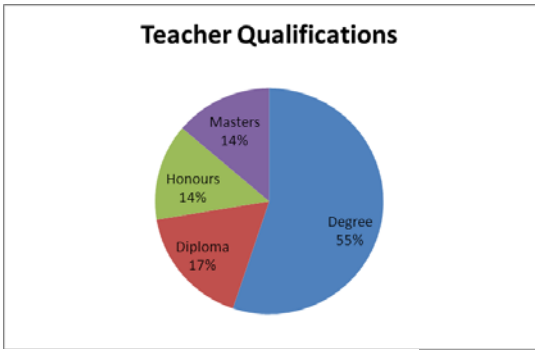
Teachers perceptions regarding the impact of technology on productivity was measured by consolidating the responses to thirteen questions on TAC questionnaire. 40% of teachers felt that technology hampers productivity.

4.4.3 Teacher Knowledge & Skills Dimension

The responses from the teacher questionnaires and interviews was consolidated and mapped against the descriptive indicators in order to capture data related to the knowledge and skills dimension. The questions were grouped according to the specific subscales for each attitudinal measure and the results consolidated accordingly.

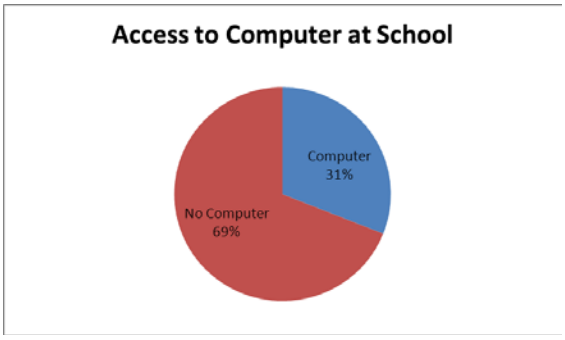


igure 27 Teacher Attendance at Computer Course

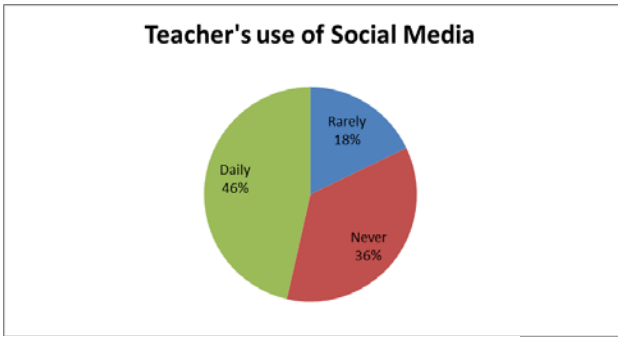


igure 28 Teacher Qualifications

The results indicate that 33% of the teachers surveyed had never attended a computer course, while 46 % of respondents last attended a computer course more than 2 years previously.



igure 29 Teacher's Access to Computer at

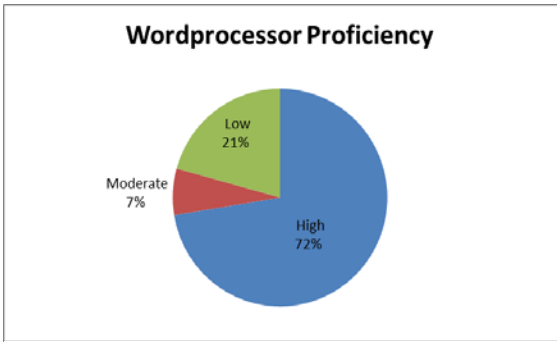


igure 30 Teacher's Use of Social Media

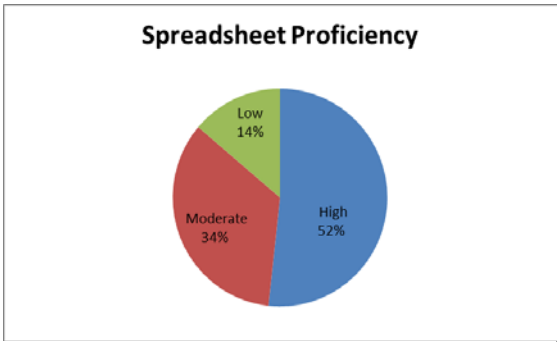
More than two-thirds of the teacher's surveyed do not have access to a computer at school. 46% of the respondent's indicated that they made use of social media on a daily basis, while 35% had never used social media.

The results from the self-evaluation of proficiency in selected applications revealed that 72% of teacher's consider themselves highly proficient in wordprocessor use.

52% rate their proficiency at spreadsheet use as high; while 52% consider themselves moderately proficient in internet use.

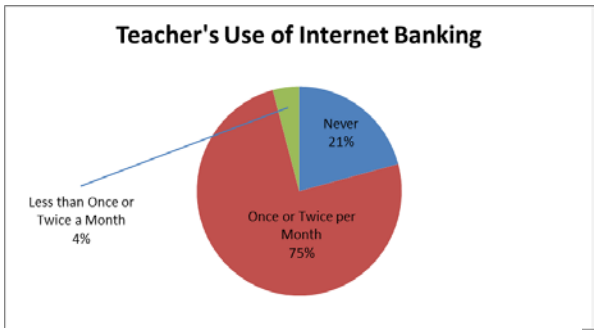


igure 31 Teacher Proficiency : Wordprocessing

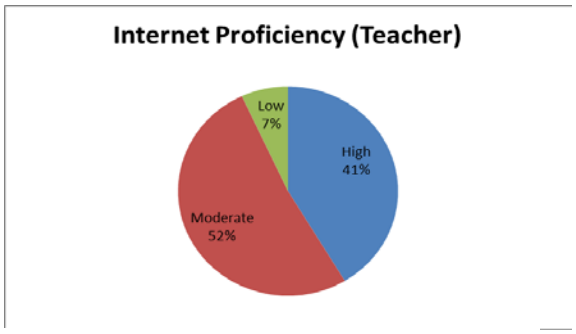


igure 32 Teacher Proficiency : Spreadsheets

While most of the teacher's surveyed use internet banking once or twice per month, 21% have never made use of internet banking.



igure 33 Teacher's Use of Internet Banking

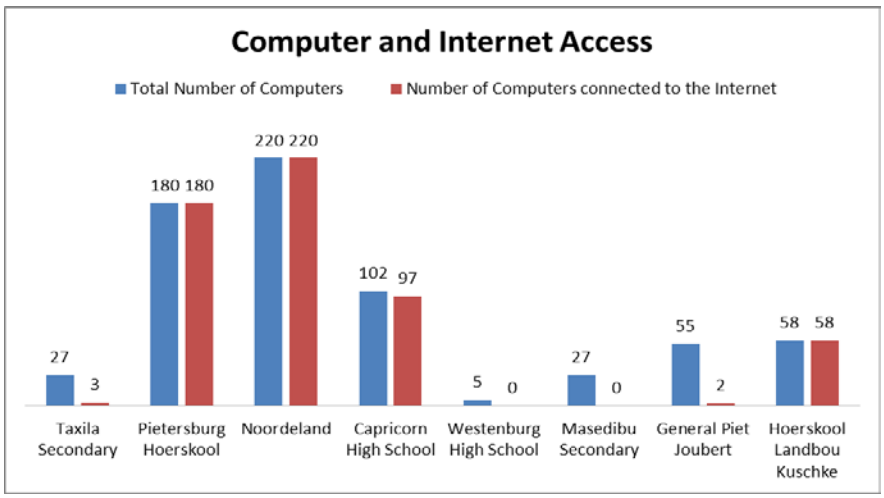


igure 34 Teacher Proficiency : Internet

4.5 School (Administrative actors)

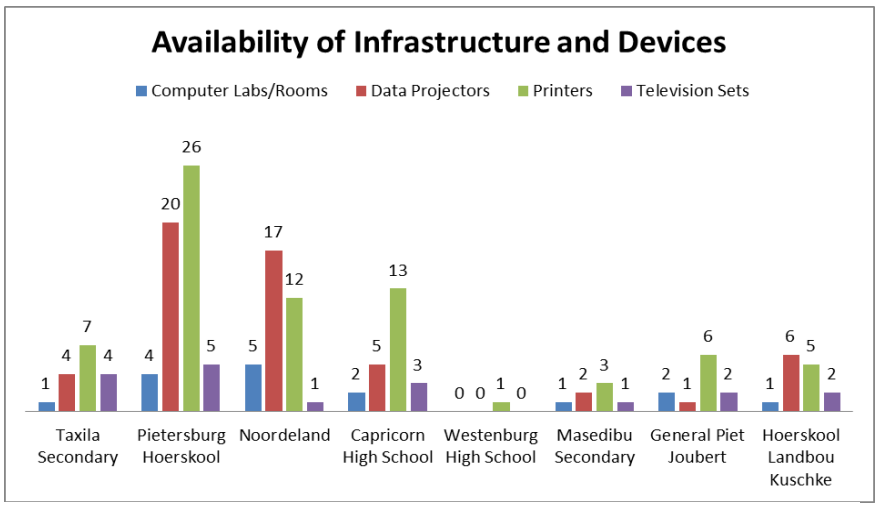
4.5.1 Technology Availability and Support Dimension

There is a general disparity in the distribution of computers and internet access amongst the school surveyed. Only three of the eight schools have internet access available on all computers. There are two schools which do not have internet access.



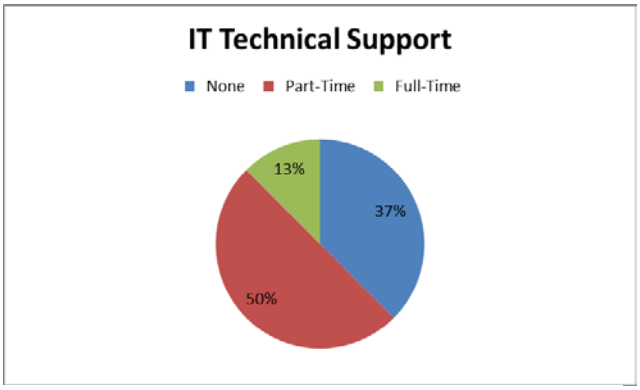
igure 35 Number of Computers and Internet Access

The disparity in internet access also extends to other technology devices; with some schools having no complementary peripherals such as printers and data projectors; or a computer lab.

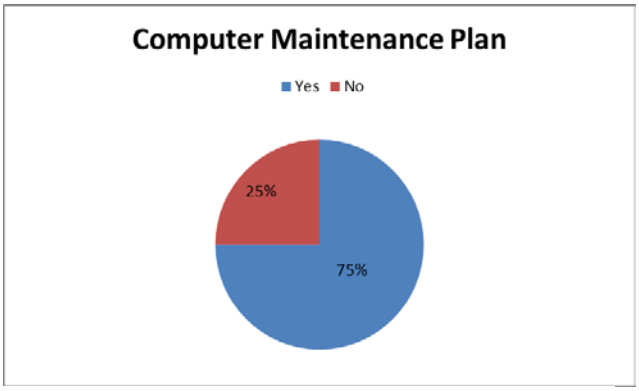


igure 36 Availability of Infrastructure and Devices

Four of the eight schools have access to IT technical support on a part-time basis. One school has employed a full-time technician to maintain computer equipment. Three schools have no access to technical support. Six of the eight schools surveyed do not have a computer maintenance plan.

