Information and Communications Technology Integration in Teaching and Learning: A Critical Analysis

Desmond Wesley Govender

INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT) INTEGRATION IN TEACHING AND LEARNING: A CRITICAL ANALYSIS

by

Desmond Wesley Govender

Submitted in fulfillment of the requirements for the degree of

Doctor of Philosophy in Information Systems & Technology

at the

University of KwaZulu-Natal

Supervisor: Prof. M. S. Maharaj

August 2006

Acknowledgements

I wish to thank the University of Pennsylvania (Faculty of Education) and the George Washington University for hosting me during my 7 week academic visit in 2004. During this time, a major part of the literature review was done using their extensive and well resourced libraries.

I also wish to thank the National Research Foundation (NRF) for funding which enabled me to do the necessary field work for this study.

Much appreciation and thanks goes to my supervisor, Prof. Manoj Maharaj, for going the extra mile in his support and guidance.

I wish to thank my wife, Irene Govender, for the continuous encouragement, support and academic goals that she set for me, from the inception of my studies. I also thank my two sons Stanton and Joash for their patience, understanding and sacrifices they made during the course of my study.

Finally, I thank God for the strength and ability that He has given me to persevere and accomplish this task.

Declaration

This thesis is the original work of the author and has not otherwise been submitted in any form for any degree or diploma to any University. Where use has been made of the work of others, such has been duly acknowledged in the thesis.

--- 20/08/2007
Signature (D.W.Govender) Date

DURBAN

Place

Abstract

Technology availability is quite often mistaken for technology adoption and use. In the White Paper on E-Education, launched by the South African National Department of Education, the government has indicated its intention to ensure that every school has access to a wide choice of diverse, high quality communication services which will benefit all learners and local communities. It is important that the National Department of Education recognizes that, regardless of the amount of technology and its sophistication, technology will not be used unless educators have the skills, knowledge and attitudes necessary to infuse it into the curriculum. The study focused on educator preparedness to integrate Information and Communications Technology (ICT) into the curriculum. The findings of the study suggest that educators have positive attitudes towards ICT integration in education. One strong predictor of educators' attitudes towards ICT integration was computer attributes followed closely by cultural perceptions and, to a limited extent, by computer competence. Educator attitudes were also predicted by constructs extracted from the different Information Systems (IS) model/theories for technology adoption. The strongest construct to predict educators' attitudes toward ICT integration was extrinsic motivation followed by perceived usefulness, complexity, perceived behavioural control and relative advantage. The results point to the importance of educators' vision of technology itself, their experiences with it, their perceived computer competence, and the cultural conditions that surround its introduction into schools in shaping their attitudes towards technology and its subsequent diffusion into their educational practice. A combination of the different constructs from the IS models/theories was able to account for as much as 83% of the variance in educator attitudes toward technology and thus technology adoption. This is a significant result since most previous research has only been able to account for between 17% and 69% (Venkatesh *et al.,* 2003) of the variance in user intentions to use technology. These constructs (the strong predictors) were grouped to form a new model which is proposed for predicting educator technology adoption. Further, Perceptual Control Theory was used as a framework for understanding educator adoption of technology. This framework considers educators' use of technology by examining the goals of educators and how the use of technology might help or hinder their goals. Educator lack of computer competence is a major challenge for the KwaZulu-Natal Department of Education, and an immediate plan of action is required that will address this through educator professional development.

Table of Contents

List of Tables

List of Figures

Glossary of Terms

Learners	In South Africa, the word refers to what are commonly known as pupils, in the United Kingdom, and students in the United States.
Educator	In South Africa, the word educator is the official designated word for what is universally known as teacher.
FET learner	In the South African Education system, any learner in the Further Education and Training (FET) band, that is grades 10, 11 & 12 or in an FET College, is called an FET learner.
Technology Proficiency	The ability to use a computer with its related tools and applications.
Cognitive Perspective	The recall or recognition of specific facts, procedures or concepts.
Affective Perspective	How one deals with one's emotions, feelings, values, appreciation, motivation, enthusiasm, and relations.
Behavioural Perspective	A person's physical movement, coordination or use of motor skill.

List of Abbreviations

CCSSO	Council of Chief State School Officers
CEM	Council of Education Ministers
DOE	Department of Education
DOI	Diffusion of Innovation
EDC	Education Development Cooperation
EMIS	Education Management and Information Systems
EX-DET	Former Department of Education and Training – African Education
EX-HOD	Former House of Delegates Department of Education and Training – Indian Education
EX-HOR	Former House of Representatives Department of Education- Coloured Education
EX-NED	Former Natal Education Department- White Education
FET	Further Education and Training
GET	General Education and Training
GIS	Geographic Information System
HE	Higher Education
HET	Higher Education and Training
IBM	International Business Machines
ICT	Information and Communications Technology
ISDN	Integrated Services Digital Network
IT	Information Technology

ITTE	Information Technology in Teacher Education
KZN	Province of KwaZulu-Natal in South Africa
NCS	National Curriculum Statement
NETF	National Education and Training Forum
NQF	National Qualifications Framework
OBE	Outcomes Based Education
OERI	Office of Educational Research and Improvement
OLS	Open Learning System
OTA	Office of Technology Assessment
SD	Standard Deviation
SPSS®	Trademark for the Data Mining Statistical Analysis Software Package SPSS.
SRI	Sanford Research Institute
STDC	The Shortline Teacher Development Centre
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UK	United Kingdom
UKZN	University of KwaZulu-Natal
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USA	United States of America
UTAUT	Unified Theory of Acceptance and Use of Technology

WebCT®	Trademark for the Course Management System called WebCT

Note: For the purpose of convenience and ease of reading the male gender was used without any prejudices in the write up.

1. Information and Communications Technology Integration in Education

1.1. Introduction

Based on economic, social and pedagogical rationales, the introduction of Information and Communication Technology (ICT) into schools is seen as a necessary course of action for the qualitative improvement of methodologies in teaching and learning (Pedretti *et al.* 1999). Internationally, many governments have launched major programs and invested substantial capital to support projects that implement ICT in education (Pelgrum 2001). When properly implemented these initiatives are expected to aid the important educational reform that ICT-based teaching can support by transforming learners into active knowledge constructors. Hamza & Alhalabi (1999) have commented that an educated citizen in the year 2020 will be more valuable as an employee, because he or she will be able to produce more builders of theory, synthesisers, and inventors of strategy than one who manages facts.

Benzie (1995), indicated that many national programs launched by governments to introduce ICT in schools have been of limited success, not only because they were formulated in non-educational realms, but also because they were not based upon research. In Rogers'(1995) terms, the "initiation stage", which demands information gathering and planning, seems to be missing in this headlong process of technology implementation. One of the many reasons this study was initiated was to implement this information gathering and planning in the Province of KwaZulu-Natal (KZN), so as to assist the KwaZulu-Natal Provincial Department of Education with ICT integration in their schools. Young (1991) remarked that in many cases computers were introduced into schools not as a means, but as an end. Computers were provided with no supplementary measures to enable educators to develop positive attitudes toward the new tools and to use them. This has often resulted in ad hoc approaches to implementation. In this approach, technology availability is mistaken for technology adoption and use. However, as Baylor and Ritchie (2002 p.398) state,

> *"regardless of the amount of technology and it's sophistication, technology will not be used unless faculty members have the skills, knowledge and attitudes necessary to infuse it into the curriculum".*

That is, educators should become effective agents to be able to make use of technology in the classroom. Ultimately, educators are the most important agents of change within the classroom arena. It is for this reason that the researcher was interested in educators' attitudes and their preparedness to integrate ICT into the school curriculum.

1.2. Background and Rationale

The National Department of Education (DOE) in South Africa has launched a White Paper on E-Education (DOE, 2003). The government wants to ensure that every school has access to a wide choice of diverse, high quality communication services which will benefit all learners and local communities. The E-Education policy goal, as stated in the White Paper, hopes that every South African learner in the General Education and Training (GET) and Further Education and Training (FET) bands, will be ICT capable; that is, will be able to use ICTs confidently and creatively to help develop the skills and knowledge needed to achieve personal goals and to be full participants in the global community, by the year 2013. To achieve this we need educators who firstly have the correct attitudes towards technology, who are ICT competent and who are aware of methodologies to effectively integrate ICT into the curriculum.

The four principal rationales for introducing technology in education, according to Hawkridge *et al.* (1990) are:

1. Social. This recognises the role which technology now plays in society, the need for education to reflect the concerns of society, and the need to demystify technology for learners.
2. Vocational. This rationale requires the system to prepare learners for jobs which require skills in technology.
3. Pedagogical. The pedagogical rationale proposes that technology will assist the teaching-learning process through better communications and higher quality materials, and will enhance teaching of traditional subjects in the curriculum.
4. Catalytic. Finally, technology can produce a catalytic effect - not only on education, but on society as a whole - by improving performance, teaching, administration, management, increasing effectiveness, making a positive impact on the education system as a whole, altering the power relationships between educators and learners, and providing skills for disadvantaged communities that can be used for liberation and transformational purposes.

Despite the exciting possibilities proposed in the latter two rationales, most arguments for use of ICTs in education focus on the social and vocational aspects. The researcher was more interested in the third and fourth rationales, which have a direct bearing on ICT integration in schools. This translates into the research problem as outlined in the next section.

1.3. Research Problem

Do educators in KwaZulu-Natal have the necessary attitudes and competence to achieve the goals as outlined in the White Paper on E-Education? The aim of this research is to investigate teacher preparedness and competence in the use of ICT in an educational environment. This research was operationalised by asking the following questions:

1. What are the attitudes of high school educators in KZN toward ICT in education as defined by Zimbardo (1997)? (Chapter 5).
2. What are the educators' perceptions of:
    a. computer attributes as defined by Rogers (1995)?
    b. cultural relevance (Thomas, 1987) of computers to the South African society and schools?
    c. their level of computer competence as defined by Vannatta (2002)?
    d. the different constructs extracted from different information system models/theories on technology adoption? (Chapter 6)
3. What is the best predictor of educators' attitudes toward ICT in education? (Chapter 7)
4. To what extent are educators using computers for general administrative use and/or in their teaching, and are there reasons for this use or non-usage? (Chapter 8)
5. What are the ICT related challenges faced by the KwaZulu-Natal Department of Education in trying to redress the legacy of unequal education of the past decades, as characterized by the apartheid policy? (Chapter 9)

1.4. Outline of Study

Recent studies (Bullock 2004, Kersaint *et al.* 2003) have shown that the successful implementation of educational technologies depends largely on the attitudes of educators, who eventually determine how and when technology will be used in the classroom. Studies have also pointed to a wide range of factors affecting attitudes. There are also a number of elements that are seen as obstacles which prevent the use of ICT in the classroom. These can range from lack of resources, to educator lack of knowledge and skills. A number of theories/models exists in information systems research which can be used to determine user acceptance and adoption of a new technology. A detailed literature review encompassing all of the above aspects is covered in chapter 2, and is the basis of this study.

The White Paper on E-Education in South Africa was released in September 2003 by the National Department of Education. One of the goals of this paper is to address the use of ICTs in Education. The paper makes a very bold statement that every South African learner in the General and Further Education and Training (GET & FET) bands will be ICT capable by the year 2013. The initial reading of the White Paper on E-Education is what gave rise to concerns with respect to ICT integration and initiated this research. Chapter 3 is a synopsis of the White Paper on E-Education (DOE, 2003). Since schools will be making use of electronic communications and transactions in conducting their everyday affairs, a synopsis of the Electronic Communications and Transactions (ECT) Act 25 of 2002 has been.

Chapter 4 details the design and methodology of this study.

Chapter 5 details the analysis and discussion of data and results for research question 1 which deals with the attitudes of educators.

Chapter 6 details the analysis and discussion of data and results for research question 2 which deals with perceptions of educators.

Chapter 7 details the analysis and discussion of data and results for research question 3 which deals with the best predictor of educator attitudes and thus technology adoption.

The reasons that educators are not using technology may not only be as a result of lack of resources or lack of technology competence. This study does show that there is a lack of ICT skills amongst educators; however, the researcher does not believe that this is the only reason for non-use of ICT in the classroom. Quite concerning, is that the results show that as much as 85% of educators who are in schools with computer rooms for teaching and learning and who have computer competence, do not use the computers to aid in teaching and learning. This concern is pursued using a Perceptual Control Theory based perspective, as supported by Zhao & Cziko (2001). Chapter 8 presents the analysis and discussion of data and results for research question 4, which addresses this issue.

Three hundred years of de facto segregation, followed by 40 years of systematic suppression of the Black majority population through a stated policy of "separate but equal", has left South Africa with a legacy of which it is finding itself hard to rid. While it may be argued that the demise of the minority government and the introduction of universal franchise in 1994 had given the present government ample time to address and redress the inequalities in the education system, the researcher argues that this is not the case. Chapter 9 presents the analysis and discussion of data and results for research question 5, which addresses the challenges facing the departments of education.

The South African government has recognised that ICTs can expose learners to larger international contexts; a development that poses both opportunities and challenges for the educator in the classroom. Educator professional development in general, and development with respect to ICTs in particular, should be seen as an integral part of daily practice for all educators and schools. Such activities should be enhanced through the use of ICTs for professional development, allowing interactivity between and among educator expert groups. Chapter 10 presents some issues in educator professional development related to ICT integration. A process for educator professional development is proposed.

In Chapter 11, a conclusion for this study, including some recommendations is presented.