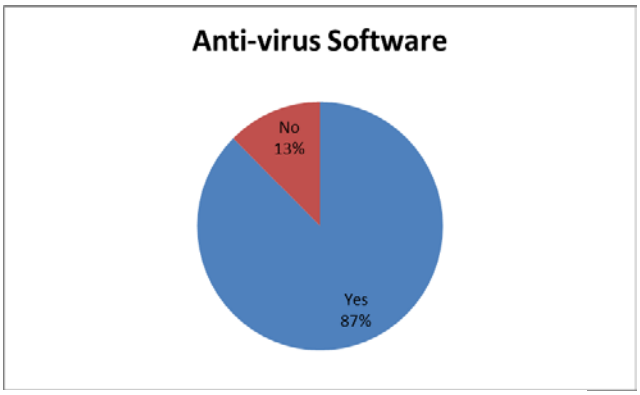


igure 37 IT Technical Support

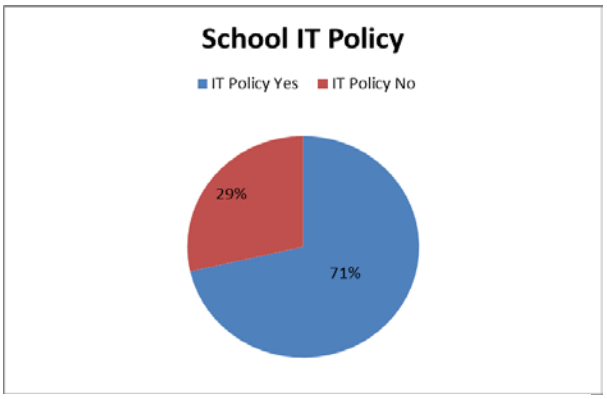


igure 38 School Maintenance Plan

87% of the schools surveyed have anti-virus software installed on their computers and 71% have a School IT policy.

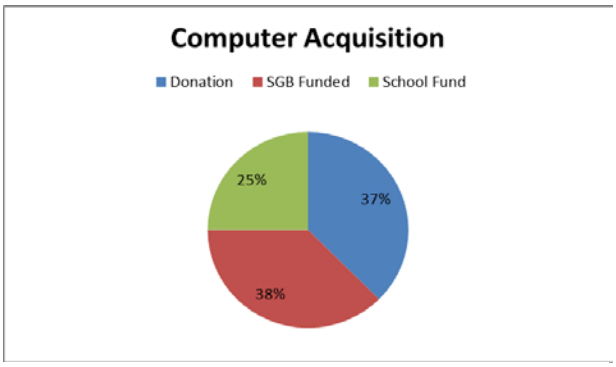


igure 39 Anti-virus Software

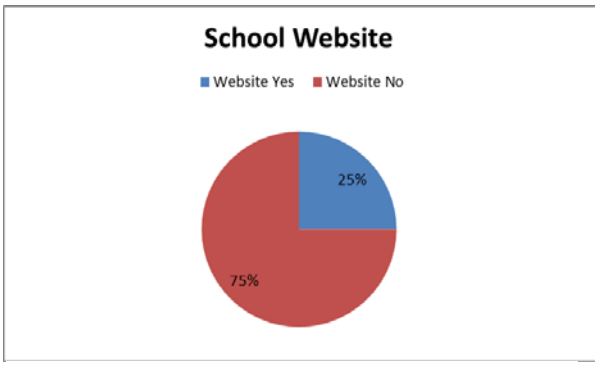


igure 40 School IT Policy

4.5.2 Leadership Support and Community/Home/Parent/ Mediation Dimension

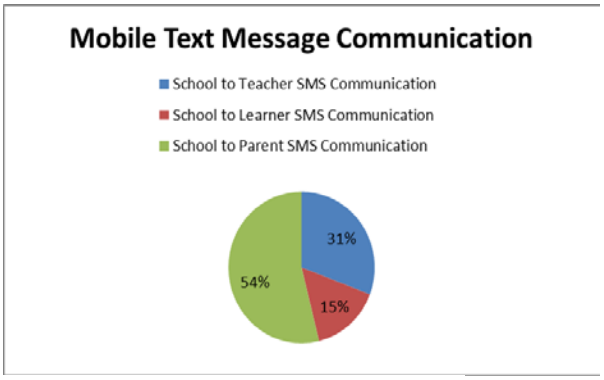


igure 41 Computer Acquisition

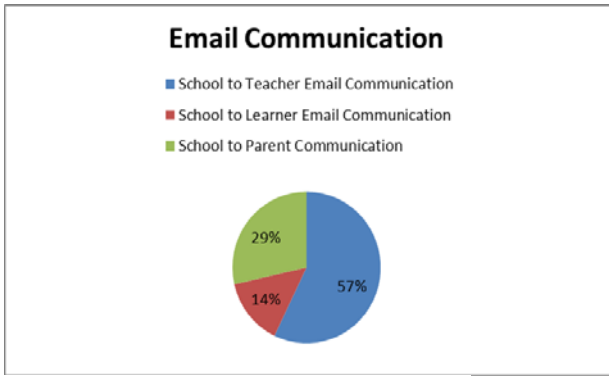


igure 42 School Website

All of the schools surveyed acquired computers through a combination of donations by private businesses and individuals; school governing body (SGB) fund-raising or surplus school funds. Six of the eight schools have a school website.



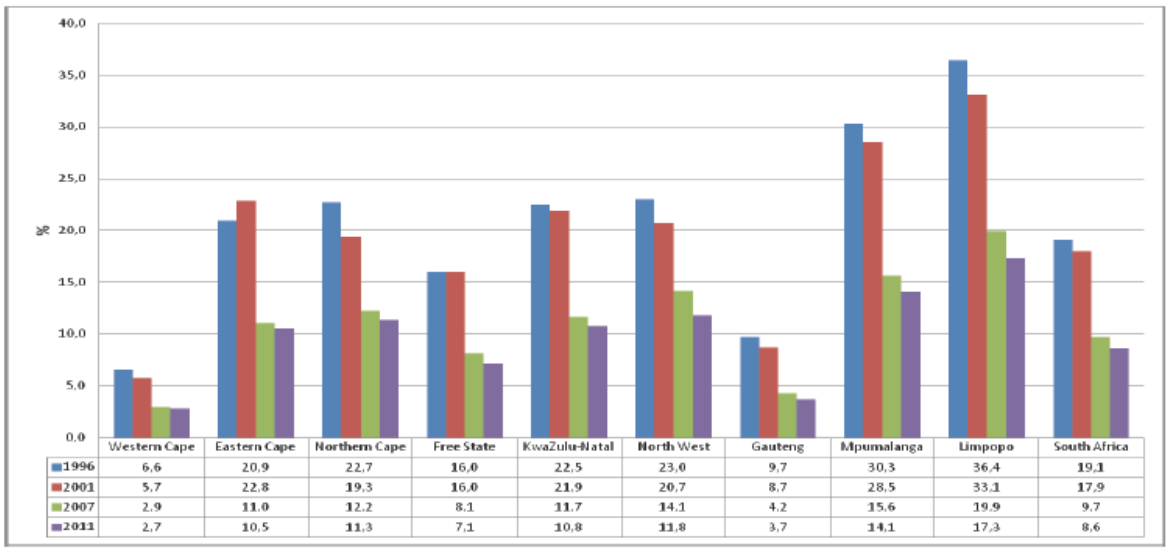
igure 43 Mobile SMS Communication



igure 44 Email Communication

Email and mobile sms communication between schools and teachers, learners and parents varies from school to school with school-to-teacher email communication being highest, followed by school-to-parent sms.

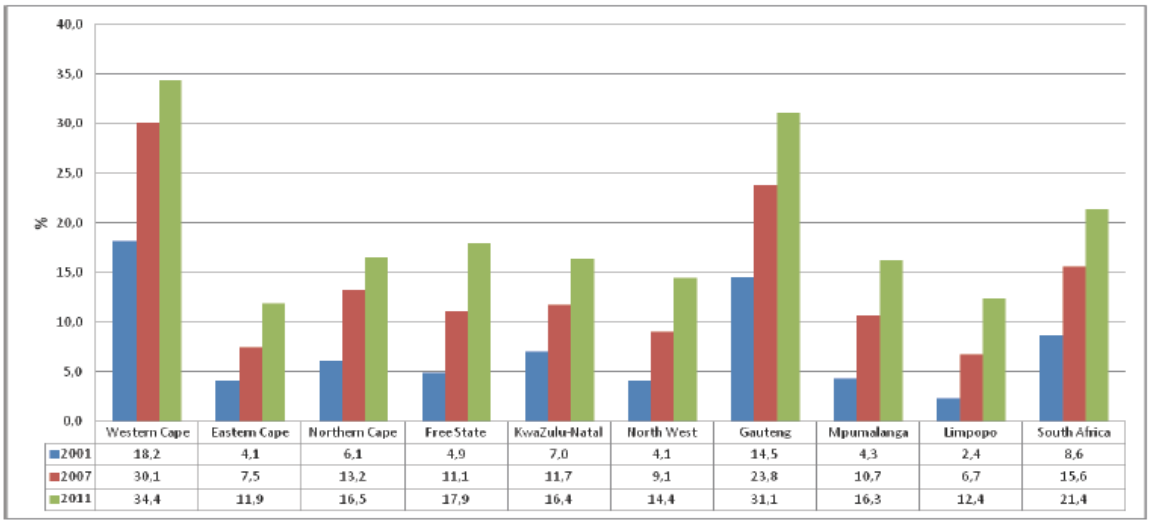
4.6 Environment (Contextual actors)



	Western Cape	Eastern Cape	Northern Cape	Free State	KwaZulu-Natal	North West	Gauteng	Mpumalanga	Limpopo	South Africa
1996	6,6	20,9	22,7	16,0	22,5	23,0	9,7	30,3	36,4	19,1
2001	5,7	22,8	19,3	16,0	21,9	20,7	8,7	28,5	33,1	17,9
2007	2,9	11,0	12,2	8,1	11,7	14,1	4,2	15,6	19,9	9,7
2011	2,7	10,5	11,3	7,1	10,8	11,8	3,7	14,1	17,3	8,6

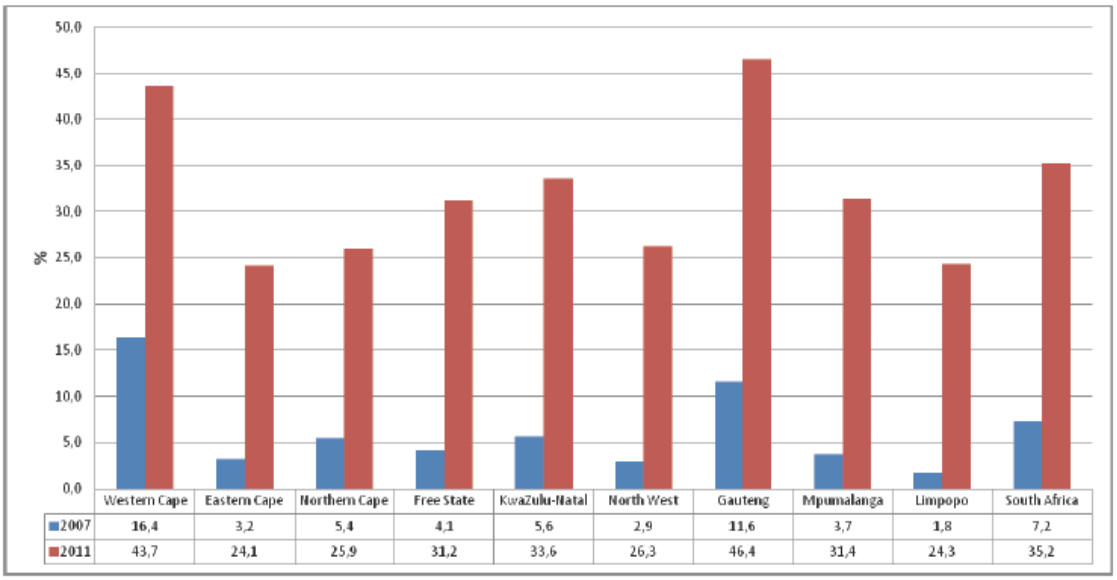
igure 45 Attainment of education for individuals aged 20 years and older by province: Census 1996, 2001, 2011 and Community Survey 2007.

Figure 45 shows that the percentage of people aged 20 years and older with no schooling has been decreasing over the period 1996 to 2011. Limpopo has the highest number of people (17.3%) aged 20 years and older with no schooling.



	Western Cape	Eastern Cape	Northern Cape	Free State	KwaZulu-Natal	North West	Gauteng	Mpumalanga	Limpopo	South Africa
2001	18,2	4,1	6,1	4,9	7,0	4,1	14,5	4,3	2,4	8,6
2007	30,1	7,5	13,2	11,1	11,7	9,1	23,8	10,7	6,7	15,6
2011	34,4	11,9	16,5	17,9	16,4	14,4	31,1	16,3	12,4	21,4

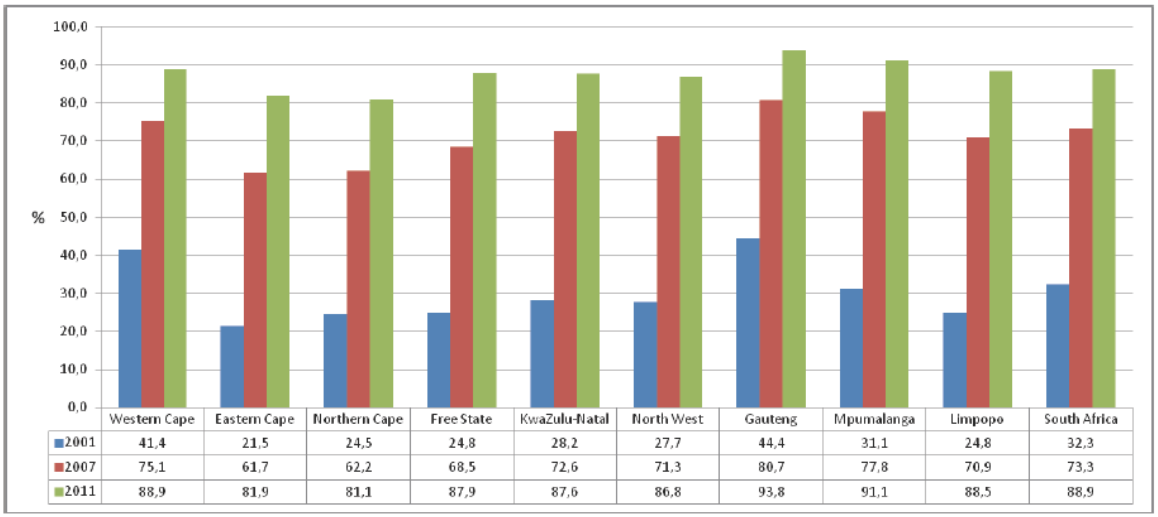
igure 46 Percentage of households that have a computer in working order by province: Census 2001, 2011 and Community Survey 2007



	Western Cape	Eastern Cape	Northern Cape	Free State	KwaZulu-Natal	North West	Gauteng	Mpumalanga	Limpopo	South Africa
2007	16,4	3,2	5,4	4,1	5,6	2,9	11,6	3,7	1,8	7,2
2011	43,7	24,1	25,9	31,2	33,6	26,3	46,4	31,4	24,3	35,2

igure 47 Percentage of households with access to the internet: Community Survey 2007 and Census 2011

The Western Cape recorded the highest number of households having a computer; and this figure has grown from 18.2% in 2001 to 34.4% in 2011. The number of households owning computers in Limpopo also grew during this period, but remains the lowest in the country at 12.4% in 2011.

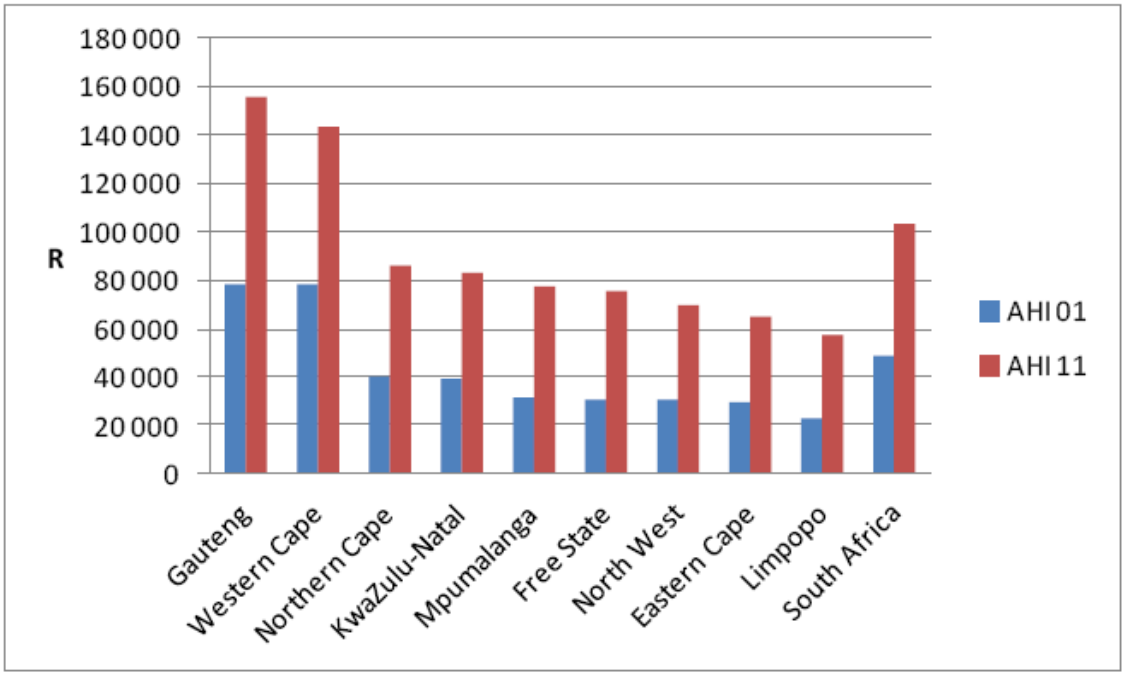


	Western Cape	Eastern Cape	Northern Cape	Free State	KwaZulu-Natal	North West	Gauteng	Mpumalanga	Limpopo	South Africa
2001	41,4	21,5	24,5	24,8	28,2	27,7	44,4	31,1	24,8	32,3
2007	75,1	61,7	62,2	68,5	72,6	71,3	80,7	77,8	70,9	73,3
2011	88,9	81,9	81,1	87,9	87,6	86,8	93,8	91,1	88,5	88,9

igure 48 Percentage of households with access to a working cell phone: Community Survey 2007 and Census 2011

Household access to the Internet in Limpopo grew dramatically between 2001 (1.8%) and 2011 (24.3%). However, the Province still records the lowest percentage of households with an Internet connection in South Africa. (see figure 47). Figure 48 indicates that the percentage of households that have a cell phone in working order

increased nationally from 32,3% in 2001 to 88,9% in 2011. Gauteng had the highest percentage (93,8%), while Limpopo has the fourth highest cellphone penetration rate in South Africa (88.5%).



igure 49 Average household income (A I) by province: Census 2001 and 2011

Average Household Income (AHI) in Limpopo is recorded at R57000.00 p.a. - the lowest for South Africa's nine provinces. (see figure 49).

4.7 What does the e-Education White Paper Say

Most countries across the globe have introduced computers into schools on the basis that learners need to be equipped with the necessary technology skills to be able to cope with living in the 21st century. In South Africa, the Department of Education's e-Education policy outlines a framework for the implementation of a strategy that expands the use of ICT's for improving the quality of teaching and learning in South Africa's schools. The main goal of the policy is to ensure that every learner in South Africa's schools is ICT-capable by 2013. In order to achieve this goal, schools are expected to obtain the necessary infrastructure; and to transform themselves into e-schools with qualified and competent teachers who are able to facilitate enhanced learning and teaching through the use of ICT's. Furthermore, these e-schools are expected to be managed by administrators who are competent in the use of ICT's for the planning and management of the school; and they must

also work towards harvesting a culture in schools that supports the practice of using ICT's.

The concept of e-Education, as outlined in the framework, extends beyond computer literacy and the ability to operate a technology device – it is also the ability to:

- Apply ICTs, access, analyse, evaluate, integrate, present, and communicate information.
- Create knowledge and information by adapting, applying, designing, inventing, and authoring information.
- Function in a knowledge society by using appropriate technology and mastering communication and collaboration skills. (Isaacs, 2007).

While the intentions laid out in the framework are noble and laudable, the reality is that very few technology interventions in schools have been able to achieve the desired policy outcomes. A number of reasons have been advanced for this. Ford and Botha (2010) suggest three issues that are primarily responsible for failed e-Education projects. These are:

1. Lack of ICT-literacy at a general level amongst users
2. Stringent and structured forms of teaching with little or no scope for lateral thinking
3. Realisation of the importance of technology but inability to incorporate it into learning and teaching due to a lack of training, inadequate infrastructure and lack of integration within the current curriculum.