2. Literature Review

2.1. Introduction

As a recent educational innovation, the computerization of education is a complex process in which many agents play a role. Forces at the micro-level of the educational system (educators and learners) may be influential in facilitating, or impeding, changes that are outside the control of the ministries of education (Pelgrum 2001). Unfortunately, much of the early research on computer uses in education has ignored educators' attitudes toward the new machines (Harper 1987). Many studies have focused on the computer and its effect on learners' achievement, therefore overlooking the psychological and contextual factors involved in the process of educational computerization (Clark 1983 & Thompson *et al.* 1992). What follows is an investigation into the different concepts that were used in this study in an attempt to answer the research questions as stated in chapter 1. Also, some initiatives that different countries have embarked on in attempting to address ICT integration have been included. While many of these initiatives have been adopted as much as ten years ago, it is the opinion of the author that our country is only now entering a similar stage of development and therefore the need to include it in the write-up.

2.2. Educators' Attitudes

Recent studies (Kersaint *et al.* 2003) have shown that the successful implementation of educational technologies depends largely on the attitudes of educators, who eventually determine how they are used in the classroom. Bullock (2004) found that educators' attitudes are a major enabling/disabling factor in the adoption of technology. Similarly, Kersaint *et al.* (2003) found that educators who have positive attitudes toward technology, feel more comfortable with using it, and usually incorporate it into their teaching. In fact, Woodrow (1992) asserts that any successful transformation in educational practice requires the development of positive user attitude toward the new technology. The development of educators' positive attitudes toward ICT is a key factor, not only for enhancing computer integration, but also for avoiding educators' resistance to computer use (Watson 1998). Watson (*ibid* p. 191) warns against the severance of the innovation from the classroom educator and the idea that "the educator is an empty vessel into which this externally defined innovation must be poured".

According to Rogers (1995 p.161) "peoples' attitudes toward a new technology are a key element in its diffusion". Roger's *Innovation Decision Process* theory states that an innovation's diffusion is a process that occurs over time through five stages: Knowledge, Persuasion, Decision, Implementation and Confirmation. Accordingly, "the innovation-decision process is the process through which an individual (or other decision-making unit) passes, namely:

1. from first knowledge of an innovation,
2. to forming an attitude toward the innovation,
3. to a decision to adopt or reject,
4. to implementation of the new idea, and finally
5. to confirmation of this decision".

Owing to the novelty of computers and their related technologies at that time, studies concerning technology diffusion in education have often focused on the first three phases of the innovation decision process. This focus is also because the status of computers in education is, to a great extent, still precarious in most developing countries. In cases where technology was very recently introduced into the educational system - as is the case in most developing countries in Africa - studies have mainly focused on the first two stages; that is, on knowledge of an innovation and attitudes about it.

Rogers' premise concerning individuals' shift from knowledge about technology, to forming attitudes toward it, and then to its adoption or rejection, corroborates the general and widely accepted belief that attitudes affect behaviour directly or indirectly (Ajzen & Fishbein 1980 and Zimbardo *et al.* 1997). Abas's 1995 study (*cited* in Mumtaz 2000) involving Malaysian schools, found educators' attitudes to be a major predictor of the use of new technologies in instructional settings. Christensen's 1998 study in Texas shows that educators' attitudes toward computers affect not only their own computer experiences, but also the experiences of the learners they teach. In fact, it has been suggested that attitudes towards computers affect educators' use of computers in the classroom, and the likelihood of their benefiting from training. Positive attitudes often encourage less technologically capable educators to learn the skills necessary for the implementation of technology-based activities in the classroom (Kluever *et al.* 1994). This has much bearing on this study since one finds that educators in KZN have strongly positive attitudes towards technology; however, 68.1% lack core proficiency, and 65.5% have little to no proficiency in the use of technology in the classroom.

Knezek and Christensen's (2002) analysis of several major cross-cultural studies - completed during the 1990s, and related to ICT in education - suggests that educators advance in technology integration through a set of well-defined stages, which sometimes require changes in attitude more than changes in skills. According to Zimbardo *et al.* (1997), changing individuals' behaviour is possible once their attitudes have been identified. Zimbardo and his associates suggest that attitudes are made up of three components: affect, cognition, and behaviour. The affective component represents an individual's emotional response, or liking to a person, or object. The cognitive component consists of a person's factual knowledge about a person or object. Finally, the behavioural component involves a person's overt behaviour directed toward a person or object. Zimbardo *et al.* (*ibid* p. 52) contends that "even though we cannot predict the behaviour of single individuals, we should be able to predict that people (in general) will change their behaviour if we can change their attitudes...". The latter assertion explains, to a large extent, the wide interest in the study of attitudes toward technology. This study addresses

the affective, cognitive and behavioural components of educators' attitudes towards technology (Questionnaire, No.10, Appendix A).
Unfortunately, the task of pinning down educators' attitudes has not always been an easy one. Watson (1998) considers educators' attitudes as the most misread impeding force in the integration of computers in educational practices. As Zimbardo *et al.* (*ibid* p.53) note, the complexity of attitudes and their interrelationship with behaviour, and many other variables, summons considerations for "the maze of variables and processes that could affect attitudes, beliefs, and action."

Studies (Thomas 1987, Rogers 1995, Knezek & Christensen 2002, Li 2002) have pointed to a wide range of factors affecting attitudes toward ICT. The variations in the factors identified by different researchers might be attributed to differences in context, participants, and type of research. One of the major factors affecting people's attitudes toward a new technology is the attributes of the technology itself (Rogers 1995). Rogers identifies five main attributes of technology that affect its acceptance and subsequent adoption: relative advantage, compatibility, complexity, observability and trialibility. A new technology will therefore, be increasingly diffused if potential adopters perceive that the innovation:

1. has an advantage over previous innovations,
2. is compatible with existing practices,
3. is not complex to understand and use,
4. shows observable results, and
5. can be experimented with on a limited basis before adoption.

This study addresses the first 4 of the above attributes in determining educators' attitudes toward technology (Questionnaire, No.11, Appendix A).

Rogers & Shoemaker (1971) found that relative advantage, compatibility and observability are positively related to adoption, whereas complexity is negatively correlated. Sooknanan's 2002 study in Trinidad and Togo found that relative advantage, compatibility, and observability are significantly related to the educators' attitudes toward computers. However, the results show no relationship between complexity and educators' attitudes. This study shows that relative advantage, compatibility and non-complexity, significantly, are positively correlated to educators' attitudes towards computers. The results show a very weak correlation between observability and educators' attitudes.

Rogers (1995) and Thomas (1987) emphasize the importance of the cultural/social norms of a given country to the acceptance of technology among its people. Potential adopters may resist a technological tool because it may not fit within their micro- or macro-cultures. Thomas (*ibid* p.15) proposes, "How acceptable a new technology will be in a society depends on how well the proposed innovation fits the existing culture". Thomas refers to his hypothesis as the *cultural suitability* factor. Both Rogers (*ibid*) and Thomas (*ibid*) note that few studies have considered the influence of people's cultural perceptions on their adoption of technological innovations. Among the very few researchers examining cultural norms, (Li 2002, Volman *et al.* 2005), Li explores the effects of national culture on learners' use of the Internet, and the differences between Chinese and British learners in terms of use of the Internet. The researcher found that there are differences in Internet experience, attitudes, usage, and competence between Chinese and British learners. Most of these differences are related to learners' national culture.

This study also attempts to ascertain whether educators feel that the present technology fits into the South African culture, or if it hinders one's culture in some way, and whether or not this affects educators' attitudes towards the technology. (Questionnaire, No.12, Appendix A).

In addition to computer attributes and cultural norms, previous research suggests that educators' attitudes toward computer technologies are also related to educators' computer competence. In their study of the correlation between educators' attitude and acceptance of technology, Francis-Pelton & Pelton (1996 p. 1) maintain, "Although many educators believe computers are an important component of a learner's education, their lack of knowledge and experience lead to a lack of confidence to attempt to introduce them into their instruction". A large number of studies show that educators' computer competence is a significant predictor of their attitudes toward computers (Berner 2003, Na 1993 and Summers 1990). Al-Oteawi (2002 p.253) found that most educators who show negative or neutral attitudes toward the use of ICT in education lack knowledge and skill regarding computers that would enable them to make "an informed decision".

In this study, educator competence has also been considered, (Questionnaire, No.14, Appendix A). However, for the purpose of this study, competency is broken down into core competency (minimum skills that the researcher feels that every educator should have) and overall competency (skills with tools and applications that an educator needs to aid in ICT integration in the classroom).

2.3. Theories Used in Information Systems (IS) Research

Explaining user acceptance and adoption of a new technology is often described as one of the most mature research areas in the contemporary information systems (IS) literature (e.g., Hu *et al.* 1999). Research in this area has resulted in several theoretical models, with roots in information systems, psychology, and sociology, which routinely explain over 40 percent of the variance in an individual's intention to use technology (e.g., Davis *et al.* 1989; Taylor and Todd 1995b; Venkatesh and Davis 2000). Researchers are confronted with a multitude of models from which they must either "pick and choose" constructs across the models, or choose a "favored model" and largely ignore the contributions from alternative models.

The following is an explanation of 5 models/theories that were chosen because of their bearing on this study. The constructs from the different models were used in our regression analysis in chapter 7.

2.3.1 Theory of Reasoned Action

Ajzen and Fishbein's (1975) "Theory of Reasoned Action" was developed in 1967 and is divided into three main areas. The first area is intention. The main premise of this theory is that a person's intention is the main predictor and influencer of behaviour. If a person has an intention to accomplish a goal then they will more than likely succeed and conversely if there is no such intention then those particular goals will more than likely remain unachieved.

The Theory of Reasoned Action (TRA) suggests that there are two main influencers of intention: Attitude toward the behaviour and Subjective Norms. The TRA posits that an individual's behaviour is driven by behavioural intentions where behavioural intentions are a function of an individual's attitude toward the behaviour and subjective norms surrounding the performance of the behaviour.

The second area, attitude toward the behaviour, is defined as the individual's positive or negative feelings about performing a particular behaviour. It is determined through an assessment of one's beliefs regarding the consequences arising from a particular behaviour and an evaluation of the desirability of these consequences. Formally, overall attitude can be assessed as the sum of the individual consequence times desirability assessments for all expected consequences of the behaviour. Mathematicall this can be written as:

$$A_o = \sum_i (C_i \times D_i),$$

where A_o is the overall attitude, C_i is the i^{th} individual consequence and D_i is the i^{th} desirability assessment.

The third area, subjective norm, is defined as an individual's perception of whether people important to the individual think that the behaviour should be performed. The contribution of the opinion of any given referent is weighted by the motivation that an individual has to comply with the wishes of that referent. Hence, overall subjective norm can be expressed as the sum of the individual perception times motivation assessments for all relevant referents. Once again one may express this mathematically as

$$S_o = \sum_i (P_i \times M_i),$$

where S_o is the overall subjective norm, P_i is the importance attached to the ith referent by the individual and M_i is the weighted value attached to the opinion of the ith referant.

Algebraically TRA may then be represented as $B \approx B_I = w_1 A_o + w_2 S_o$ where B is behaviour, B_I is the behavioural intention, A_o is the attitude toward behaviour, S_o is the subjective norm, and w_1 and w_2 are weights representing the importance of each term.

The following is a diagrammatic representation of the "Theory of Reasoned Action".

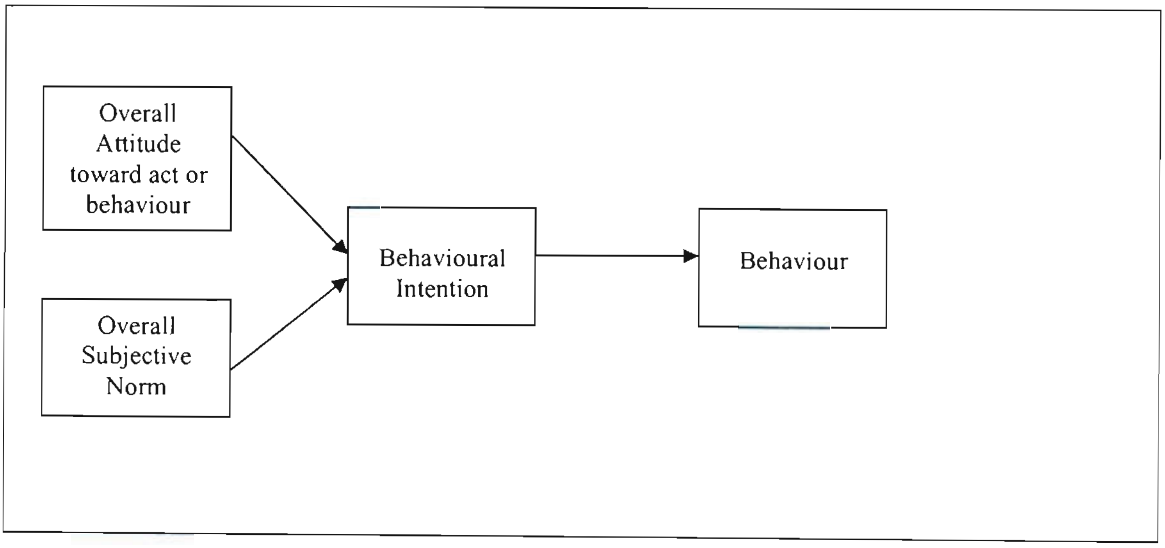

Figure 1: Theory of Reasoned Action

The model has some limitations including a significant risk of confusion between attitudes and norms since attitudes can often be reframed as norms and vice versa. A second limitation is the assumption that when someone forms an intention to act, they will be free to act without limitation. In practice, constraints such as limited ability, time, environmental or organisational limits, and unconscious habits will limit the freedom to act. The Theory of planned behaviour (TPB) attempts to resolve this limitation.

2.3.2 Theory of Planned Behaviour (TPB)

The TPB posits that an individual's behaviour is driven by behavioural intentions where behavioural intentions are a function of an individual's overall attitude toward the behaviour, the overall subjective norms surrounding the performance of the behaviour, and the individual's perception of the ease with which the behaviour can be performed. (behavioural control).