Evidence gathered from the research undertaken in this project appear to support this view and will be expanded upon further in the coming chapters.

Chapter 5

5. Multiple Interpretations : Technology-use and e-Education

5.1 Introduction

Results of this study have revealed that while most teachers and learners actively interact with electronic technologies, such engagements are patchy and do not find expression in any structured arrangement in schools. Where electronic technologies have been used for instructional purposes, it has been confined to accessing information for teaching or for preparing study material and class notes. This excludes ICT-specific subjects such as Information Technology (IT) and Computer Applications Technology (CAT) which are generally offered as formal school subjects against a prescribed curriculum.

Factors that affect the utilisation and integration of electronic technologies in the schools surveyed are consistent with those prevalent in the literature and include: limited availability of technology devices; poor connectivity; lack of training for teachers; lack of technical support and maintenance; no pedagogical and administrative support; and lack of teacher involvement in decision making relating to electronic technologies. While these factors are commonly identified in the literature as the main culprits responsible for hampering technology integration in schools, this study sought to establish a common cause relationship between personal, administrative and contextual elements as separate but related factors that are responsible for the poor track record of technology integration efforts in schools. Upon analysing the results of this research, the following specific observations can be made within the context of the research questions initially posed by this study.

In attempting to answer the question related to the extent to which the perceptions, experiences and attitudes of individuals are linked to their use of technology, we have examined the responses of learners and teachers and an interpretation of the findings is presented below.

5.2 Classroom (Personal actors)

5.2.1 Learner Attitude Dimension

In analysing the responses related to learner attitudes towards computers, it is evident that many learners (37%) do not consider interaction with computers to be a

satisfying experience (see figure 15). This position was confirmed by the responses received from learners to questions which asked them to indicate their views on "computer importance." Only 49% of the learners surveyed felt that computers are important. 7% were uncertain, while 44% felt that computers are not important. (see figure 16).

The attitude of learners towards school work and school in general is low, with only 46% of learners showing a commitment towards school. (see figure 18). The responses from questions related to learner persistence and problem-solving revealed similar results, with only 40% of learners demonstrating tendencies towards persistence in problem-solving. (see figure 19). The survey also revealed that there is low capacity for creativity amongst learners, with only 42% demonstrating creative tendencies. (see figure 17).

The value of email as a communication tool is also viewed conservatively amongst learners, with only 49% believing that email can improve communication, while 48% stating that email actually hampers communication.

5.2.2 Teacher Attitudes Dimension

Teacher responses to the questionnaires revealed marked differences in opinion regarding the value of technology-based interventions in schools. Responses to questions related to computer-enthusiasm, computer-anxiety and computer-avoidance mirrored each other fairly accurately with 47% of teachers expressing enthusiasm and receptiveness towards technology, and 44% resisting technology use. (see figures 21,22 and 23).

The responses elicited from questions related to the "impact of technology on society" and the "productivity-improvement" potential of computers, drew similarly conservative responses, with 47% of teachers indicating that technology has a positive impact on society and only 50% believing that computers improve productivity. (see figures 24 and 26).

5.2.3 Teacher Knowledge and Skills Dimension

The study reveals that 55% of the teachers surveyed hold a degree qualification. The remainder is made up of an even spread of teachers holding masters, honours and diploma qualifications. 33% of teachers surveyed have never attended a computer course, while 46% had attended a course more than two years previously. (see figure 27).

More than two-thirds of the teachers surveyed do not have access to a computer at school. 46% of the respondent's indicated that they interact with family, friends and colleagues on a daily basis using social media, while 35% have never been exposed to this medium. (see figure 30).

The results from the self-evaluation of proficiency in selected applications revealed that 72% of teacher's consider themselves highly proficient in wordprocessor use. 52% rate their proficiency at spreadsheet use as high; while 52% consider themselves moderately proficient in internet use. (see figures 31-34). The results suggests that while many teachers are proficient in the use of some technologies in their personal capacity, there is little incentive for transferring this technology endowment into the classroom.

The general attitude of teachers towards mobile phones is negative. They are viewed as disruptive and most teachers across the sample related stories of incidents in their schools where mobile phones were used to "play loud music", "communicate rude messages", "taking of obscene photographs" and of "phones being stolen". Two teachers offered alternative points of view. One teacher indicated that he was actively lobbying for the unbanning of cellphones in the classroom because he believed that it held benefits for learners. He indicated that he had encouraged all his learners to download a mobile dictionary application on to their mobile phones and this had resulted in a marked improvement in learner's spelling. Another teacher in the same school, said he actively encouraged learners in his class to use Wikipedia to research quick facts during his Geography class.

The overall result suggests that more than half of the teachers surveyed have not embraced technology and are unlikely to promote or encourage its use in the classroom. It also suggests that there is a disjuncture between policy intention ('every learner must be ICT-capable by 2013') and the actual outcome as reflected in the attitudinal perceptions of learners and teachers towards technology in the classroom.

5.3 School (Administrative actors)

The administrative factors identified as influencing technology integration in schools range from infrastructure availability to technical support and school-parent mediation. The lack of computers at school could be an indicator of a lack of computers at home as there is generally an expectation amongst parents who use technology that their children will be exposed to technology at school.

5.3.1 Technology Availability and Support Dimension

There is a general disparity in the distribution of computers and internet access amongst the school surveyed. Only three of the eight schools have internet access available on all computers. (see figure 35). There are two schools which do not have access to the Internet at all.

The disparity in internet access also extends to other technology devices, with some schools having no complementary peripherals such as printers and data projectors or a computer lab. (see figure 36).

Four of the eight schools have access to IT technical support on a part-time basis while one school has employed a full-time technician to maintain computer equipment. Three schools have no access to technical support, while six of the eight schools surveyed do not have a computer maintenance plan.

87% of the schools surveyed have anti-virus software installed on their computers and 71% have a School IT policy in place. This policy is confined to acceptable-usage procedures and rules.

5.3.2 Leadership Support and Community/Home/Parent/ Mediation Dimension

All of the schools surveyed acquired computers through a combination of donations by private businesses and individuals; school governing body (SGB) fund-raising or surplus school funds. Six of the eight schools have a school website.

Email and mobile sms communication between school-and-teacher, school-and-learner and school-and-parent varies from school to school with school-to-teacher email communication being highest, followed by school-to-parent sms. (see figures 43-44).

5.4 Environment (Contextual actors)

There are a number of environmental factors that may influence computer-use in society in general and by extension in schools. The socio-economic profile of some communities may view the resources being expended on technology as a competing threat for more pressing needs. In this study, we examined factors such as education

attainment, household income and computer-internet penetration rates in South Africa in order to compile a socio-economic profile for the Limpopo province.

5.4.1 Socio-economic Profile

Figure 45 shows that the percentage of South Africans aged 20 years and older with no schooling has been decreasing over the period 1996 to 2011. Limpopo has the highest number of people (17.3%) aged 20 years and older with no schooling. This is an alarming statistic since the attainment of education by persons aged 20 years and older is critical in promoting employability and addressing skills shortages in the South African economy. Increased educational attainment rates of those aged 20 years and older is an important indicator of employability, labour participation and development, especially in developing countries.

The Western Cape recorded the highest number of households having a computer; and this figure has grown from 18.2% in 2001 to 34.4% in 2011. The number of households owning computers in Limpopo also grew during this period, but remains the lowest in the country at 12.4% in 2011.

Household access to the Internet in Limpopo grew dramatically between 2001 (1.8%) and 2011 (24.3%). However, the Province still records the lowest percentage of households with an Internet connection in South Africa. Average Household Income (AHI) in Limpopo is recorded at R64000.00 p.a. - the lowest of South Africa's nine provinces. With the effects of inflation as well as the increasing access to jobs and a growing economy, it can be observed in Figure 5.1 that the average annual household income increased in all nine provinces quite substantially since 2001 to 2011. The average household income is lowest in Limpopo (R57 000 p.a.) and the Eastern Cape (R64 000 p.a.), whilst it is highest in the Western Cape (R143 000 p.a.) and Gauteng (R156 000 p.a.).

5.5 Cross-tabulation of Results

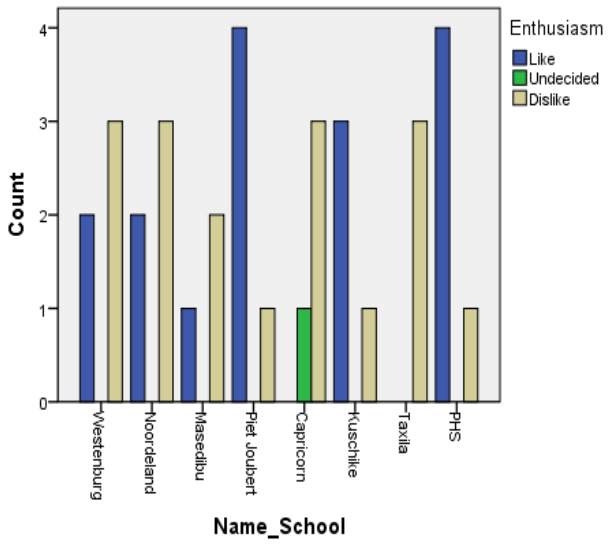
During the course of gathering data for the study, the researcher observed a number of similarities between the schools across all the dimensions. However, some schools demonstrated outlier behaviour prompting the researcher to cross-tabulate

some results by school in order to establish whether the observations have any validity.