Overall Attitude and Overall Subjective Norms are defined as in the TRA above.

Behavioural control is defined as one's perception of the difficulty of performing a particular behaviour. The TPB views the control that people have over their behaviour as lying on a continuum from behaviours that are easily performed to those requiring considerable effort, resources, etc.

Although Ajzen (1991) has suggested that the link between behaviour and behavioural control outlined in the model should be between behaviour and actual behavioural control rather than perceived behavioural control, the difficulty of assessing actual control has led to the use of perceived control as a proxy.

The following is a diagrammatic representation of the "Theory of Planned Behaviour".

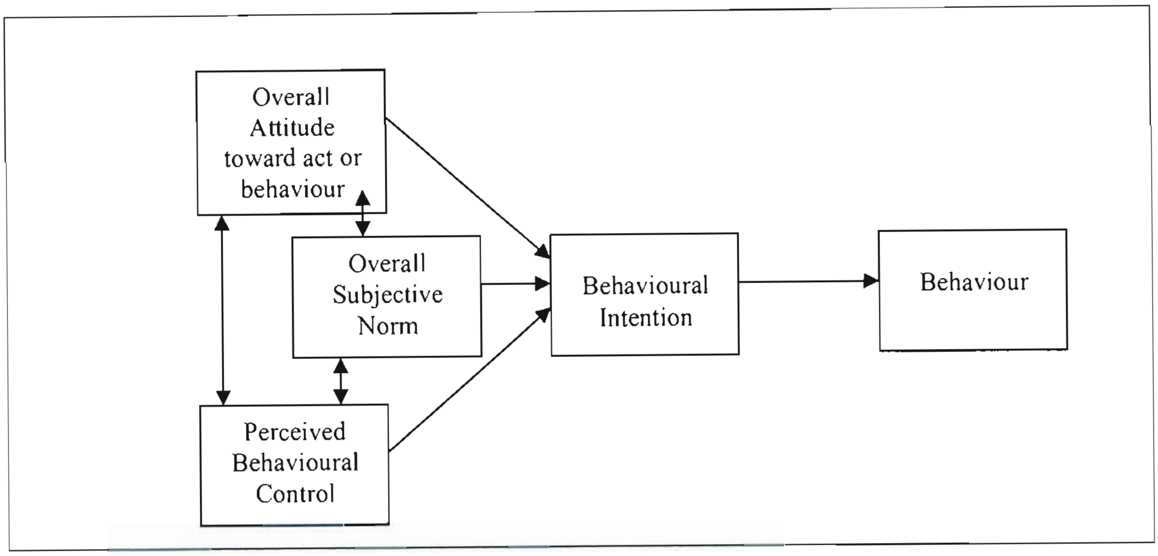

Figure 2: Theory of Planned Behaviour

Note further that a difference between TRA and TPB includes an interaction between Overall Subjective Norm and Overall Attitude toward act or behaviour as well as Perceived Behavioural Control.

2.3.3 Technology Acceptance Model

The "Technology Acceptance Model" (TAM) is an information systems theory that models how users come to accept and use a technology. The model suggests that when users are presented with a new software package or innovation, a number of factors influence their decision about how and when they will use it, notably:

- "Perceived usefulness" (PU) - This was defined by Fred Davis (1989) as "the degree to which a person believes that using a particular system would enhance his or her job performance".
- "Perceived ease-of-use" (EOU) - Davis (1989) defined this as "the degree to which a person believes that using a particular system would be free from effort".

The technology acceptance model is one of the most influential extensions of Ajzen and Fishbein's theory of reasoned action (TRA) in the literature. It was developed by Fred Davis and Richard Bagozzi (Bagozzi *et al.*, 1992; Davis *et al.*, 1989). The TAM replaces many of TRA's attitude measures with the two technology acceptance measures "ease of use", and "usefulness". The TRA and TAM, both of which have strong behavioural elements, assume that when someone forms an intention to act, that they will be free to act without limitation.

In the real world, however, there will be many constraints, such as limited ability, time constraints, environmental or organisational limits, or unconscious habits which will limit the freedom to act (Bagozzi *et al.*, 1992).

The following is a diagrammatic representation of the "Technology Acceptance Model".

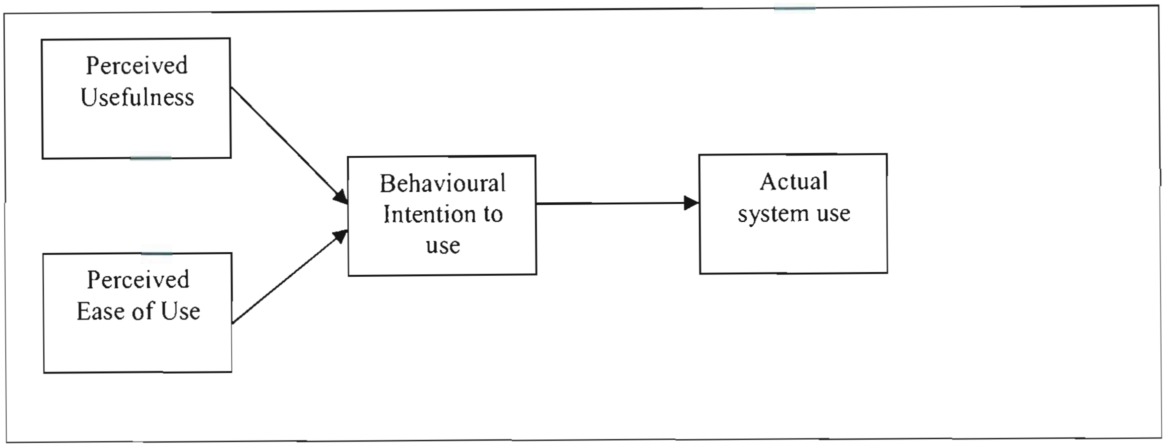

Figure 3: Technology Acceptance Model

Bagozzi Davis and Warshaw noted:

> *"Because new technologies such as personal computers are complex and an element of uncertainty exists in the minds of decision makers with respect to the successful adoption of them, people form attitudes and intentions toward trying to learn to use the new technology prior to initiating efforts directed at using. Attitudes towards usage and intentions to use may be ill-formed or lacking in conviction or else may occur only after preliminary strivings to learn to use the technology evolve. Thus, actual usage may not be a direct or immediate consequence of such attitudes and intentions."(Bagozzi et al., 1992)*

Earlier research on the diffusion of innovations also suggested a prominent role for perceived ease of use. Tornatzky and Klein (1982) analysed the relationship between the characteristics of an innovation and its adoption, finding that compatibility, relative advantage, and complexity had the most significant relationships with adoption across a broad range of innovation types. Eason (as *cited* in Stewart, 1986) studied perceived usefulness in terms of a fit between systems, tasks and job profiles, using the terms "task fit" to describe the metric.

Several researchers have replicated Davis's original study (Davis, 1989) to provide empirical evidence on the relationships that exist between usefulness, ease of use and system use (Davis *et al.* 1989; Hendrickson, Massey & Cronan, 1993; Segars & Grover, 1993; Subramanian 1994; Szajna 1994). Much attention has focused on testing the robustness and validity of the questionnaire instrument used by Davis (*ibid).* Adams *et al.* (1992) replicated the work of Davis (*ibid*) to demonstrate the validity and reliability of his instrument and his measurement scales. They also extended it to different settings and, using two different samples, they demonstrated the internal consistency and replication reliability of the two scales. Hendrickson *et al.* (1993) found high reliability and good test-retest reliability. Szajna (1994) found that the instrument had predictive validity for intent to use, self-reported usage and attitude toward use. This research has confirmed the validity of the Davis instrument, and supports its use with different populations of users and different software choices.

Segars and Grover (1993) re-examined Adam's *et al.* (1992) replication of the Davis's work. They were critical of the measurement model used, and postulated a different model based on three constructs: usefulness, effectiveness, and ease-of-use.

Venkatesh and Davis extended the original TAM model to explain perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes.

The extended model, referred to as TAM2, was tested and validated in both voluntary and mandatory settings (Venkatesh and Davis, 2000).

2.3.4 Unified Theory of Acceptance and Use of Technology

In an attempt to integrate the main competing user acceptance models, Venkatesh *et al.* (2000) formulated the Unified Theory of Acceptance and Use of Technology (UTAUT). This model was found to outperform each of the individual models (Venkatesh *et al.*, 2003).

The UTAUT aims to explain user intentions to use an IS and subsequent usage behaviour. The theory holds that four key constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) are direct determinants of usage intention and behaviour (Venkatesh *ibid*) Gender, age, experience, and voluntariness of use (VoU) are posited to mediate the impact of the four key constructs on usage intention and behaviour (Venkatesh *ibid*). The theory was developed through a review and consolidation of the constructs of eight models that earlier research had employed to explain IS usage behaviour (theory of reasoned action, technology acceptance model, motivational model, theory of planned behaviour, a combined theory of planned behaviour/technology acceptance model, model of PC utilization, innovation diffusion theory, and social cognitive theory (Venkatesh *ibid*)). Subsequent validation of UTAUT in a longitudinal study found it to account for 70% of the variance in usage intention (Venkatesh *ibid*).

The following is a diagrammatic representation of the "Unified Theory of Acceptance and Use of Technology " (UTAUT).

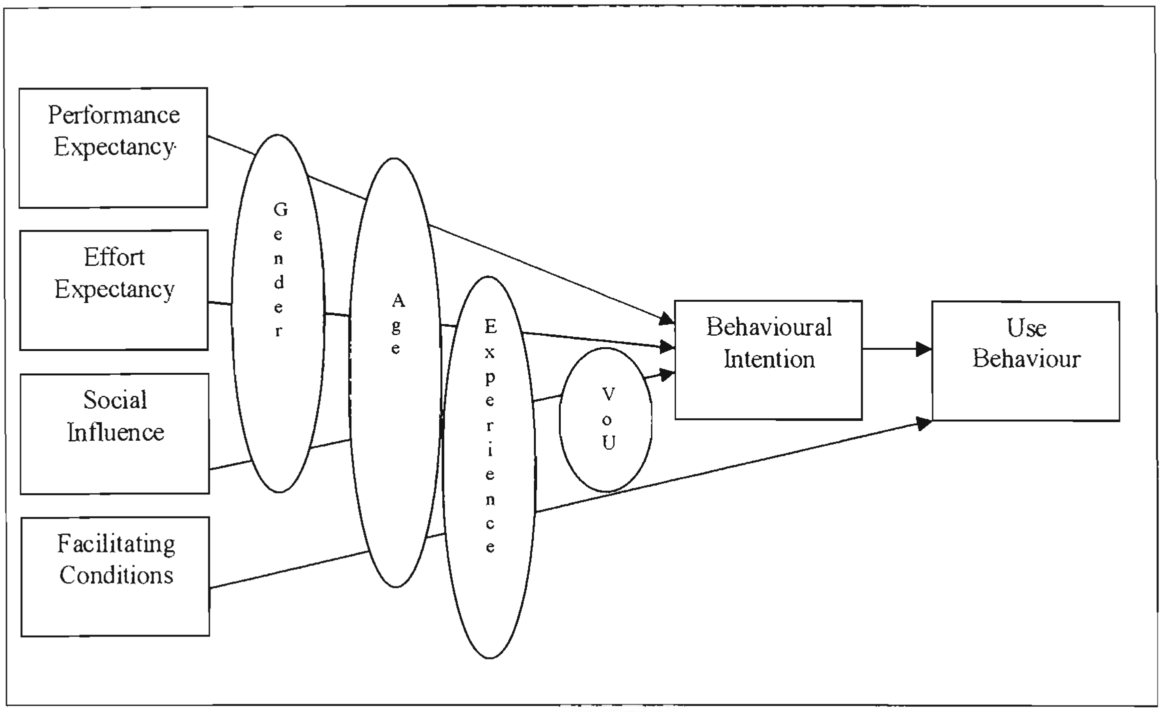

Figure 4: Unified Theory of Acceptance and Use of Technology – (adapted from Venkatesh 2003).

2.3.5 Diffusion of Innovations (DOI)

The DOI theory sees innovations as being communicated through certain channels over time and within a particular social system (Rogers, 1995). Individuals are seen as possessing different degrees of willingness to adopt innovations and thus it is generally observed that the portion of the population adopting an innovation is approximately normally distributed over time (Rogers, 1995). Breaking this normal distribution into segments leads to the segregation of individuals into the following five categories of individual innovativeness (from earliest to latest adopters): innovators, early adopters, early majority, late majority, laggards (Rogers, 1995).

Members of each category typically possess certain distinguishing characteristics as shown below:

- innovators - venturesome, educated, multiple info sources
- early adopters - social leaders, popular, educated
- early majority - deliberate, many informal social contacts
- late majority - skeptical, traditional, lower socio-economic status
- laggards - neighbours and friends are main info sources, fear of debt

When an adoption curve is converted to a cumulative percent curve a characteristic S curve is generated that represents the rate of adoption of the innovation within the population (Rogers, 1995). The rate of adoption of innovations is impacted by five factors as stated earlier: relative advantage, compatibility, trialability, observability, and complexity (Rogers, 1995). The first four factors are generally positively correlated with rate of adoption while the last factor, complexity, is generally negatively correlated with rate of adoption (Rogers, 1995). The actual rate of adoption is governed by both the rate at which an innovation takes off and the rate of later growth. Low cost innovations may have a rapid take-off while innovations whose value increases with widespread adoption (network effects) may have faster late stage growth. Innovation adoption rates can, however, be impacted by other phenomena. For instance, the adaptation of technology to individual needs can change the nature of the innovation over time. In addition, a new innovation can impact the adoption rate of an existing innovation and path dependence may lock potentially inferior technologies in place.

Diffusion of Innovation Theory in IS

Moore and Benbasat (1991), working in an IS context, expanded upon the five factors impacting the adoption of innovations presented by Rogers, generating eight factors (voluntariness, relative advantage, compatibility, image, ease of use, result demonstrability, visibility, and trialability) that impact upon the adoption of IT. Scales used to operationalize these factors were also validated in the study.

Since the early applications of DOI to IS research the theory has been applied and adapted in numerous ways. Research has, however, consistently found that technical compatibility, technical complexity, and relative advantage (perceived need) are important antecedents to the adoption of innovations (Bradford & Florin, 2003; Crum *et al.*, 1996) leading to the generalized model presented below.

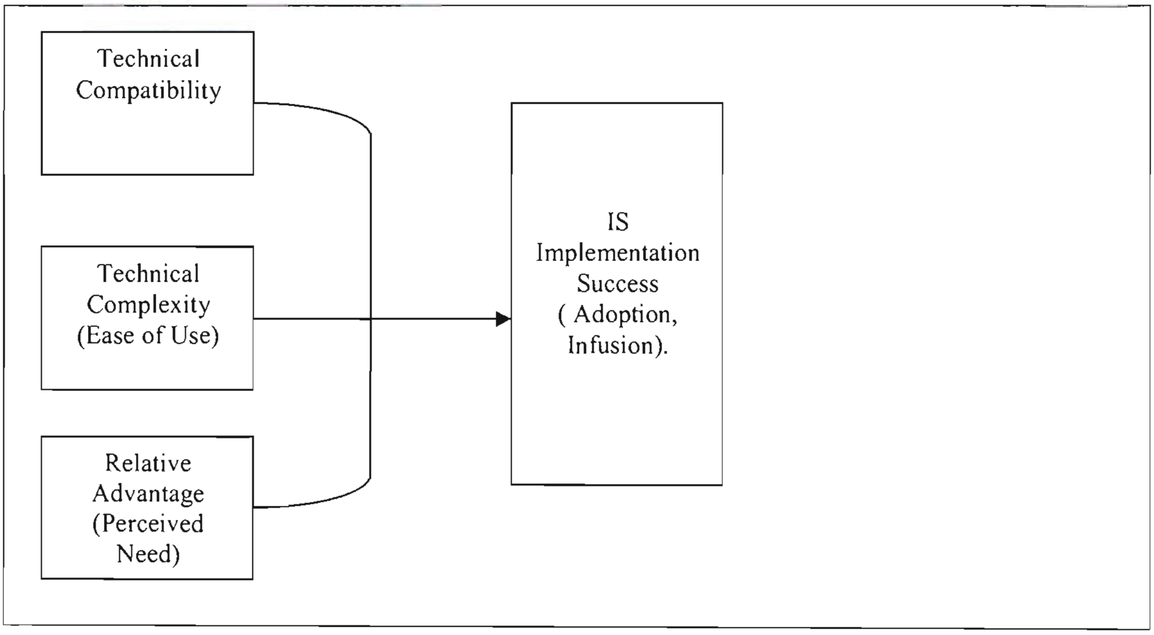

Figure 5: Diffusion of Innovation Theory

The following table shows a comparison of the above five models/theories with brief descriptions of the model/theory and the core constructs with definitions.

Theory of Reasoned Action (TRA)	Core Constructs	Definitions
Drawn from social psychology, the TRA is one of the most fundamental and influential theories of human behaviour. It has been used to predict a wide range of behaviours (Sheppard *et al.*1988). Davis *et al.* (1989) applied the TRA to individual acceptance of technology and found that the variance explained was largely consistent with studies that had employed TRA in the context of other behaviours.	Attitude Toward Behaviour	"an individual's positive or negative feelings (evaluative effect) about performing the target behaviour" (Fishbein & Ajzen 1975, p. 216).
	Subjective Norm	"the person's perception that most people who are important to him think he should or should not perform the behaviour in question"(Fishbein & Ajzen 1975, p. 302).
Theory of Planned Behaviour (TPB)	**Core Constructs**	**Definitions**
TPB extended TRA by adding the construct of perceived behaviour control. In TPB, perceived behavioural control is theorized to be an additional determinant of intention and behaviour. Ajzen (1991) presented a review of several studies that successfully used TPB to predict intention and behaviour in a wide variety of settings. The TPB has been successfully applied to the understanding of individual acceptance and usage of many different technologies (Harrison *et al.*; Mathieson 1991; Taylor & Todd 1995).	Attitude Toward Behaviour	Adapted from TRA
	Subjective Norm	Adapted from TRA
	Perceived Behavioural Control	"the perceived ease or difficulty of performing the behaviour" (Ajzen 1991, p. 188). In the context of IS research, "perceptions of internal and external constraints on behaviour" (Taylor & Todd 1995b, p. 149)

Technology Acceptance Model (TAM) & TAM2	Core Constructs	Definitions
The TAM is tailored to IS contexts, and was designed to predict information technology acceptance and usage on the job. Unlike the TRA, the final conceptualization of the TAM excludes the attitude construct in order to better explain intention parsimoniously. The TAM2 extended the TAM by including subjective norm as an additional predictor of intention in the case of mandatory settings (Venkatesh & Davis 2000). The TAM has been widely applied to a diverse set of technologies and users.	Perceived Usefulness	"the degree to which a person believes that using a particular system will enhance his or her job performance" (Davis 1989, p. 320).
	Perceived Ease of Use	"the degree to which a person believes that using a particular system will be free of effort" (Davis 1989, p.320).
	Subjective Norm	Adapted from TRA/TPB. Included in TAM2 only.
Unified Theory of Acceptance and Use of Technology (UTAUT)	**Core Constructs**	**Definitions**
UTAUT aims to explain user intentions to use an IS and subsequent usage behaviour. The theory holds that four key constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) are direct determinants of usage intention and behaviour (Venkatesh *et. al.*, 2003). Gender, age, experience, and voluntariness of use are posited to mediate the impact of the four key constructs on usage intention and behaviour (Venkatesh *et. al.*, 2003).	Performance Expectancy	"the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (Venkatesh *et al.* 2003, p.447).
	Effort Expectancy	"degree of ease associated with the use of the system" (Venkatesh *et al.* 2003, p. 450).
	Social Influence	"the degree to which an individual perceives that important others believe he or she should use the new system" (Venkatesh *et al.* 2003, p. 451).
	Facilitating Conditions	"the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (Venkatesh *et al.* 2003, p. 453).

Diffusion of Innovation (DOI)	Core Constructs	Definitions
Grounded in sociology, DOI (Rogers 1995) has been used since the 1960s to study a variety of innovations, ranging from agricultural tools to organizational innovation (Tornatzky & Klein 1982). Within information systems, Moore and Benbasat (1991) adapted the characteristics of innovations presented by Rogers (1971) and refined a set of constructs that could be used to study individual technology acceptance. Moore and Benbasat (1996) found support for the predictive validity of these innovation characteristics (see also Agarwal & Prasad 1997, 1998; Karahanna *et al.* 1999; Plouffe *et al.* 2001).	Relative Advantage	"the degree to which an innovation is perceived as being better than its precursor" (Moore & Benbasat 1991, p. 195)
	Ease of Use	"the degree to which an innovation is perceived as being difficult to use" (Moore & Benbasat 1991, p. 195).
	Image	"The degree to which use of an innovation is perceived to enhance one's image or status in one's social system" (Moore & Benbasat 1991, p. 195).
	Visibility	The degree to which one can see others using the innovation in the organization (adapted from Moore & Benbasat 1991).
	Compatibility	"the degree to which an innovation is perceived as being consistent with the existing values, needs and past experiences of the potential adopters" (Moore & Benbasat 1991, p. 195).
	Results Demonstrability	"the tangibility of the results of using the innovation, including their observability and communicability" (Moore & Benbasat 1991, p. 203).
	Voluntariness of Use	"the degree to which use of the innovation is perceived as being voluntary, or of free will" (Moore & Benbasat 1991, p. 195).

Table 1: Constructs with Definitions of Different Technology Adoption Models/Theories.

2.4. ICT in Schools

Research data indicate that the introductory step for computers in schools is using them in administrative tasks, and not as part of the learning process (McCannon & Crews 2000). This study tries to ascertain the extent to which educators are using the computer for simple administrative tasks (Questionnaire, No.15, Appendix A). There is also indication that educators proceed to adopt ICT in stages. Wells & Anderson (1995, as *cited* in Demteriadis 2003) have reported that educators initially focus on their own interaction with the new medium, and as they gradually become comfortable with the technology, they start deliberating upon potential learning benefits that could result from the use of the computer. Myhre (1998) concludes that this increased familiarity with computers allows educators to turn their interest to the pedagogical use of technology (rather than its operational issues), but also emphasizes that such change processes do not occur rapidly and are not easily achieved.

Zhao & Cziko (2001) pose two important questions:

1. "Under what conditions are educators motivated to use technology in the classroom?" and

2. "What kind of instructional methodology do educators employ after deciding to use technology?"

They formulate an answer to the first question, employing a Perceptual Control Theory (PCT) based perspective. According to PCT (McClelland 1998 & Powers 1973) the activation of purposeful agents (such as human beings) towards success of their objectives occurs when a discrepancy is detected between what is perceived, and what is internally established, as a standard of reference. Discrepancies could emerge either as a result of changing perceptions about conditions of external environment, or as an alteration of internal reference conditions. As a result, the individual begins to vary his behaviour, trying to minimize the discrepancy and its consequences. These internal reference conditions should be conceptualized as parts of a hierarchy where higher-level conditions (goals) are the most important to maintain. Oftentimes people accept that they need to alter lower level goals, in order to achieve success at higher levels. An interesting element of the PCT approach is that human perception about environmental conditions (and not human behaviour) is considered as the independent variable that defines further human actions, which have as objective the task to minimize detected discrepancies. In line with this perspective, the following three conditions are identified as necessary for educators to use technology (Zhao & Cziko *ibid*):

1. Educators must believe that technology can more effectively achieve, or maintain, a higher level goal than what has been used previously ("effectiveness"). This relates directly to what educators believe to be advantages of computers in the classroom (Questionnaire, No.11, 1-4, Appendix A).

2. Educators must believe that using technology will not cause a disturbance to other, higher level goals that they evaluate as more important than the one being maintained ("disturbances"). This relates directly to what educators believe to be compatibility issues with the use of computers in the classroom (Questionnaire, No.11, 5-8, Appendix A).

3. Educators must believe that they have the ability and resources to use technology ("control"). This relates to the non-complexity/simplicity of the use of computers in the classroom (Questionnaire, No.11, 9-13, Appendix A).

It is, therefore, supposed that if these conditions are met, educators will introduce ICT in the classroom. However, there is some evidence that ICT is assimilated into the established way of teaching without educators making effective use of the new medium to create innovative learning experiences. "Technology use reflects traditional classroom methodology, though affording some increased attention to the individual learner. It still depends too much on highly motivated pioneering principals and educators" (Demteriadis 2003 p.19). Also "information technology in the classroom is used in an ineffective way and it has been proved difficult to integrate within traditional curriculum settings" (Jules Van Belle & Soetaert 2001 p.31).

2.5. ICT and its Impact

A number of researchers (Bork 1985, Chlopak 2003, Papert 1980 & Ragosta 1983) view computers as having an influential effect on teaching and learning processes. They state that, with the use of computers in the classroom, schools would become more learner-centered and that more individualised learning would take place than ever before. In the learner-centered classrooms of today, with the aid of computers, learners are able to collaborate, to use critical thinking, and to find alternative solutions to problems (Jaber 1997). However, the shift from educator-centered delivery, to a learner-centered model potentially leads to a resistance to change. Learner-centered teaching is challenging educators to review their teaching and learner learning methods (Jaber *ibid*). Research done by Dwyer *et al.* (1991) indicates that computers can be used in collaboration for all subject areas, but that educators have to take into account the different styles of teaching and the learners involved in this learning. This type of teaching requires a change in both the educator's method of teaching, and the methods of learning, the amount of time needed to learn how to use the technology, and the location of models that work with technology (Sheingold & Hadley 1990).

Negroponte *et al.* (1997) argue:

> *... that digital technologies can enable learners to become more active and independent learners. The Internet will allow new "knowledge-building communities" in which children and adults from around the globe can collaborate and learn from each other. Computers will allow learners to take charge of their own learning through direct exploration, expression, and experience. This shifts the learner's role from "being taught" to "learning" and the educator's role from "expert" to "collaborator" or "guide"* (p.1).

2.6. Apple Classrooms of Tomorrow

In 1985, five Apple Classrooms of Tomorrow (ACOT) were created at sites across the United States as part of a research collaboration between universities, public schools and Apple Computer, Inc. The research completed by Sandholtz *et al.* (1997) on the ACOT study encompasses 10 years of gathering information that includes educators' personal accounts of their experiences in teaching in these classrooms. Results suggest that the impact of technology on education has the potential to change education in a beneficial way, if done under certain circumstances. In the ACOT classrooms, learners use technology as a tool to collect, organize, and analyse data, to enhance presentations, to conduct simulations, and to solve complex problems. One of the changes seen over this time period is the positive change in the lower achieving learners; that is the ones educators could not reach with educator-centered learning. These learners began to respond to the alternate ways of expressing their knowledge, which not only raised their self-esteem, but also enhanced their status with their educators and their peers.

The ACOT study shows changes in educator and learner interactions. Educators are observed more as being guides or mentors, and less as fulfilling the role of lecturers. The cooperative and task-related interactions among the ACOT learners are spontaneous and more extensive than in traditional classrooms. Learner interest in computers did not decline with routine use. Educator peer sharing began to increase as learners and educators sought support from one another. Other changes seen during this study were that educators began teaming and working across disciplines. School schedules were made to accommodate unusually ambitious class projects by the administrators and the educators. Educators and learners started to show mastery of technology and began to integrate several kinds of media into lessons or projects. Classrooms were a mix of traditional and non-traditional learning. Educators were changing the physical layout of the classroom, along with daily schedules, to give learners more time on projects.