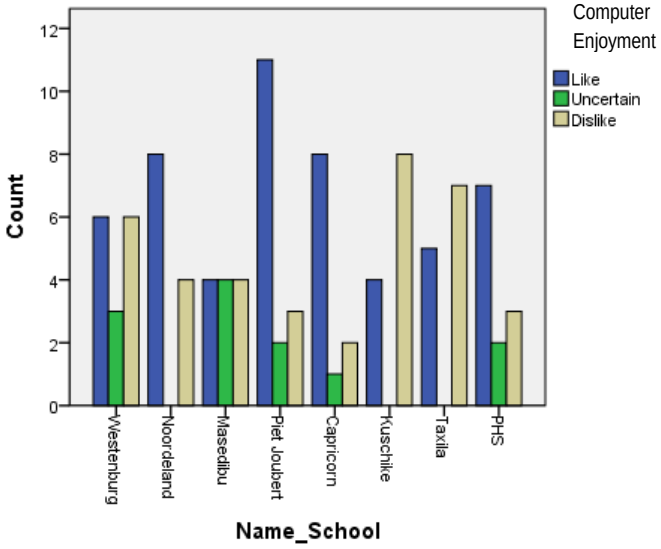
5.5.1 Teacher Computer enthusiasm and enjoyment

While the consolidated results from the survey reflect an even spread between teachers who 'like' to use computers and those who 'dislike' computers, there is a marked difference in attitudes between different schools. (see figure 49). It is worth noting that in those schools where computer infrastructure is relatively abundant, teachers tend to be enthusiastic about computers and enjoy using them. In this particular sample, the school with the second fewest computers also has the least amount of teachers who say they 'like' computers.

igure 49 Teacher Computer Enthusiasm by School



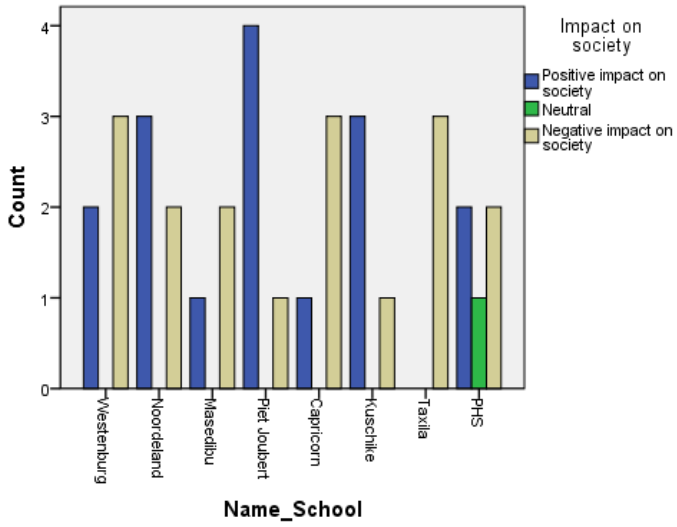
igure 50 Teacher Computer En oyment by School



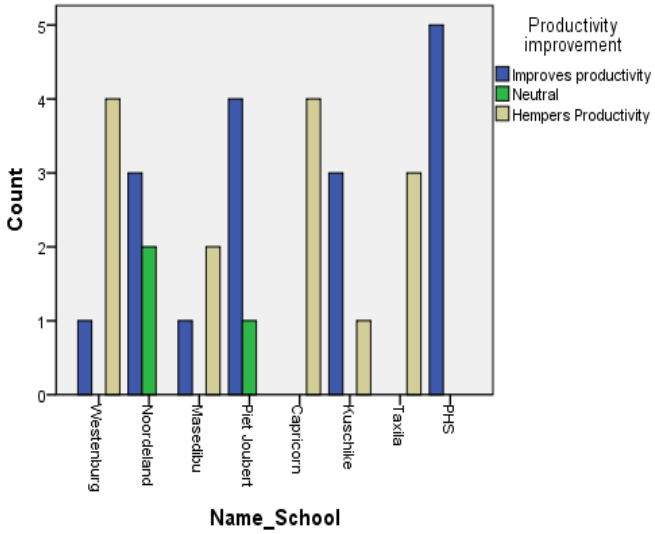
5.5.2 Teacher Perceptions of the Impact of Technology on Society and Productivity

The perception of teachers regarding the impact of computers on society also varies between schools. In keeping with the previous trend, teachers in schools that are better resourced in terms of technology, tend to view technology more favourably than their counterparts in less resourced school environments. Similarly, teachers who have access to computers at school, tend to correlate technology with improved levels of productivity. (see figures 52-53).

igure 52 Teacher perceptions of the Impact of Technology on Society by school



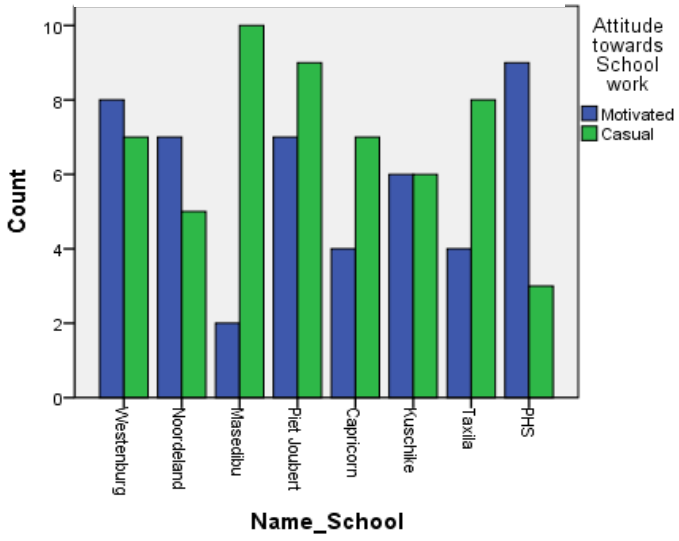
igure 53 Teacher perceptions on the Impact of technology on Productivity by school



5.5.3 Learner Attitudes Towards School And School Work

The evidence suggests that learner attitudes towards school work and school in general is low across the sample. However, the school with access to the most technology resources is also the school with the most motivated learners; and the school with the least amount of resources has the least motivated learners. This is consistent with the ACOT study which found that in addition to overall improvements in performance and attendance, student attitudes towards themselves and their work also improved when they had access to computers (Rusten, 2003). Interestingly, learners in the one school in the sample that does not have any computers available for learning and teaching, has the second highest number of motivated learners.

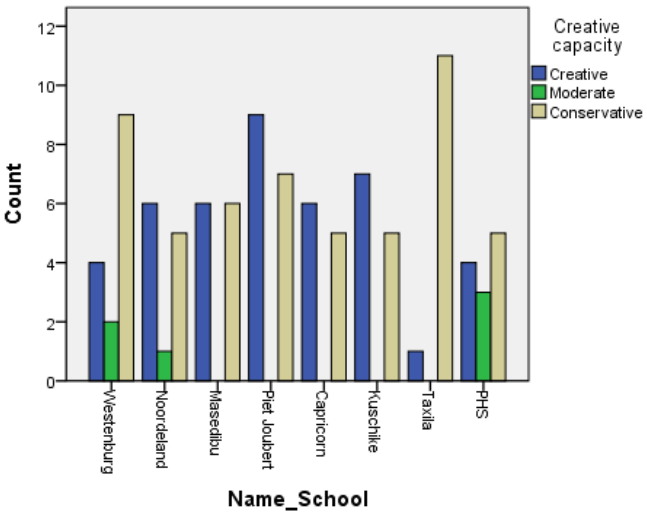
igure 54 Learner Attitudes Towards School Work, by school



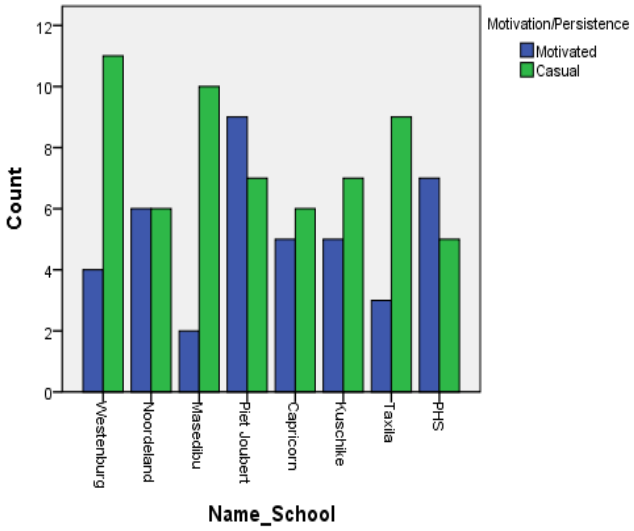
5.5.4 Learner Creative Capacity and Persistence in Problem-solving

The results suggest that there is a conservative tendency towards creativity amongst learners in most schools. Only two schools presented a majority of learners with positive creative capacity. This may be attributed to the fact that the one school in question is a trade-orientated school offering subjects of a more practical nature (eg. woodwork, fashion design, welding, etc.); and the other school specialises in offering farming and agriculture-oriented subjects. The remaining schools may be demonstrating attributes that are consistent with an instructivist school culture where teachers do the talking and learners do the listening with few opportunities for creative expression or collaboration.

igure 55 Learner Creative Capacity



igure 56 Learner Persistence and Motivation in Problem-solving



The key finding of this survey is that there are no specific technology elements which are consistently considered as being negative by a large portion of the sample. In general, the majority of the elements were rated positive by the respondents. However, the continued disparity in the availability of technology resources amongst schools, both in quantitative and qualitative terms cannot be overstated. While this inequality may be most apparent in comparisons between historically advantaged and previously disadvantaged schools, there is also a generally understated disparity in equality between rural and urban schools. Therefore, any ICT interventions must be accordingly stratified. Considering the rapid pace of technological innovation, the frequency at which teacher's computer skills are being upgraded is inadequate. The low percentage of teachers who have access to a computer at school also

represents a significant constraint in terms of advancing the cause for technology integration in the classroom. It is also an indication of the unequal distribution of technology resources amongst schools and may explain why there are disparities in levels of technology uptake and adoption between the schools. Another observation is that half of the teacher's surveyed use social media on a daily basis while a third of teachers have never been exposed to it at all. The popularity of social media and its influence in shaping the minds of young people suggest that this medium presents a unique opportunity for teachers to engage with their learners in a collaborative atmosphere. That more than half of the teachers surveyed have never or rarely use social media is a discrepancy that must be reversed. Lastly, mobile phones present a substantial opportunity for bringing technology closer to the classroom. High mobile penetration rates means that these devices can be deployed far more easily and equitably across socio-economic strata than traditional computers. The challenge is for school management to generate relevant content for their use in a school setting; and for policymakers to expand the scope of policy to accommodate multi-contextual models for technology integration in schools.

Chapter 6

6. Reflections

6.1 What is Policy

According to the online Merriam-Webster Dictionary,[15] policy is "a definite course or method of action selected from among alternatives, and in light of given conditions, to guide and determine present and future decisions." While this definition may give us an understanding of policy in objective technical terms, it conveys little about the objectives of policy. Another online resource, The Free Dictionary,[16] offers a more nuanced definition thus: "a course of action, guiding principle, or procedure considered expedient, prudent or advantageous." When we consider that the quality of water we drink, food we consume and air we breathe is determined by policy, we begin to appreciate the value of defining policy within the context of "society's greater good." We also begin to appreciate the need for policy to be flexible and accommodative of the unique characteristics of particular settings within which the policy is expected to apply. Public policy is ultimately the outcome of a decision which is deemed to be in the public interest; and policy development involves the selection of choices about the most appropriate means to a desired end. (Torjman, 2005). In theory, this would involve the weighing-up of multiple options and considering the potential impact of each. In doing so, the following are key factors that must be considered:

1. Who benefits from this policy?
2. Who may be negatively affected?
3. What is the social cost of implementing this policy?
4. What is the monetary cost of implementing this policy?
5. Is there an opportunity cost associated with implementing this policy?

In short, policy should seek to achieve a virtuous desired goal that is considered to be in the best interests of all members of society.