The ACOT study brought to focus that meaningful use of technology in schools went beyond simply putting computers in classrooms. Technology is not a change agent for education. Technology, when used as an integrated tool together with the curriculum can make a difference in education.

2.7. Obstacles that Prevent the Use of ICT in Schools.

There are many elements identified as obstacles in the way of introducing ICT in schools (Lim & Chai 2004, Pelgrum 2001). Pelgrum presents a list of 10 such issues that educational practitioners perceive as serious impediments for realizing their ICT related goals. From this group of 10 issues, the following three can be considered as most prominent:

1. An insufficient number of computers,
2. educator lack of knowledge/skills, and
3. difficulty with integrating the computer into instruction.

Ely (1993) similarly distinguishes the following major conditions as relevant to ICT implementation:

1. Educator dissatisfaction with the status quo,
2. lack of the existence of knowledge and skills, and
3. limited availability of resources.

The two taxonomies identify, more or less, the same issues: Ely's "existence of knowledge and skills" relates to Pelgrum's "educators' lack of knowledge/skills". Ely's "limited availability of resources" is relative to Pelgrum's "insufficient number of computers". Finally, Ely's "dissatisfaction with the status quo" is directly related to what Zhao and Cziko (2001) described as "discrepancies that activate the individual". The issue of educators' confidence in their ICT competence, as a major factor for integrating technology in teaching, is also reported in other studies. Mooij and Smeets (2001) state that if educators are not confident in their ability or competence to handle computers this may hamper their willingness to introduce technology in their classroom. In an international study (Smeets *et al.* 1999) also reports that the most important reason educators mention for not using ICT is that they are not familiar with ICT or they feel unsure about it. This ICT competence factor is the same one to which Zhao and Cziko (2001) refer as a "Control Principle".

This study tries to ascertain the perceptions of educators with respect to their technology proficiency (Appendix A, Table 1, No.14). Results show that this did impact technology use in the classroom.

Some other important factors are also recorded as significantly influencing ICT use in schools. Educators claiming to follow more innovative educational practices (use of inquiry, project-oriented work, and hands-on activities) are more likely to use new technologies, than those who adhere to the more traditional instructional approaches (Honey & Moeller 1990 as *cited* in Demteriadis *et al.* 2003). According to Mooij and Smeets (2001), the school manager's policy and budgetary decisions and the general attitude of the school manager (his commitment and decisions), are expected to be relevant to the ICT innovation process.

Three major issues that are repeatedly identified by research as important for introducing ICT into the classroom are:

1. "Control" (possessing working knowledge of ICT, being confident, having control over technology) as an enabling and psychologically reassuring factor.
2. "Resources" (number of available computers) as an enabling factor.
3. "Inner dissatisfaction" (dissatisfaction with the current status) as a motivating-activating factor.

2.8. Other Barriers to Technology Integration

Most of the examples that are quoted here, result from studies undertaken in either the USA or UK. The reason for this is that these countries have already been through, or are in the process, of ICT integration into the school curriculum. There are, therefore, key aspects that one can learn from these studies. Access to technology is one issue; however, use of this technology is another (Sutherland 2004). In Washington, a report in the CEO Forum on Education and Technology (1997) states that less than 3 percent of American schools are at the leading edge of effectively integrating technology into classroom practices. According to the U.S. Congress Office of Technology Assessment (OTA 1995), most education leaders believe the under-utilization of technology in education is a result of at least four factors:

1. inadequate educator training,
2. a lack of vision of technology's potential for improving teaching and learning,
3. a lack of time to experiment, and
4. inadequate technical support.

Specifically, the OTA lists the following barriers to educators' use of technology:
Lack of educator time to:

➢ experiment with new technologies,

- share experiences with other educators,
- plan lessons using technology, and
- attend technology courses or meetings.

Access:

- Hardware and software are limited.
- Upgrades, support, and training are continuing costs.
- Technologies may not be located in, or near, the classroom.
- Much of the hardware in schools is old and cannot handle newer applications.
- Telecommunications requires new, or updated wiring, or phone lines.

Vision:

- Schools and districts need technology planning and leadership.
- Educators need an understanding of curricular uses of technology.
- Educators lack models of technology for their professional use.
- Models on best uses change as technologies change.

Training and Support:

- Districts spend far less on educator training, than on hardware and software.
- Training focuses on the mechanics, not on integrating technology into the curriculum.
- Few schools have a full-time, school-level computer coordinator.

Current Assessment Practices:

- Standardized tests may not reflect what learners learn using technology.

- Educators are held immediately accountable for changes that take time to show results.

Studies on technology integration suggest that one of the most important factors related to the successful integration of technology, is effective leadership (Livesay & Murray 1992). Often, the impetus for a technology initiative will be a visionary district superintendent or a school principal; someone who will lead the development of a shared vision and philosophy for school improvement, form partnerships, solicit the support of the community and educators, leverage resources, and provide effective oversight. Sometimes, however, leadership comes from the government. In North Carolina, for example, the state legislature and Department of Public Instruction have created a vision and have identified goals for technology integration across the state. A consistent theme across all states is that where there is no collaboration among leaders, there may be pockets of successful programs or initiatives, but these are usually dependent on individuals, and when the individuals leave, the programs disappear (Council of Chief State School Officers 1991).

Robertson *et al.* (1996) argue that educators' resistance to computer use is divided into several broad-based themes:

- resistance to organisational change,
- resistance to outside intervention,
- time management problems,
- lack of support from the administration,
- educators' perceptions, and
- personal and psychological factors.

They carried out a study that considers the information technology (IT) skills of staff and Grade 8 learners in a secondary school, after a short acquaintance with them, and prior to their receiving personal palmtop computers. Access to the palmtop increased the staff's use of generic applications in their work, particularly for administration (for example, class registers and assessment scores). A minority of staff remained unconvinced about the potential of the computer and many were dissatisfied with the amount and quality of professional development in the use of the palmtop, and in ICT in general. Learners learned about the main, content-free [1] applications relatively quickly and used them frequently. It is quite evident from Robertson's study amongst others, that there is a need for adequate and careful training so that educators become aware of the range of uses and possible benefits of ICT.

Although technology integration is a difficult, time-consuming, resource-intensive endeavour, it results in improved learning and teaching (OTA 1995). Many educators who initially believe that technology integration is more trouble than it is worth, are willing to use it in their classes if they see it as beneficial for their learners (Sheingold & Hadley 1990). Perhaps the most effective way to help educators see the potential benefits, is for school leaders and the community, developing a shared vision for improved outcomes, as articulated in district and school technology plans - plans that specify reasonable expectations for success (Means & Olson 1994).

2.9. Stages of Development

Over the course of the ACOT study, researchers have been studying the changes in educators' beliefs, attitudes, and behaviours and have identified stages of development that educators go through on their way fully integrating technology into their instructional programs. These stages and characteristics are summarized in Table 2 below as adapted from Dwyer *et al.* (1991).

[1] Content-free software aims to represent flexible tools which can be shaped by educators or learners to suit their needs; such as word processors, desktop publishers and databases.

STAGE	CHARACTERISTICS
Entry	As the classrooms begin to change, educators have doubts about Technology integration.
Adoption	Educators use technology to support traditional text-based drill and practice. Learner achievement shows no significant decline or improvement. Self-esteem and motivation are strong. Learner attendance is improved and discipline problems are few.
Adaptation	Educators thoroughly integrate technology into traditional classroom practice. Learner productivity is increased. Learners produce more and faster. Learners are more actively engaged in learning.
Appropriation	Educators and learners personally appropriate technology. Educators gain a perspective on how profoundly they can alter the learning experience. Learners have highly evolved technology skills and can learn on their own. Learner work patterns and communication become collaborative, rather than competitive.
Invention	Educators are prepared to develop entirely new learning environments that utilise technology as a flexible tool. Educators view learning as an active, creative and socially interactive process. Knowledge is something learners construct, rather than something that can be transferred.

Table 2: Stages of Development

Over time, technology use changes the way educators teach. As they grow in their use of technology, they become more willing to experiment, their teaching becomes more learner-focused, and they tend to establish collaborative working relationships with other educators. After approximately four years of participating in the ACOT studies, classrooms become an interesting mix of traditional and non-traditional teaching and learning. Educators are experimenting with new kinds of tasks for learners, and they encourage far more collaboration among learners (Dwyer 1994). These changes occur only when educators and administrators have flexibility in changing the classroom environment and rearranging schedules to accommodate different patterns of teaching and learning.

Evans-Andris (1995) summarise three styles of computing use among educators: avoidance, integration and technical specialisation. These styles play a significant role in learner access to computer technology. Her study evolves over an 8-year period in elementary schools. The dominant style of computing among educators is that of avoidance. In this case, educators typically distance themselves from computers and otherwise reduce the amount of time they spend attending to computer-related activities. Their learners have limited and repetitive use of software intended for drill and practice, or word processing. Drill and practice in the South African context can be seen as automated rote learning. Generally, these educators sustain a low level of interaction with learners while they work with computers. In contrast, educators engaged in 'integration' generally embrace computers. They integrate the technology into their teaching methods and curriculum, their working day, and the learning experiences of learners. They select drill and practice software based on curricular goals and the needs of their learners. In addition they introduce a broad range of computer applications, and develop creative and engaging projects that integrate computer activities with more normal instruction. As in integration, educators engage in 'technical specialisation' embrace computers and view the technology as a challenge. These educators promote computers in their schools, and their activities relating to computing typically demonstrate strong teaching methods such as consistent use, preparation, and delivery of planned lessons involving the computer. During lessons they also focus their efforts on teaching learners about the technical aspects of computers.

2.10. Schools as Organisations

In a study of projects to promote educational changes in America, Canada and the United Kingdom (UK), Fullan (1991) found that one of the most important fundamental problems in education reform is that people do not have a clear and coherent sense of the reasons for educational change, what it is and how to proceed with making changes. As a result, there is much faddism, superficiality, confusion, and failure of change programmes, unwarranted and misdirected resistance and misunderstood reform. He maintains that educators who resist change are not rejecting the need for change, but are often expected to lead developments when they are given insufficient long-term opportunities to make sense of the new technologies for themselves. However, Davis (1999) (as *cited* in Mumtaz 2000) argues that schools are changing to respond to their communities' need for technology training, and their own need for increased resources. This is illustrated in a primary school where parents have become support staff and provide courses to other adults in a rural region. Leaders need to become aware of this pervasive nature of ICT so that they ensure that their organisations continue to fulfill their proper functions.

Cuban (1993) (as *cited* in Mumtaz 2000) provides an explanation as to why new technologies have not changed schools as much as they have other organisations:

> *"First, cultural beliefs about what teaching is, how learning occurs, what knowledge is proper in schools, and the learner-educator (not learner machine) relationship dominate popular views of proper schooling.*
>
> *Second the age-graded school, an organisational invention of the late nineteenth century, has profoundly shaped what educators do and do not do in classrooms, including the persistent adaptation of innovations to fit the contours of these age-graded settings."(p. 186)*

Cuban (*ibid*) goes on to describe three possible scenarios for the classroom of 2003, which he calls the technophile's, the preservationist's and the cautious optimist's. The technophile's scenario of electronic schools of the future is one where an abundance of better machines and software enables learners to 'learn more and with less difficulty' (p. 192). In this scenario 'learners will come to rely on the machines and one another to teach them and ... educators will become coaches to help learners with what needs to be learnt' (p. 193). The second scenario is the preservationist's, in which the fundamental structures of schools are maintained but schooling is improved. Technology is perceived to be important, but only as a tool that educators use to help learners' productivity. In this scenario, technology is used to support what schools have always done. Cuban (*ibid*) calls the third scenario the cautious optimist's and defines this as a scenario in which there is a slow, but steady movement 'towards fundamental changes in teaching and schooling' (p. 195). Initially the researcher hoped that the results of this study would show to what extent each of these scenarios hold true for the classrooms in KZN. The results show that there is very limited technology use in the classroom. Schools with computer rooms for teaching, in this survey, fall into the cautious optimists scenario to a very limited extent; however, this is only true for computer related subjects. Chapter 5 gives a more detail analysis of computer use.

2.11. Factors that Encourage Educators to Use Technology

Mumtaz (2000) reports on a study examining the factors relating to the uptake of ICT in teaching. A questionnaire is used to collect evidence from educators about their ICT experiences, expertise and use in teaching, their attitudes to the value of ICT for teaching and learning, the training they had received and, when relevant, their reasons for being a member of an ICT related association. The results show that the educators who are already regular users of ICT have confidence in using ICT, perceive it to be useful for their personal work and for their teaching, and plan to extend ICT use further in the future. The factors that are found to be the most important to these educators in their teaching are making the lessons:

- more interesting,
- easier,
- fun for them and their learners,
- more diverse,

- increasingly motivating for the learners, and
- more enjoyable.

Additional, more personal factors include:

- improving presentation of materials,
- allowing greater access to computers for personal use,
- giving more power to the educator in the school,
- giving the educator more prestige,
- making the educators' administration more efficient, and
- providing professional support through the Internet.

Veen (1993) carried out a study 8 years earlier to describe the day-to-day practice of four educators from a Dutch secondary school who are implementing ICT in their classrooms. The educators are provided with a computer at home, and a computer and a liquid crystal display in their classrooms. School factors play an important role in how the educators make use of their computers, including the essential technical support of 20 hours per week and the positive attitude of the principal. However, educator factors outweigh the school factors in explaining the educators' use of computers. These educator-level factors are grouped into two subcategories: beliefs and skills. The most important of these are educators' beliefs regarding what should be in the curricula (content) and the way in which their subjects should be taught (pedagogy). The skills that most influence their uses of computers are those ranging from the educators' competence in managing classroom activities, to their pedagogical skills, and, less importantly, their technical skills. The most important finding from Veen's work is that if the software matches the educator's pedagogy, they make use of it.

Several studies (for example, Baylor & Ritchie 2002, Becker 1994, Hadley & Sheingold 1993, Sheingold & Hadley 1990) use survey data to identify factors likely to be evident in educators who, to some extent, have integrated computers into their teaching practices. Sheingold & Hadley (1990) conduct a nationwide survey of fourth to twelfth grade educators in the USA. The three major factors involved in these 'accomplished' educators' success are:

- educator motivation and commitment to their learners' learning and to their own development as educators,
- the support they experienced in their schools, and
- access to sufficient quantities of technology.

In addition, these educators work in schools where hardware and access to resources is twice the average, and in which they are comfortable with technology and use computers for many purposes. They perceive that their teaching practices become more learner centered with the integration of technology in their curriculum, and they hold higher expectations of their learners. Sheingold & Hadley's (1990) study also identifies that the source of motivation for educators to use technology includes gains in learning and using computers for their own development as educators. They foresee wider success among educators if "ample technology, support, and time for educators to learn the technology are provided, and if an academic and cultural structure exists to encourage educators to take an experimental approach to their work" (p. 30).

In Hadley & Sheingold's (1993) report, segmentation analysis is used to assess if there are common responses that identify subgroups in the sample. This analysis indicates that there are five main segments or types of educators and circumstances in this sample, including 'enthusiastic beginners', 'supported integrated', 'high school naturals', 'unsupported achievers' and 'struggling aspirers'. These subgroups diverge on the following factors:

- experience and comfort with technology,
- grade level taught,

- applications and practices they use,
- extent of support at school, and
- the extent of collaboration with colleagues at school.

This analysis indicates that not all 'accomplished', technology-using educators possess similar qualities, but that a diverse and complex combination of factors has an impact on their path to success.

Constructivist theory posits that learners make sense of the world by synthesizing new experiences into what they have previously understood. When content is meaningless to the learners' world view, when they are taught as if they were passive recipients of knowledge, or when they have little engagement in the instructional tasks, learners have no incentive to construct their own knowledge, and little motivation to retain information or to transfer its use to novel situations (Govender 2001).

Becker & Riel (2000) conduct a study on constructivist classrooms that examine the relationships between professional engagement and teaching practice, including instruction involving computer use. Professional engagement is measured by the frequency with which educators have informal substantive communications with other educators at their school, the frequency and breadth of professional interactions with educators at other schools, and the breadth of involvement in specific peer leadership activities, mentoring, and workshop and conference presentations.

The study finds that educators who regularly participate in professional interactions and activities beyond their classroom, teach in different ways to educators who have minimal contact with their peers or profession. The more extensively involved educators are in professional activities, the more likely they are to have teaching philosophies compatible with constructivist learning theory, teach in ways consistent with a constructivist philosophy and use computers more often, and in exemplary ways. Their use of computers with learners is not limited to gaining computer competence, but extends to involvement in cognitively challenging tasks where computers are tools to promote communicating, thinking, producing, and presenting ideas. Data on software use and objectives for computer use suggest that these educators recognize the features of technology that grant learners access to a broader community and knowledge base, beyond the walls of the classroom. They are able to incorporate the use of computers into learner activity more effectively than educators who fail to participate in their professional community. Educators who fail to participate in their professional community are more likely to focus on traditional methods of delivery of information and on direct instruction. They do not place a high value on collaborative knowledge building in the classroom or for themselves in the educational community. The role of the learner is to listen, learn and repeat.

Becker & Riel (*ibid*) conclude that those educators extensively involved in professional activities are in a position – when granted sufficient authority and time - to help other educators move towards being more accomplished users of computer technology.

Carney (1998) examines an educator development programme, STDC (the Shortline Teacher Development Centre), aimed at integrating technology into the constructivist classroom. Carney explores whether or not several factors common to exemplary computer-using educators are addressed in this setting. Analysis is focused on the four elements deemed crucial for effective educator learning:

1. Challenges to frames of reference. To generate new responses, professionals must be placed in situations of uncertainty. Three forces seem to be creating these conditions of uncertainty: technology, new teaching contexts and converging reforms. The need to integrate technology is the most powerful of the three in challenging familiar practice and knowledge.

2. Situated learning. The notion of situated cognition (Brown *et al.* 1989) is a basic cognitive principle of constructivist theory. In the STDC, educators

are able to see operational illustrations of constructivism supported by technology in classrooms. They are able to have direct experience with new practice of technology integration.

3. Collaborative reflection. This is where educators should work in collaborative relationships with colleagues as '... collaborative reflection groups can provide a direction for individual change efforts ...' (Hasseler & Collins 1993, as *cited* in Mumtaz 2000 p. 11). The STDC recognises the importance of educator reflection in its basic objectives, and provides collaborative contexts through regular, structured discussion, as well as informal sharing.

4. Long-term collegial interaction. The learning gained by individual educators is not likely to be translated into reformed practice without long-term collegial interaction. Collaborative support greatly increases the likelihood that changes in practice will be sustained. The STDC provides a basis for collegial support by encouraging educators to continue their interactions beyond the program, through personal contact and by email, as well as by offering the 3-day seminar as an opportunity to return for additional sharing and support. Carney (*ibid*) concludes that the STDC helped educators integrate technology into a context of standards-based curriculum, constructivist pedagogy and authentic assessment.

The above elements have much bearing for educators in South Africa, and in particular for this sample. It is expected that a system of clustering of schools would help promote collaborative reflection and collegial interaction, as well as promote computer mediated instruction in schools in KZN.

Hruskocy *et al.* (2000) suggests that training school learners to serve as technology experts may aid integration of computers into the classroom setting by encouraging the educators to become more motivated, frequent users of technology and to express a desire to learn alongside their learners.

For schools in KZN, it is envisaged that the UKZN will provide this training for learners (outreach programme) to serve as technology experts and, therefore, aid the integration of ICTs into the classroom.

Pedretti *et al.* (1999) in the TESSI (Technology Enhanced Secondary Science Instruction) project, conducts a qualitative case study of the professional development of two educators involved in a collaborative effort to advance technology implementation in high school science classrooms. The research concludes that technology should not be regarded as a substitute for educators, but rather as a means of enhancing and transforming instructional practice. It is found that the educators integrated technologies incrementally into their programmes, courses and curricula. Time previously spent on educator talk is gradually replaced with practices that promote learner use of a range of multimedia technologies including:

- software-generated simulations to develop and extend understanding of science concepts,
- laserdiscs and videos,
- computer-interfaced probes/sensors in laboratory situations to collect data,
- computer applications to process and analyse laboratory data,
- presentation software to present information,
- interactive testing programs to assess learning, and
- software for recording marks.

Each new addition of multimedia technology requires negotiation between the educators and the school management, collaborative decision making and curriculum adaptation. Pedretti *et al.* conclude that the TESSI case study confirms that the integration of technology in classrooms can significantly transform teaching and learning.

2.12. The Role of the Educator in Relation to ICT and its Effect on Pedagogy

Research into pedagogy and ICT in the United Kingdom (UK) carried out by Moseley & Higgins (1999) (as *cited* in Mumtaz 2000) focuses on the teaching of numeracy and literacy in primary schools using ICT. The research draws on school improvement methodologies and makes use of a model of teaching and learning that regards pedagogy as being about educators' behaviours in the classroom. An important factor determining educators' behaviours, according to the model, is Pedagogical Content Knowledge, which is defined as "the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organised, represented and adapted to the diverse interests and abilities of learners, and presented for instruction" (p. 10). Further characteristics of teaching and learning contained in the model come from the learners themselves, and the context of the teaching and learning process. How ICT fits into this model depends on whether educators see ICT as changing the nature of their subject and the way it is understood, or whether ICT is seen as a tool for teaching another artefact in the classroom. Moseley & Higgins (*ibid*) studied the attitudes of a small sample of educators and found that educators who successfully make use of ICT have the following characteristics:

- A positive (rather than negative) attitude towards ICT. Educators who have positive attitudes towards ICT itself will be positively disposed towards using it in the classroom.
- Learner choice, rather than educator direction. Educators who prefer directive styles of teaching tend to rate their own competence as low,

and make use of helpers with ICT.

- Learner empowerment as learners, rather than learners receiving instruction.
- A preference for individual study, rather than learners receiving instruction.

Olson (1981) (as *cited* in Mumtaz 2000) develops the idea that the computer offers educators ways to enhance what and how they teach, but at the same time threatens those very practices by calling them into question. The very presence of the computer implies something about what the educator values, it symbolises the educator's interest in modern trends and his capacity to cope with the latest teaching technologies. However, the computer also threatens illusions which educators have about what they are doing (Solomon 1986, Watson 1987). Some think computers make better educators, others imagine that computers help educators improve what they already do. Olson *(ibid)* further adds that educators act to protect their influence over core elements of their work, such as covering the curriculum and maintaining their credibility. However, these protective strategies for maintaining classroom influence may erode the potential of computer-based teaching. Achieving the full benefits of computers in the classroom may require the educator under observation to tolerate more ambiguity, increase individual attention, and engage learners in divergent thinking. All of these create risks. These risks are managed, but overprotection of these core elements may set a limit to reform of the curriculum through computer-based teaching, unless educators and software designers critically consider the way in which educators exercise influence in the classroom.

Scrimshaw (1997) (as *cited* in Mumtaz 2000) examines the educator's role in classrooms regarding computers. He argues that educators need to teach the process of learning, rather than its products. The conventional learning skills, such as locating, collating and summarising information, and identifying connections and contradictions within a body of information, all need to be explicitly moved to the centre of the curriculum. The development of such skills needs to be supported using appropriate forms of software. This requires the explicit teaching of ways of organising cooperative activities involving computers, whether in face-to-face groups around a single machine, or through cooperation at a distance via a conferencing or email system. In order to do this, educators themselves need more opportunities and support in using the new technologies in collaborative contexts, so that they can both identify the problems and possibilities for themselves, and find ways to model these activities in their own practice with learners. When introducing these newer technologies, educators also need time to reflect on current research.

2.13. Studies of Educators Learning to Integrate Technology into their Teaching

McDougall & Squires (1997) argue that the Perspectives Interactions Paradigm, designed for educational software assessment, can further provide an organising framework for thinking about educator professional development and for structuring evaluative thinking in the use of information technology (IT). They consider a set of five commonly observed *foci* for educator professional development activities in the IT area. These are:

1. Skills in using particular software applications. These activities aim to develop educators' skills in using specific software packages or applications, such as word processors, an operating system, or Internet access software.

2. Integration of IT in existing curricula. These activities focus on the integration of the use of technology into the curriculum with which an educator is working.

3. IT-related changes in curricula. The use of IT in educational contexts has opened up many possibilities for curriculum change; often these reflect IT-related changes in the nature of disciplines.

4. Changes in educator roles. IT in classrooms can be associated with significant changes in the classroom climate, and educator and learner roles in learning; for example, groupwork and collaborative learning activities can be enhanced when IT is used.

5. Underpinning theories of education. Opportunities for such sustained examination and reflection on the underpinning principles in education are most typically provided by educators through enrolment in formal courses.

In South Africa, the integration of IT into curricula is a prominent feature of the new National Curriculum Statements of many of the FET subjects. IT-related changes in curricula are also very evident in, for example, subjects like Engineering Drawing (Technical Drawing) where CAD (Computer Aided Drawing) has been introduced, Geography which has introduced GIS (Geographical Information System) and Accounting which has introduced Pastel Accounting. This presents the Department of Eduaction (KZN) with a huge challenge of educator professional development. Results of this study show that most educators lack core computer competence and this must be addressed first, before ICT integration can take place.

McDougall & Squires (*ibid*) go on to locate each of the above *foci* in the framework provided by the Perspectives Interactions Paradigm. Consideration of the interaction between the perspectives of the designer and the educator raises issues related to explicit, implicit or even absent curriculum considerations in the use of IT. When explicit links to a syllabus are made, activities will naturally be seen as fitting into the existing curriculum rather than as changing it. Professional development activities involving the first three *foci* outlined above can be considered in terms of this perspective's interaction. The educator-learner perspective's interaction explicitly raises issues related to the learning situation. A consideration of changes in the distribution of responsibility for teaching and learning, between the educator and learner(s), is implied. In this context, classroom educators can be regarded as managers and supporters, as opposed to directors of learner-focused activities. Collaboration between peers, particularly in small groups, often becomes very important when IT is used (Hoyles *et al.* 1994). Such changes in classroom environments clearly have implications for educator professional development. Professional development activities focused on changes in educator roles - as in the fourth focus listed above – can also be linked to this perspective's interaction. The interaction between the designer's and learner's perspectives enables the raising of issues relating to ways in which the use of IT-related activities can aid learning. This perspective's interaction is essentially concerned with the theory of learning that underpins the use of an IT application, and implies a knowledge and understanding of cognition. Professional development activities on issues related to this perspective's interaction would be included in the fifth focus. The framework was applied to a school-based, professional development programme in an Australian school with a policy to integrate IT use across both primary and secondary classes. McDougall & Squires (*ibid*) conclude that such a programme does provide an approach to IT professional development that is both authentic, and comprehensive, and conclude that such programmes should be school-focused.