[15] www.merriam-webster.com/dictionary/policy

[16] www.thefreedictionary.com/policy

6.2 Digital Exclusion

The unequal distribution of economic resources in South African society has been the subject of longstanding debate and continues to dominate the public discourse. While the focus of this debate has largely been on land and minerals, there is a growing inequality amongst South Africans when it comes to digital access. Concerns regarding the exclusion of large numbers of the world's population from the benefits of technology were initially taken-up under the banner of the "digital divide." More recently however, there has been a shift in concern from mere access to technology to a concern regarding how technology is actually being used.

Digital exclusion results in a significant disadvantage when it comes to participation in the activities that are vital to daily life in the modern world. People and communities who are excluded are deprived of access to economic opportunity, civic engagement, cultural expression, communication, and access to educational resources and information. Our increasing reliance on ICT's in public, economic and social life means that the digitally excluded also become excluded from society itself.

For many South African's, particularly in rural communities like Limpopo, schools do not only serve as an educational institution for children. They also provide an entry point into the wider world. Historically, schools served as a community meeting point and an information hub. It was where people collected their mail and where they had access to a telephone; and any effort aimed at community e-enablement, especially in rural communities, should begin with the proper resourcing of schools.

6.3 ow Does South Africa's e-Education Policy Measure Up

While the scope of South Africa's e-Education Policy provides for far-reaching technology interventions in education; and espouses noble values, the reality is that very few schools have realised the desired outcomes that the policy was meant to achieve. While some of the schools surveyed in this study have made small advances in technology implementation, these gains have occurred in spite of policy rather than because of it.

When one reflects on technology in education we generally visualise a modern computer lab with all the high-tech paraphernalia that goes with it. The reality is that many schools do not even have access to basic infrastructure such as clean running

water, electricity or adequate learning materials such as chalk-boards, desks and books. And even if infrastructure challenges are being addressed through expanding educational budgets, the bureaucratic nature of the education system must be transformed to accommodate curriculum flexibility and a collaborative atmosphere in schools. As was mentioned earlier in this research, Becker and Riel (1999) found that the work of integrating instructional technology strategies into practice is a complex process and that teachers encounter either a bureaucratic culture or a professional culture in their school. Bureaucratic cultures tend to give teachers autonomy in their classrooms, but restrict their participation in curricular and organisational decisions. The bureaucratic culture hinders innovative practice and collaboration among teachers and must be addressed during pre-service training of teachers.

In planning for the integration of ICT's in education, policy makers would be well advised to begin by determining the specific educational objectives that the technology seeks to serve prior to being brought on board. This means that the role of technology within particular educational contexts should be well defined within broad education policy itself. According to both Guttman and Haddad, technology is only a tool and it cannot compensate for weaknesses in education policy (Gutman, 2003; Haddad, 2007). Policies without specific outcomes and monitoring and evaluation tools will not achieve desired objectives. There are often huge gaps between policies and the changes in classroom practice that they are intended to affect (Cohen & Hill, 2001). National ICT policies are more likely to result in positive outcomes if they are flexible and accommodative of multi-situational contexts.

6.3 Conclusion

In addressing the main research question, the following can be said regarding policy interventions that will help to address the challenges facing computer-implementation programmes in Limpopo schools:

1. Recognise that the implementation of technology in schools is not intended to fix existing problems in education.

2. The need for a stratified approach towards technology implementation in schools. The one-size-fits-all model espoused in the current e-Education Policy, does not adequately consider the unique characteristics of each school setting in terms of teacher and learner attitudes, infrastructure availability or the socio-economic conditions of particular communities.

3. The implementation of technology in schools cannot be left to the school. The resource disparity between schools means that some schools will advance more rapidly than others, thereby widening the equality gap between schools.

4. Technology integration programmes into schools must be accompanied by similar efforts in generating content for use in the schools. Unless there is relevant content that can be deployed onto the technology, computers and other devices will continue to sit at the edge of the classroom rather than on the desk.

5. e-Education policy must include provisions that promote digital inclusion beyond the classroom.

A refined policy approach is needed – one that appreciates the significance of contextual factors and accommodates flexibility in the design and deployment of technology for the learner's, and ultimately society's, greater good.

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Appendix A

School General Questionnaire

Dear Respondent,

Thank you for your participation in this survey. This questionnaire is one of many that forms part of anacademic exercise towards the completion of my Master's Degree. The survey asks questions about technology and how it is used by learners, educators and school administrators in Polokwane, Limpopo.

Your cooperation in completing this questionnaire will be greatly appreciated and I would like to assure you that your responses to this survey will be treated with the strictest confidence and will not reflect any of your personal details.

Thank You,

General Information

Name of School	
Year Established	
Number of enrolled learners	
Number of Educators	
Number of Administration Staff	

Physical Infrastructure

Total number of classrooms	
Number of Computer classrooms/labs	
Number of libraries/media centre	
Number of auditoriums	
Number of telephone extensions	
Number of internet connections	

Technology & Resources Infrastructure

Number of computers available for school administration	
Number of computers available for learning & teaching	
Are your computers networked	
Number of data-projectors	
Number of printers	
Number of television sets	
Number of learners taking Computer studies as a subject	
Number of Computer Teachers	
How did the school acquire the computers (Donation/Department issue/Purchased by school)	
Does your school have a computer technician (full-time/part-time	

Does your school have a computer maintenance plan	
Are your computers installed with anti-virus software	

Internet

Number of Computers connected to the internet	
Name of Internet Service Provider	
Internet bundle (eg. Telkom ADSL, Mobile)	

Technology Use & Management

	Yes	No
Do you have a school IT/Computer policy		
Does your school have its own website		
Does your school have its own email address		
Do you use sms to communicate with learners		
Do you use sms to communicate with teachers		
Do you use sms to communicate with parents		
Do you use email to communicate with learners		
Do you use email to communicate with teachers		
Do you use email to communicate with parents		

Appendix 2

Teacher General Questionnaire

Dear Respondent,

Thank you for your participation in this survey. This questionnaire is one of many that forms part of an academic exercise towards the completion of my Master's Degree. The survey asks questions about technology and how it is used by learners, educators and school administrators in Polokwane, Limpopo.

Your cooperation in completing this questionnaire be greatly appreciated and I would like to assure you that your responses to this survey will be treated with the strictest confidence and will not reflect any of your personal details.

Thank You,

Please mark **ONLY ONE** option with a cross ñXò

Question 1

Please indicate you gender	M	F

Question 2

Please select your age group	
	21-24
	25-29
	30-35
	36-42
	43-49
	50+

Question 3

How long have you been teaching	Less than 2 years
	2-5 years
	5-9 years
	9-15 years
	15-25 years
	More than 25 years

Question 4

Please indicate your race	African	Coloured	Indian	White

Question 5

Please indicate your Nationality	

Question 6

Please state your highest qualification	None
	Matric
	Diploma
	Degree
	Honours
	Masters
	Doctorate

Question 7

I have a computer at home	Yes	No

Question 8

I have access to the Internet at home	Yes	No

Question 9

I have a computer at school	Yes	No

Question 10

I have access to the Internet at school	Yes	No

Question 11

I have an email address at school	Yes	No

Question 12

I have my own email address at home	Yes	No

Question 13

Please mark **ONLY ONE** option in each row with a cross ñXò

		Daily	Once or Twice a Week	Once or twice a month	Less than once or twice a month	Never
A	I make use of cell-phone banking					
B	I send smsôs					
C	I receive smsôs					
D	I use my cell phone to take pictures					
E	I can access emails on my cell-phone					
F	I play games on my cell-phone					
G	I download music/movies					
H	I use Mxit on my cell-phone					
I	I use Whatsapp on my cell-phone					
J	I use Facebook on my cellphone					
K	I use Twitter on my cell-phone					

Question 14

I have attended a computer course	
	This year
	Last year
	2 years go
	More than 2 years ago
	Never

Question 15

Please mark **ONLY ONE** option in each row with a cross ñXò

		Daily	Once or Twice a Week	Once or twice a month	Less than once or twice a month	Never
A	I make use Internet banking					
B	I use a digital camera					
C	I check my email					
D	I use Facebook					
E	I use Twitter					
F	I play computer games					
G	I download music/movies					
H	I use a computer to prepare for my lessons					
I	I use a computer to communicate with colleagues, friends and family					
J	I use a computer to search for information about my lessons					
K	I use a data projector					
L	I use a computer to do assignments for my own studies					
M	I use a tablet device (Apple Ipad / Samsung Galaxy Tab / Etc.					

Question 16

Please mark **ONLY ONE** option in each row with a cross ñXò

Please rate your level of proficiency in the use of the following:

		Very High	High	Moderate	Low	Very Low
A	Wordprocessing software					
B	Spreadsheet software					
C	Presentation software					
D	Database software					
E	Internet browser software					
F	Email software					
G	Graphics software					

Question 17

Please write a brief paragraph on your impressions about technology in general and how you feel about its use in schools.

Appendix 3

Learner General Questionnaire

Dear Respondent,

Thank you for your participation in this survey. This questionnaire is one of many that forms part of an academic exercise towards the completion of my Master's Degree. The survey asks questions about technology and how it is used by learners, educators and school administrators in Polokwane, Limpopo.

Your cooperation in completing this questionnaire will be greatly appreciated and I would like to assure you that your responses to this survey will be treated with the strictest confidence and will not reflect any of your personal details.

Thank You,

Please mark **ONLY ONE** option with a cross ñXò

Question 1

Please indicate you gender	M	F

Question 2

Please indicate your race	African	Coloured	Indian	White

Question 3

I have a computer at home	Yes	No

Question 4

I have access to the Internet at home	Yes	No

Question 5

I have a computer at school	Yes	No

Question 6

I have access to the Internet at school	Yes	No

Question 7

I have my own email address at home	Yes	No

Question 8

Please mark **ONLY ONE** option in each row with a cross ñXò

		Daily	Once or Twice a Week	Once or twice a month	Less than once or twice a month	Never
A	I make use a of cell-phone					
B	I send smsôs					
C	I receive smsôs					
D	I use my cell phone to take pictures					
E	I can access emails on my cell-phone					
F	I play games on my cell-phone					
G	I download music/movies					
H	I use Mxit on my cell-phone					
I	I use Whatsapp on my cell-phone					
J	I use Facebook on my cellphone					
K	I use Twitter on my cell-phone					
L	I play games on (XBOX/PS3/Wii)					
M	My parents communicate with me on my cell-phone					
N	My friends communicate with me on my cell-phone					

Question 9

I have attended a computer course	
	This year
	Last year
	2 years go
	More than 2 years ago
	Never

Question 10

Please mark **ONLY ONE** option in each row with a cross ñXò

		Daily	Once or Twice a Week	Once or twice a month	Less than once or twice a month	Never
A	I make use Internet banking					
B	I use a digital camera					
C	I check my email					
D	I use Facebook					
E	I use Twitter					
F	I play computer games					
G	I download music/movies					
H	I use a computer to do my homework and assignments					
I	I use a computer to communicate with colleagues, friends and family					
J	I use a computer to search for information about my studies					
K	I use a tablet device (Apple Ipad / Samsung Galaxy Tab / Etc.					
L	My parents use a computer					
M	My parents use a cell-phone					

Question 11

Please mark **ONLY ONE** option in each row with a cross ñXò

Please rate your level of proficiency in the use of the following:

		Very High	High	Moderate	Low	Very Low
A	Wordprocessing software					
B	Spreadsheet software					
C	Presentation software					
D	Database software					
E	Internet browser software					
F	Email software					
G	Graphics software					

Question 12

Please write a brief paragraph on your impressions about technology in general and how you feel about its use in schools.