Davis (1997), using McDougall & Squires's Perspective Interactions Paradigm, reflects on professional development for IT in a wide range of contexts. Davis found that there are a further two *foci* that need to be added to the list of five: changes in the manager role and evaluation of development in this framework. Davis suggests that the addition of a focus to the framework should be changes in the management of IT in the learning environment. Without the professional development of senior managers, including senior educators, any framework will be unable to hold its structure against stresses imposed by traditional educational organisations. McDougall & Squires' case study operates within a benevolent ethos and supportive management, but others will need to work towards such an ideal. Davis further points out that an evaluation framework for educator professional development should, itself, have an evaluation focus to feed back information into our knowledge of educator professional development. Davis concludes that the framework may well apply beyond IT, to any innovation in education. The DOE KZN will need to take cognisance of the new roles that managers (principals) will need to play in facilitating ICT integration in their schools.

In 1996, the British Educational Communications and Technology Agency (BECTA) (Youngman & Harrison 1998) carried out a study that seeks to develop educator competence and confidence in the use of ICT with portable computers. Approximately 1150 educators in 575 primary and secondary schools are provided with a multimedia portable computer together with two Internet subscriptions, core software and a number of CDROM titles. The study shows that the degree of computer literacy of many educators increases to the extent that even relatively inexperienced educators are quickly able to use their computer's power to evaluate a variety of software packages, and to filter, import and export information in order better to suit their own curriculum purposes. Educators' confidence and competence changes for the better; they feel that their knowledge of IT has increased 'substantially', educators change their ways of working and their enthusiasm for their work increases. The most significant benefit to learners was indirect, as a result of the educators' more expert use of tools for creating high-quality classroom materials and improved access to resources. The study shows that four conditions contributed to the success of the project:

1. Initial and immediate success with the technology through the hands-on demonstration and the provision of user-friendly hardware and software.
2. Personal ownership and exclusive use of a machine over an extended period.

3. The portability of the equipment so that it could be moved between work areas, and between home and school.
4. Formal and informal support – the combination of the ownership and portability provided educators with a greater variety of support from peers and other sources.

It is concluded that this Multimedia Portables for Educators Pilot is very successful in leading to a significant enhancement of the ICT skills of the great majority of educators who took part. Similar findings have been discovered by Selinger (1996) in a study of the effect of the loan of computers on 1000 learners studying at a distance, on a part-time, initial educator education course at the Open University United Kingdom. In this study, 25% of educators indicated that they do not have access to a computer. The KZN Department of Education will need to take note of this when planning for educator professional development in the use of IT.

One can also draw on the lessons learned by researchers at Stanford Research Institute (SRI) International and the Education Development Corporation (EDC) who have studied schools where technology is used extensively and identified eight important factors that contribute to their success:

1. Technology initiatives should start with instructional goals. The Office of Educational Research & Improvement (OERI) points out that, unless the school staff start out with an instructional goal, technology is most likely to be used to reinforce the status quo (Piele 1989). In the South African context, schools will need to ensure that ICT integration is part of their learning programmes, as directed by the National Curriculum Statements (NCS).

2. Technology must be linked to curricular goals and frameworks. In the South African context, this is quite evident in the new NCS for different subjects in the FET phase.

3. Technology and the assessment system must be compatible. In the South African context, the new policy for assessment in the FET phase requires a 25% continuous assessment component which makes use of learner projects and portfolios.

4. Educators and technology need to work together. Technology in isolation is not likely to make much, if any, impact on learning. It is the decisions and actions of well-trained educators that determine technology's ultimate instructional effectiveness. Educators who are most successful at technology integration are those who are so comfortable with technology that they effortlessly know when to use it for learner-focused learning and when to use direct instruction (Dwyer, 1994). In KZN, the core computer competence of educators must be urgently addressed through educator development programmes.

5. Educators require ongoing pedagogical and technological support. It takes an average of four or five years for educators to reach a point where they can effortlessly mix technology-based instruction strategies with traditional instruction (Sheingold & Hadley 1990), therefore, they require extensive professional development and technical support. Schools that are successfully integrating technology into their instructional programs have made a strong commitment to professional development for their educators.

6. Community and parent involvement enhances the likelihood of success. Consistent with other studies of successful efforts at school reform, the literature on technology integration shows that the chances for success are increased when parents and the community buy into the instructional goals of the reform, and understand the implications in terms of costs, other activities, and likely effects on test scores (Means *et al.* 1993).

7. Business plays an important role in technology and school reform.

8. Another key to successful technology integration is the ability and willingness of school administrators and educators to use additional resources provided from outside the school to initiate and support fundamental changes (CCSSO 1991).

2.14. ICT Paradigms in Teacher Education

Willis *et al.* (1999) carried out a review of research on information technology in teacher education (ITTE). They argue that ITTE research can be categorised into three paradigms: empirical, critical and interpretive.

Survey research of Becker provides examples of empirical research that have made a major contribution to ITTE and have accurately portrayed the situation of computer use in schools (Becker 1994). His research provides valuable information about the changing classroom practices related to computers.

Critical theory brings to light the inequities that are inherent in modern capitalist societies. Apple (1993,1991) (as *cited* in Mumtaz 2000) discusses in detail whether or not the teaching profession will be enhanced by the advent of technology. He concludes that if current research trends continue, the profession will be disempowered and de-skilled as teaching is redefined as a management job that focuses on keeping the computers running, while the machines deliver specific, skills-based instruction to learners who are being prepared for boring, demeaning jobs in a capitalist society that views people as resources to be used as the employer sees fit. Monke (1997) (as *cited* in Mumtaz 2000) uses a detailed case study of the diffusion of technology into the public schools of Des Moines, Iowa, to highlight the significant and serious hidden costs to educators and administrators. A critical perspective is also used by Chisholm & Wetzel (1998) to evaluate computer-supported lessons created by a group of elementary educators. They found the lessons are strong on integration, with a focus on high-level thinking skills.

The third research paradigm for ITTE is interpretivism. This is related to forms of research that are often described as qualitative. Much more emphasis is placed on understanding the context of research, as much of the meaning is in the context. An example of an interpretivist approach is the work of Norum (1997), who reports observations of two high school educators who are learning to use a television-based distance education system to deliver foreign language instruction to learners in several different schools in the Denver area. Norum uses case study methodology, but reports the case studies in the format of a non-fictional education story. Using a multi-paradigmatic approach, Willis *et al.* (1999) draw together the main threads of what the research reveals for today; for example, that educators have very positive attitudes towards the use of technology in education, but are far less confident about their ability actually to use the technology, and do not think that their educator training programmes prepared them to use technology in innovative ways. Also, research shows that educator training faculties, although positive about IT, do not have a strong background in integrating that into educator education courses they teach. From my interaction with students at UKZN, they also indicate that their educator training programmes do not prepare them to integrate ICTs in the classroom. Many lecturers (my colleagues), involved in educator training do not integrate ICT in their teaching even though they are moderate to highly competent in the use of the computer. This ties up with Norums *(ibid)* finding that even though lecturers are positive about IT, they do not have a strong background in integrating ICT into their educator education courses.

Willis *et al.* (*ibid*) conclude that there are isolated examples of 'islands of excellence' that illustrate what can be done in ITTE. The diffusion rate is slow and a major focal point for ITTE research could be on the process of change and diffusion. More detailed case studies on the process of change, how it is handled and how it occurs are needed. More case studies on diffusion of innovations are also necessary, as well as studies of how they were created and how they will be disseminated so that other educator education programmes can use them if they wish. Also, more reports are required from the educators who have been involved in integrating the innovation into their classroom. More bias-related findings in terms of gender, social class and ethnic background use of ICT are needed from critical theory research, as well as ways of readdressing the balance. More development and dissemination of resources and tools for using technology effectively in educator education also need to be developed.

2.15. Reservations about ICTs

Despite its undoubted advantages, the use of technology in education is not viewed without criticism by all. There is a fear that, as ICTs open up new opportunities, they also create new divisions, new disparities, and cultural dominance (UNESCO 1999; Gladieux & Swail 1999). Scepticism arises from concerns about the motivations of those supporting technology, the possibility of cultural imperialism, the impact on quality, access and equity, and doubts about the reality of cost-effectiveness. Despite the apparent widespread diffusion of computers in society, access is still stratified by socio-economic class, gender, race and geographical location (NTIA 1998). Wilson *et al.* (1998) express a common concern about American domination of the Internet, where over 70% of content in 1996 was United States (US) generated (Byron & Gagliardi 1998). Courses developed by US institutions contain cultural assumptions not necessarily shared by learners from other countries.

The dominance of the English language on the Internet is also cause for concern. Devine (1997) criticises the lack of focus in educational technology on improving curricula and methods of assessment, while laying emphasis on the optimisation of technological infrastructure, or on gaining efficiencies, either through cost reduction or value added approaches.

2.16. Costs and ICTs

While the potential of ICTs to reduce costs is often *cited*, there is very little evidence of cost reduction and there is little research to support the contention that ICT use in education is cost-effective (McClure 1993, Noble 1998). McClure (*ibid*) was unable to find studies documenting improved educational output per unit cost. Instead, he found that the educational gains had been at huge cost, in terms of investment in both equipment and software, but more significantly, in academic and support staff time.

The rise in interest in the US in the provision of on-line education has been underpinned by a belief in the existence of a global market which will lead to immense profits for entrepreneurial institutions (Marchese 1998). However, others, particularly academics in universities, are sceptical about the existence of a market on this scale and the likely cost savings of replacing on-campus courses with on-line teaching (Noble 1999, University of Illinois 1999).

Many proponents of ICTs in education appear unduly dismissive, or unaware of the real costs of technology. Online telephone charges for Internet access (for effective use, these charges need to be waived or subsidized) and training costs (successful implementation requires educators to be fully trained in both technical and pedagogical aspects of technology, while technicians also require frequent updating), result in high financial output. Additionally, the dominance of the English language and US-based material gives rise to expenditure on adaptation, localisation, and translation. Finally, the increasing cost of clearing copyright access to materials is also placing a financial burden on schools.

Despite these reservations, it seems inevitable that education is being transformed by ICTs because of the overarching globalisation processes at play. The question to be asked is, who pays? It is clear that disadvantaged groups will not be in a position to pay the high costs involved. In some cases, industry has taken the lead in the absence of government support. Byron and Gagliardi (1998) - noting that computer companies introduced computers into US schools in the 1960s and 1970s - state that industry recognises the benefits of fostering the educational market, and in educating populations to be competent in, and dependent on, the new ICTs. Some 80% of funding for the UK Education Superhighways initiative is provided by industries such as IBM, INTEL, Microsoft and British Telecom. In 2000, Microsoft donated R2 billion worth of software (Microsoft Office 2000 professional and copies of Encarta) to K-12 schools in the US, while Intel invested R650 million in providing training to some 400,000 educators in 20 countries. In South Africa, Microsoft has offered free software (Microsoft Office suite) to schools. Only schools who have computers / computer rooms have accepted this offer. However, there are concerns about leaving the development of education products to industry. Byron and Gagliardi (1998) note that most commercially-produced educational software should more correctly be classified as "edutainment", rather than pedagogically useful tools. The increased commodification of education by the market is seen as a potential threat to democracy (Council of Europe 1999).

2.17. International Agencies and Strategies for ICTs and Lifelong Learning

International agencies have played a key role in promoting ICTs in education. UNESCO has been promoting ICT use in education since 1949, when it supported the production of the first educational radio programmes in Colombia (UNESCO 1999). It has played a major pioneering role in harnessing new technologies for formal and non-formal education.

The World Bank Institute has launched a distance learning initiative aimed at training key officials in a wide range of government organisations in the developing world, through a network of high technology distance learning centres linked together with videoconferencing (World Bank Institute 1999).

The Council of Europe initiated a study in 1999 on Lifelong Learning which considers ways in which the new ICTs can contribute to equity and social cohesion. The European Union has developed a number of policies supporting the Information Society, Lifelong Learning, and Open and Distance Learning. The memorandum on e-learning: Designing Tomorrow's Education (CEC 2000a) seeks to mobilise key role players in order to accelerate changes in the education and training systems for Europe's move to a knowledge-based society.

Walker (1989), a former director of the Scottish Microelectronics Development programme, lists three preconditions for the successful implementation of new information technologies in a national education system:

1. Government should appreciate the financial resources and operational requirements of the system,
2. government should give time to, and take responsibility for, decision-making and implementation strategies, and
3. there should be a policy of integrated support services, including educator and technician training, curriculum and assessment, as well as hardware and software provision.

International strategies supporting the use of ICTs in education have taken on a number of forms, reflecting the particular political and institutional structures in place. Some international initiatives consist of strongly centralised actions, whereas others are more decentralised. There is general agreement in the literature that, for successful implementation of ICTs, strong centralised support from government is essential, but that localised support from schools, colleges, and education authorities is crucial in implementing innovations. In particular, where the level of access to technology is low, centralised action is essential. For these reasons, the KZN Department of Education must take on a more active role (centralised action) in promoting the implementation of ICTs in the classroom. In more technology rich societies, such as the US, locally generated projects may be successful (Byron & Gagliardi 1998).

The following is an account of a number of initiatives which have been undertaken at national level in different countries to support the use of ICTs in education, in general. While many of these initiatives have been adopted as much as ten years ago, it is the opinion of the author that our country is only now entering a similar stage of development and therefore the need to include it. These initiatives have focused on a number of areas, including subsidising equipment purchase, distribution of free equipment, promoting lower connection charges, development of local learning centres, training, and pedagogical improvements. The main thrust of support has been in developing an ICT infrastructure within institutions, while the issue of providing affordable access to lifelong learners outside the institutions has yet to be tackled effectively.