Appendix 4

Teacher Attitude Toward Computers (TAC)

Survey of Teachers' Attitudes Toward Computers

Name: _____ Date: _____

To the Educator:

This questionnaire is composed of well-validated portions of several attitudinal surveys that havebeen used with teachers in the past. We will use the combined information to help develop a profile of how teachers view technology.

1. How long have you been teaching?

_____ 0-1 years _____ 2-5 years _____ 6-10 years

_____ 11-15 years _____ 15+ years

2. How would you rate your experience with computers? (Check all that apply)

_____ I have never used a computer and I don't plan to anytime soon.

_____ I have never used a computer but I would like to learn.

_____ I use applications like word processing, spreadsheets, etc.

_____ I use computers for instruction in the classroom.

How often?

_____ Daily

_____ Weekly

_____ Occasionally

3. Currently I use the computer approximately _____ hours per week in the classroom.

4. At the beginning of this school year, I used the computer approximately _____ hours per week in the classroom.

5. If you do use computers, what type of training have you received? (Rank order all that apply).

_____ No training

_____ Basic Computer Literacy (on/off operations, how to run programs)

_____ Computer applications (word processing, spreadsheets)

_____ Computer integration (how to use in classroom curriculum)

6. Where did you receive your training? (Rank order all that apply).

_____ Self-taught

_____ School district

_____ College or university

_____ Other- please specify _____

Do you have a computer at home? ___ Yes ___ No

Gender: ___ M ___ F

Age: ___ 18-25 ___ 26-30 ___ 31-35 ___ 36-40 ___ 41-45 ___ 46+

Please read each statement and then circle the number which best shows how you feel.

(1) SD = Strongly Disagree
(2) D = Disagree
(3) A = Agree
(4) SA = Strongly Agree

(1) I enjoy doing things on a computer.	1é 2é 3é 4
(2) I am tired of using a computer.	1é 2é 3é 4
(3) I will be able to get a good job if I learn how to use a computer.	1é 2é 3é 4
(4) I concentrate on a computer when I use one.	1é 2é 3é 4
(5) I enjoy computer games very much.	1é 2é 3é 4
(6) I would work harder if I could use computersmore often.	1é 2é 3é 4
(7) I think that it takes a long time to finish when I use a computer.	1é 2é 3é 4
(8) I know that computers give me opportunities to learn many new things	1é 2é 3é 4
(9) I can learn many things when I use a computer.	1é 2é 3é 4
(10) I enjoy lessons on the computer.	1é 2é 3é 4
(11) I believe that it is very important for me to learn how to use a computer.	1é 2é 3é 4
(12) I think that computers are very easy to use.	1é 2é 3é 4
(13) I feel comfortable working with a computer.	1é 2é 3é 4
(14) I get a sinking feeling when I think of trying to use a computer.	1é 2é 3é 4
(15) Working with a computer makes me nervous.	1é 2é 3é 4
(16) Using a computer is very frustrating.	1é 2é 3é 4

(17) I will do as little work with computers as possible. 1é 2é 3é 4

(18) Computers are difficult to use. 1é 2é 3é 4

(19) Computers do not scare me at all. 1é 2é 3é 4

(20) I can learn more from books than from a computer. 1é 2é 3é 4

Instructions: Mark one space between each adjective pair.

Computers are:

21. Unlikable _____ _____ _____ _____ _____ _____ _____ Likable (41)
22. Unhappy _____ _____ _____ _____ _____ _____ _____ Happy (42)
23. Bad _____ _____ _____ _____ _____ _____ _____ Good (43)
24. Unpleasant _____ _____ _____ _____ _____ _____ _____ Pleasant (44)
25. Tense _____ _____ _____ _____ _____ _____ _____ Calm (45)
26. Uncomfortable _____ _____ _____ _____ _____ _____ _____ Comfortable (46)
27. Artificial _____ _____ _____ _____ _____ _____ _____ Natural (47)
28. Empty _____ _____ _____ _____ _____ _____ _____ Full (48)
29. Dull _____ _____ _____ _____ _____ _____ _____ Exciting (49)
30. Suffocating _____ _____ _____ _____ _____ _____ _____ Fresh (50)

Instructions: Please circle the appropriate number to indicateyour agreement or disagreement with each statement.
1 = Strongly Disagree (SD)
2 = Disagree (D)
3 = **Undecided (U)**
4 = Agree (A)
5 = Strongly Agree (SA)

31. I can't think of any way that I will use computers in my career. (74) 1é 2é 3é 4é 5

32. Knowing how to work with computers will (78) 1é 2é 3é 4é 5
increase my job possibilities.

33. I will do as little work with computers as possible. (81) 1é 2é 3é 4é 5

34. I do not think I could handle a computer course. (84) 1é 2é 3é 4é 5

35. Computers make me feel uneasy and confused. (87) 1é 2é 3é 4é 5

36. Computers can help me to learn things more easily. (91) 1é 2é 3é 4é 5

37. Knowing how to use computers will help me do well in my career (93) 1é 2é 3é 4é 5

38. Knowing how to use computers is a worthwhile skill. (94) 1é 2é 3é 4é 5

39. Having computer skills helps you get better jobs. (97) 1é 2é 3é 4é 5

40. I like to talk to others about computers. (98) 1é 2é 3é 4é 5

41. Computers can be exciting. (99) 1é 2é 3é 4é 5

42. I like reading about computers. (100) 1é 2é 3é 4é 5

43. Knowing about computers will help me earn a living. (109) 1é 2é 3é 4é 5

44. I don't need computers for my future work. (113) 1é 2é 3é 4é 5

45. I have a lot of self-confidence when it comes to using a computer (117)	1é 2é 3é 4é 5
46. I see the computer as something I will rarely use in my daily life as an adult. (123)	1é 2é 3é 4é 5
47. Computers have the potential to control our lives. (134)	1é 2é 3é 4é 5
48. Our country relies too much on computers. (135)	1é 2é 3é 4é 5
49. Computers dehumanize society by treating everyone as a number. (138)	1é 2é 3é 4é 5
50. Computers are changing the world too rapidly. (142)	1é 2é 3é 4é 5
51. Computers isolate people by inhibiting normal social interactions among users. (144)	1é 2é 3é 4é 5
52. I hesitate to use a computer for fear of making mistakes I cannot correct. (145)	1é 2é 3é 4é 5
53. If I used a computer, I could get a better picture of the facts and figures. (148)	1é 2é 3é 4é 5
54. If I had a computer at my disposal, I would try to get rid of it. (150)	1é 2é 3é 4é 5
55. Computers are probably going to be an important part of my life. (151)	1é 2é 3é 4é 5
56. I will probably never learn to use a computer. (154)	1é 2é 3é 4é 5
57. Someday I will have a computer in my home. (164)	1é 2é 3é 4é 5
58. Use of computers in education almost always reduces the personal treatment of students. (176)	1é 2é 3é 4é 5
59. I feel comfortable when a conversation turns to computers (178)	1é 2é 3é 4é 5
60. Teacher training should include instructional applications of computers. (179)	1é 2é 3é 4é 5
61. The challenge of solving problems with computers does not appeal to me. (185)	1é 2é 3é 4é 5
62. I think working with computers would be enjoyable and stimulating. (186)	1é 2é 3é 4é 5
63. Learning about computers is interesting. (187)	1é 2é 3é 4é 5
64. I enjoy using a computer (188)	1é 2é 3é 4é 5
65. Computers are boring. (189)	1é 2é 3é 4é 5
66. Studying about computers is a waste of time. (192)	1é 2é 3é 4é 5
67. It is fun to figure out how computers work. (193)	1é 2é 3é 4é 5
68. Learning about the different uses of computers is interesting (194)	1é 2é 3é 4é 5
69. Computers would motivate students. (196)	1é 2é 3é 4é 5

70. Computers would help students improve their writing. (198) 1é 2é 3é 4é 5

71. Computers would stimulate creativity in students. (199) 1é 2é 3é 4é 5

72. Computers would help me organize my work. (201) 1é 2é 3é 4é 5

73. Computers would increase my productivity. (202) 1é 2é 3é 4é 5

74. Computers would save me time. (203) 1é 2é 3é 4é 5

75. I look forward to using a computer on my job. (209) 1é 2é 3é 4é 5

76. Learning to operate computers is like learning any new skill - (214) 1é 2é 3é 4é 5
the more you practice, the better you become.

77. I am afraid that if I begin to use computers I will become (215) 1é 2é 3é 4é 5
dependent upon them and lose some of my reasoning skills.

78. I dislike working with machines that are smarter than I am. (218) 1é 2é 3é 4é 5

79. I feel apprehensive about using computers. (219) 1 2 3 4 5

80. If given the opportunity, I would like to learn about and (224) 1é 2é 3é 4é 5
use computers.

81. I have avoided computers because they are unfamiliar and (225) 1é 2é 3é 4é 5
somewhat intimidating to me.

82. I feel helpless when asked to perform a new task on the (233) 1é 2é 3é 4é 5
computer.

83. Working with computers makes me feel isolated from other people. (241) 1é 2é 3é 4é 5

84. I would like to spend more time using a computer. (243) 1é 2é 3é 4é 5

85. I do not feel I have control over what I do when I use a computer (244) 1é 2é 3é 4é 5

86. If I can, I will take subjects that will teach me to use computers. (246) 1é 2é 3é 4é 5

87. Computers sometimes scare me. (247) 1é 2é 3é 4é 5

88. Working with computers means working on your (251) 1é 2é 3é 4é 5
own, without contact with others.

89. Working with a computer makes me feel very nervous. (256) 1é 2é 3é 4é 5

90. Using a computer prevents me from being creative. (257) 1é 2é 3é 4é 5

91. I feel threatened when others talk about computers (258) 1é 2é 3é 4é 5

92. Computers are confusing. (259) 1é 2é 3é 4é 5

93. Computers make me feel uncomfortable. (260) 1é 2é 3é 4é 5

94. You have to be a ñbrainòto work with computers. (261) 1é 2é 3é 4é 5

95. Not many people can use computers. (262) 1é 2é 3é 4é 5

96. I get a sinking feeling when I think of trying to use a computer. (263) 1é 2é 3é 4é 5

97. I will take computer courses. (267)	1é 2é 3é 4é 5
98. I would never take a job where I had to work with computers. (272)	1é 2é 3é 4é 5
99. Electronic mail (E-mail) is an effective means of disseminating (274) class information and assignments.	1é 2é 3é 4é 5
100. I prefer E-mail to traditional class hand-outs as an information (275) disseminator.	1é 2é 3é 4é 5
101. More courses should use E-mail to disseminate class (276) information and assignments.	1é 2é 3é 4é 5
102. E-mail provides better access to the instructor. (277)	1é 2é 3é 4é 5
103. The use of E-mail creates more interaction between students (278) enrolled in the course	1é 2é 3é 4é 5
104. The use of E-mail creates more interaction between student (279) and instructor	1é 2é 3é 4é 5
105. The use of E-mail increases motivation for the course. (280)	1é 2é 3é 4é 5
106. The use of E-mail makes the course more interesting. (281)	1é 2é 3é 4é 5
107. The use of E-mail makes the student feel more involved. (282)	1é 2é 3é 4é 5
108. The use of E-mail helps the student to learn more. (283)	1é 2é 3é 4é 5
109. The use of E-mail helps provide a better learning experience. (284)	1é 2é 3é 4é 5

(End)
Thank you!
TAC Ver. 3.2b
3/98

Appendix 5

Learner Computer Attitude Questionnaire (CAQ)

Computer Attitude Questionnaire

Name: _____ Gr ade Level (9-12): _____

This survey contains 7 brief parts. Read each statement and then circle the number which best shows how you feel.

(5) SD = Strongly Disagree
(6) D = Disagree
(7) U = Undecided
(8) A = Agree
(9) SA = Strongly Agree

Part I

(1) I enjoy doing things on a computer.	1.....2.....3.....4.....5
(2) I am tired of using a computer.	1.....2.....3.....4.....5
(3) I will be able to get a good job if I learn how to use a computer.	1.....2.....3.....4.....5
(4) I concentrate on a computer when I use one.	1.....2.....3.....4.....5
(5) I enjoy computer games very much.	1.....2.....3.....4.....5
(6) I would work harder if I could use computers more often.	1.....2.....3.....4.....5
(7) I know that computers give me opportunities to learn many new things.	1.....2.....3.....4.....5
(8) I can learn many things when I use a computer.	1.....2.....3.....4.....5
(9) I enjoy lessons on the computer.	1.....2.....3.....4.....5
(10) I believe that the more often teachers use computers, the more I will enjoy school.	1.....2.....3.....4.....5
(11) I believe that it is very important for me to learn how to use a computer.	1.....2.....3.....4.....5
(12) I feel comfortable working with a computer.	1.....2.....3.....4.....5
(13) I get a sinking feeling when I think of trying to use a computer.	1.....2.....3.....4.....5
(14) I think that it takes a long time to finish when I use a computer.	1.....2.....3.....4.....5
(15) Working with a computer makes me nervous.	1.....2.....3.....4.....5
(16) Using a computer is very frustrating.	1.....2.....3.....4.....5
(17) I will do as little work with computers as possible.	1.....2.....3.....4.....5

(18) Computers are difficult to use. 1.....2.....3.....4.....5

(19) Computers do not scare me at all. 1.....2.....3.....4.....5

(20) I can learn more from books than from a computer. 1.....2.....3.....4.....5

Part II

(21) I study by myself without anyone forcing me to study. 1.....2.....3.....4.....5

(22) If I do not understand something, I will not stop thinking about it. 1.....2.....3.....4.....5

(23) When I don't understand a problem, I keep working until I find the answer. 1.....2.....3.....4.....5

(24) I review my lessons every day. 1.....2.....3.....4.....5

(25) I try to finish whatever I begin. 1.....2.....3.....4.....5

(26) Sometimes, I change my way of studying. 1.....2.....3.....4.....5

(27) I enjoy working on a difficult problem. 1.....2.....3.....4.....5

(28) I think about many ways to solve a difficult problem. 1.....2.....3.....4.....5

(29) I never forget to do my homework. 1.....2.....3.....4.....5

(30) I like to work out problems which I can use in my life every day. 1.....2.....3.....4.....5

(31) If I do not understand my teacher, I ask him/her questions. 1.....2.....3.....4.....5

(32) I listen to my teacher carefully. 1.....2.....3.....4.....5

(33) If I fail, I try to find out why. 1.....2.....3.....4.....5

(34) I study hard. 1.....2.....3.....4.....5

(35) When I do a job, I do it well. 1.....2.....3.....4.....5

Part III

(36) I feel sad when I see a child crying. 1.....2.....3.....4.....5

(37) I sometimes cry when I see a sad play or movie. 1.....2.....3.....4.....5

(38) I get angry when I see a friend who is treated badly. 1.....2.....3.....4.....5

(39) I feel sad when I see old people alone. 1.....2.....3.....4.....5

(40) I worry when I see a sad friend. 1.....2.....3.....4.....5

(41) I feel very happy when I listen to a song I like. 1.....2.....3.....4.....5

(42) I do not like to see a child play alone, without a friend. 1.....2.....3.....4.....5

(43) I feel sad when I see an animal hurt. 1.....2.....3.....4.....5

(44) I feel happy when I see a friend smiling. 1.....2.....3.....4.....5

(45) I am glad to do work that helps others. 1.....2.....3.....4.....5

Part IV

(46) I examine unusual things. 1.....2.....3.....4.....5

(47) I find new things to play with or to study, without any help. 1.....2.....3.....4.....5

(48) When I think of a new thing, I apply what I have learned before. 1.....2.....3.....4.....5

(49) I tend to consider various ways of thinking. 1.....2.....3.....4.....5

(50) I create many unique things. 1.....2.....3.....4.....5

(51) I do things by myself without depending upon others. 1.....2.....3.....4.....5

(52) I find different kinds of materials when the ones I have do not work or are not enough. 1.....2.....3.....4.....5

(53) I examine unknown issues to try tounderstand them. 1.....2.....3.....4.....5

(54) I make a plan before I start to solve a problem. 1.....2.....3.....4.....5

(55) I invent games and play them with friends. 1.....2.....3.....4.....5

(56) I invent new methods when one way does not work 1.....2.....3.....4.....5

(57) I choose my own way without imitating methods of others. 1.....2.....3.....4.....5

(58) I tend to think about the future. 1.....2.....3.....4.....5

Part V

(59) Which would you rather do? (circle one of each pair):

(1) read a book	or	(2) write
(1) write	or	(2) watch television
(1) watch television	or	(2) use a computer
(1) use a computer	or	(2) read a book
(1) read a book	or	(2) watch television
(1) write	or	(2) use a computer

(60) Which would be more difficult for you (circle one of each pair):

(1) read a book	or	(2) write
(1) write	or	(2) watch television
(1) watch television	or	(2) use a computer
(1) use a computer	or	(2) read a book
(1) read a book	or	(2) watch television
(1) write	or	(2) use a computer

(61) Which would you learn more from (circle one of each pair):

(1) read a book	or	(2) write
(1) write	or	(2) watch television
(1) watch television	or	(2) use a computer
(1) use a computer	or	(2) read a book
(1) read a book	or	(2) watch television
(1) write	or	(2) use a computer

Part VI

62. Electronic mail (E-mail) is an effective means of disseminating class information and assignments.	1.....2.....3.....4.....5
63. I prefer E-mail to traditional class handouts as an information disseminator.	1.....2.....3.....4.....5
64. More courses should use E-mail to disseminate class information and assignments.	1.....2.....3.....4.....5
65. E-mail provides better access to the instructor.	1.....2.....3.....4.....5
66. The use of E-mail creates more interaction between students enrolled in the course.	1.....2.....3.....4.....5
67. The use of E-mail creates more interaction between student and instructor.	1.....2.....3.....4.....5
68. The use of E-mail increases motivation for a course.	1.....2.....3.....4.....5
69. The use of E-mail makes a course more interesting.	1.....2.....3.....4.....5
70. The use of E-mail makes the student feel more involved.	1.....2.....3.....4.....5
71. The use of E-mail helps the student to learn more.	1.....2.....3.....4.....5
72. The use of E-mail helps provide a better learning experience.	1.....2.....3.....4.....5

Part VII

73. I really like school.	1.....2.....3.....4.....5
74. School is boring.	1.....2.....3.....4.....5
75. I can do well at school.	1.....2.....3.....4.....5
76. I am scared people will laugh if I make a mistake at school.	1.....2.....3.....4.....5
77. Kids like kids who do well at school.	1.....2.....3.....4.....5
78. My teachers are not very good at teaching me.	1.....2.....3.....4.....5
79. It is hard to make friends at school.	1.....2.....3.....4.....5
80. I don't learn any useful information in school.	1.....2.....3.....4.....5
81. I would like to work in a school when I grow up.	1.....2.....3.....4.....5
82. When I have a problem to solve at school I make a plan.	1.....2.....3.....4.....5

83. When I grow up I would not like to work in a school. 1.....2.....3.....4.....5

84. Do you use a computer at home? Yes _____ No_____

85. Do you have world wide web (www) access at home? Yes _____ No _____

Thank You!

(END CAQ Ver 5.22 4/97)

Appendix 6

Letter of Permission from Limpopo Department of Education

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION
OFFICE OF THE HEAD OF DEPARTMENT

Enquiries : Nemalili Eastern(Manager: Office of the HOD)
Tel Ext. : (015) 290 7702

Date : 24 May 2011

Mr.E.I.Ghoor
P.O.Box 3243
Polokwane
0700

eghoor@ledet.gov.za
0828067672

Dear Madam

RE: APPLICATION FOR PERMISSION TO CONDUCT RESEARCH: Mr.Ebrahim Ghoor-Student Number 8708485J.

1. Thank you for your letter dated the 21 March 2011 but received on the 24 May 2011. We are indeed humbled by the interest displayed by you on matters which of course affects our Education system.
2. In the light of your request, i therefore grant you permission to conduct research in Capricorn District for your Masters of Management (ICT Policy and Regulation-University of Witwatersrand).
3. It is however important to indicate that prior arrangements to conduct the latter should be arranged in advance so that teaching and learning is not sacrificed.

Research Letter: Mr.E.I.Ghoor Page 1 of 2

Cnr 113 Biccard & 24 Excelsior Street, POLOKWANE, 0700 Private bag X9489, POLOKWANE, 0700
Tel.: (015) 290 7602/7655, Fax: (015) 297 0937, E-mail: mnisivv@edu.limpopo.gov, ramukhadim@edu.limpopo.gov

The heartland of Southern Africa - development is about people!

4. Once more, we wish you all of the best in your studies and assure you of our cooperation in this regard.

Yours Sincerely



24 May 2011

Benny Boshielo
Head of Department-Education
Limpopo Province

Cc: Senior General Manager-District Coordination: Mr.M.Thamaga
Acting District Senior Manager-Capricorn: Mr.M.T.Maphwanya
Acting General Manager -ICT: Mr.M.K.J.Makwela