2.17.1. Ireland

In Ireland, significant investment in education since the 1960s has been regarded as the engine driving the current surge in economic growth. The Irish Government has recognised the importance of preparing the Irish population for entry to the Information Age and has invested heavily in the ICTs in education at primary, secondary and tertiary level. The government's White Paper on adult and continuing education, published in November 2000, makes a commitment to maximising the use of ICT in delivery of lifelong learning (Department of Education, Ireland 2000). Among the initiatives which have been launched was the Schools IT2000 initiative in 1997, where total government investment in ICT for schools was in the order of R1.2 billion by end of 2002. By 1999, schools had been supplied with 60,000 computers and 99% of schools had been linked to the Internet; some 20,000 educators had received at least 20 hours of training (Information Society Commission 1999). However, concern was expressed by the educator's union at the lack of locally produced educational software (Irish Times 1999). In addition, it has been noted that, while there has been a significant investment in infrastructure, it is unclear as to the cost of maintaining and supporting this infrastructure (Information Society Commission 1999). Other initiatives involve major role players in industry. This include providing free multimedia PCs to each of the State's 4,100 schools, and providing ISDN lines, free Internet connection, and free Internet usage for one hour of every school day for two years.

The National Development Plan in Ireland provided R6.37 billion for in-career development of educators, which is seen as critical to ensure their capacity to respond to constant challenges posed by curricular change and ICTs.

2.17.2. Portugal

In Portugal, the Minerva project - so-called because of its long period (10 years) and its national focus - is an important step in developing ICT infrastructure and in raising awareness among both educators and learners. This initiative was launched in 1985 to provide schools with equipment and train educators and educator trainers, develop educational software, and promote research on the use of ICTs in education at primary and secondary levels. By 1994, 25 centres had been established in universities and higher education institutions, and thousands of educators and learners had participated in the programme. Other projects aim at providing access to ICTs in education and include The Nonio - Twenty First Century programme (the programme for ICT in Education) which was launched in 1996. It comprises of four sub-programmes, including application of ICTs, IT training, development of educational software, dissemination of information and international cooperation. In its Green Paper for the Information Society in Portugal - launched in 1998 – The Ministry of Education states that the information society presents a double challenge to democracy and education. It is the educational system's prerogative to provide everyone with the means to master the explosion in information and to select and organise it critically (Ministry for Education 1998). The Green Paper promotes a bottom-up approach, involving local communities. It recognises the need to involve different partners in decision-making, the introduction of administrative decentralisation and autonomy for schools. It aims to meet the Council of Europe's recommendation to have all primary and secondary schools equipped with at least one multimedia PC per classroom. Among the seven measures proposed by the Green Paper are:

1. the installation of multimedia PCs connected to the Internet in all school libraries,
2. the creation of content and information services on the network as support for the school population,
3. development of school projects in educational telematics,
4. promotion of educator training for the information society,
5. revision of curricula in the light of the information society,
6. assessment of the impact of information technology programmes, and
7. promotion of the Portuguese language and culture abroad.

2.17.3. Finland

Finland had an exceptionally high level of IT and telecommunications penetration and expertise, but no clear statement of strategy (quoted in the Ministry of Finance Information Society Strategy 1996). The 1996 Information Society Strategy aims to redress this deficiency. The Strategy comprises 5 actions and 46 recommendations. Action 4 states that "everyone is to have the opportunity and basic skills for using the services of the information society and recommended the expenditure of 170 Mecu annually (0.2% of GNP)". The most significant element of expenditure is supplying schools and libraries with adequate IT and networking. The school system is to be connected to information networks by 2000. It is proposed that the learner/PC ratio in second level schools would be 7:1, the library system will be an integral part of the Information Society strategy, and government promotes use of electronic communication for education and teleworking. In an evaluation of progress in 1998, The Finnish Parliament found that availability of hardware is still a problem, multimedia educational content was limited, teaching and technical backup services are inadequate, and training of educators is required (CEC 2000b).

2.17.4. United Kingdom (UK)

The UK launched the Education Superhighways initiative in 1995 (CEC 2000b). This initiative supports 25 projects and 1000 schools and also funds projects, such as the Government Education Medical Industrial Social Information Superhighway (GEMISIS 2000) which is to link schools to homes in Cambridge through a cable network. In 1997, the National Grid for Learning was launched. This programme set targets to be achieved by 2002 with respect to Internet connection, training of educators, and use of ICT in all areas of teaching and administration.

2.17.5. Australia

In Australia, the Education Network Australia Initiative (EdNA) is part of an overall national strategy drawn up to exploit the opportunities offered by the ICTs. It aims to deliver educational services and products and to limit the costs of access to the information superhighway. Each State has initiated school-based initiatives including connection of the schools to the Internet, training and development programmes for educators, school networks, technology advisers, curriculum development and development of resources for educators and learners (Mawson 1999).

2.17.6. Japan

Japan launched a six-year national plan in 1994 which aims to equip all primary and secondary schools with computers. In 1996, another scheme was established to link schools to the Internet (this was confined initially to 100 schools). In an extension of this programme, the Child Network Plan is designed to link 1000 schools to the Internet and promote the development of information-oriented education, through the use of a high level information communications network.

2.17.7. Pakistan

The provision of access to the ICTs poses particular problems in economically deprived countries such as Pakistan. The average per capita income is too low to enable the vast majority of the population to buy computers and pay access charges, and in any case, the communications infrastructure, reliable electricity supply, and basic services are simply not available on a widespread basis. Yet, these countries cannot be isolated from the richness of resources freely available on the web. In such circumstances, the focus has been on reaching the educators at study centres who will, in turn, reach out to learners. The EDUNET programme seeks to use network possibilities for disseminating resources relevant to the curriculum, to educators and learners (Byron & Gagliardi 1998). The use of study centres must be a route that many countries in Africa will need to follow, for reasons mentioned above.

2.17.8. Africa

Africa is also characterised by underdevelopment, poverty and uneven availability of technology. According to Byron and Gagliardi (1998) the scarcity or non-existence of more traditional educational facilities and equipment in many areas, often makes suggestions for introducing the sophisticated new technologies into the education system or into grassroots communities, seem a denial of reality. Nevertheless, Chale and Michaud (1997) consider that Africa is ready for well-defined endeavours in distance learning using electronic networking and computer technology. They recognise difficulties of access, but state that infrastructure is improving and that costs will decrease as communities become linked. However, they stress the need to provide enabling legislation for telecommunications policy reforms, policies governing the growth, and the development of ICT industry and support services, and finally policies that relate to ICT support for the delivery of public goods such as education and health. The role of enabling policies is illustrated in the abandonment of all school broadcasts in Kenya in 1996, when producers of education programmes were required to bear the costs of radio broadcasts. Chale and Michaud (1997) conclude that national enabling policies must be developed to ensure the maintenance of equipment, the training of technicians, educators, administrators and users of technologies, and that these policies must be built on the principles of service accessibility and equity. In South Africa, the White Paper on E-Education hopes to address the above issues (chapter 3).

2.18. Concluding Remarks

When all is said and done, the adoption of technology is similar to the adoption of any other educational innovations; however, it is even more time consuming, labour intensive, and expensive. Is it worth it? Probably, yes. Do we have a choice? Probably not. The risks of not using technology are too great, when the rapid pace at which knowledge is expanding is considered, together with the need to communicate and compete globally in an Information Society.

3. South African Government Policy Background

3.1. Introduction

The White Paper on E-Education called "Transforming Learning and Teaching through Information and Communications Technologies" (ICTs) was released in September 2003 by the National Department of Education (DOE 2003). The National Department of Education hopes that provincial departments of education will use this White Paper in planning their ICT integration strategy for teaching and learning. The Electronic Communications and Transactions (ECT) Act 25 of 2002 became law on 30 August 2002 (ECT 2002). This marks the end of a process initiated by the South African Government in 1999 to establish a formal structure to define, develop, regulate and govern e-commerce in South Africa. Since schools will be very much involved in electronic communications, and more so the use of the Internet, certain aspects of the ECT Act will impact on the operations of educators and schools as organizations. What follows in this chapter is a synopsis of both the White Paper on E-Education and the Electronic Communications and Transactions Act in South Africa.

3.2 A Synopsis of the Government's White Paper on E-Education

3.2.1. Introduction

Between 2000 and 2003 the British Council and the South African Department of Education collaborated on a fellowship programme called Tirisano. Tirisano means working together in Setswana (one of the African languages in South Africa).

The following is an extract from the foreword of the White Paper written by the then Minister of Education (Professor Kader Asmal) which is based on the above Tirisano principle:

"This White Paper sets out the Government's response to a new information and communications technology environment in education. We want to ensure that every school has access to a wide choice of diverse, high-quality communication services which will benefit all learners and local communities. The services provided by the initiative will enhance lifelong learning and provide unlimited opportunities for personal growth and development to all. The challenge of providing modern technologies to schools in order to enhance the quality of learning and teaching will require a significant investment. Given the magnitude of the task ahead, and in the true spirit of Tirisano, the public and private sectors will have to join hands to ensure that our children receive high-quality learning and teaching. This White Paper represents a new framework for the collaboration of Government and the private sector in the provision of ICTs in education. Through this initiative, we hope that we will be able to turn our schools into centres of quality learning and teaching for the twenty-first century. We hope this White Paper will enable the education sector and all our partners to ensure optimal availability and use of ICTs in education, in a manner that will create better access to quality education for all, and bridge the digital divide, both within our country, and between our country and other parts of the world." (DOE 2003 p. iv)

Notwithstanding the above scenario – in which the government has undertaken the challenge of providing modern technologies to schools, in order to enhance the quality of learning and teaching - having access to technology does not automatically guarantee use. This study shows that, in schools where technology is available, a fair number of educators are not using it in their teaching, or even for simple, general tasks.

The White Paper on E-Education outlines the following key issues with respect to the use of ICTs in society and education:

- Education and training is undergoing a global revolution. It is driven by the changing nature of work, the realities of the information age, new global partnerships, and an awareness of the need for equal distribution of educational opportunities.

- The public expects education systems to deliver quality education for economic growth and social development. However, in the context of developing countries, quality improvement and the enhancement of excellence must take into consideration the need for increased access, equity and redress. These efforts are, in most instances, undermined by factors such as fiscal constraints, spatial barriers and other capacity-related limitations to delivery. As demonstrated in various contexts, ICTs have the potential and capacity to overcome most of these barriers.

- Internationally, the expansion of ICTs is driving significant changes in many aspects of human endeavor. At both local and national levels, properly used, ICTs have increased the effectiveness and reach of development interventions and enhanced good governance, while also lowering the cost of delivering basic social services.

- Literature has shown that (see for example Pedretti *et al.*(1999)), ICTs have improved the quality of education and training internationally. It is for these reasons that the South African government has been quick to seize the opportunity presented by the practical benefits of ICTs, as a key for teaching and learning in the twenty-first century.

- Curriculum development and delivery has been impacted upon by the ICT revolution and continues to pose new challenges for education and training systems around the world. These challenges can be summarised into three broad areas, namely:

1. participation in the information society,
2. impact of ICTs on access, cost effectiveness and quality of education, and
3. integration of ICTs into the learning and teaching process.

This study focuses on the third challenge, namely the integration of ICTs into the learning and teaching process.

3.2.2. ICTs in Schools in South Africa

Provinces are at different levels of ICT integration in education. Significant progress has been made with provincial implementation mainly in the Western Cape (the Khanya project); in Gauteng (the Gauteng OnLine project) and the Northern Cape (the Connectivity Project). No significant project has yet been undertaken in the province of KwaZulu-Natal (KZN).

Over the past few years, Government, the private sector and non-governmental organisations have responded positively, to some extent, to the challenge of bridging the digital divide. Efforts include, among others, the following:

1. ICT Professional Development

   1.1 SchoolNet SA provides online, mentor-based, in-service training for educators on introducing ICTs into the curriculum and management.

   1.2 SCOPE (Finnish Development Support), SchoolNet SA and the South African Institute for Distance Education have developed 11 Educator Development Modules for introducing ICTs into schools.

1.3 Educator training in ICT integration into teaching and learning is being provided by INTEL "Teach to the Future" an Educator Development Programme.

To what extent these programmes are succeeding is not evident. This study will show that the majority of educators in this sample do not have technology proficiency, and those who do, are not integrating ICT into their teaching.

2. Electronic Content Resources:

2.1 An Educational Portal initiated by the Department of Education provides digital content resources, and

2.2 MINDSET develops content resources and makes these available via satellite television, Internet multimedia and print supplements.

Discussions with Computer Studies educators in the Ethekweni region, reveal that they are not aware of the above initiatives.

3. Infrastructure and Connectivity:

3.1 The Telecommunications Act 103 of 1996 as amended in 2001, calls for the development of an Educational Network and the implementation of an e-rate (a discounted connectivity rate) for the General Education and Training (GET) and Further Education and Training(FET) institutions.

3.2 Microsoft has donated software and provides educator development and support.

3.3 The Digital Partnership Programme provides for 188 000 refurbished computers and 20 000 laptops; Recently 450 schools have been provided with 3 computers each to set up an e-library.

3.4 Through its licensing obligations, SENTEC is obliged to provide 500 schools with computer laboratories and educator development.

3.5 The Telkom Foundation has established Supercentres in more than 1300 schools, providing computers, software applications, Internet connectivity, monthly subscription and a rent-free telephone line.

3.6 Telkom Foundation, together with Telkom's strategic partner Thintana, has committed over R200m to support education and training in the areas of ICT, mathematics and science.

The above projects have helped to increase the number of schools with computers for teaching and learning from 12.3% in 1999 to 26.5% in 2002. However, there are still more than 19 000 schools without computers for teaching and learning.

The email facilities that have been provided by these projects are being used, in many schools, mainly as a management and administrative resource. In a small minority of cases they are being used as a teaching and learning resource. While general Internet access is increasing, the use of the Internet for teaching and learning purposes is very limited, due to high connectivity and telecommunication costs, the lack of local content and examples, and inadequate technical and pedagogical support at local level.

In schools where there are computers for teaching and learning, the teaching of computer literacy forms the most important component of ICT integration with emphasis on basic computer principles and word processing skills. Limited integration into teaching and learning is evident. This study shows that this can be attributed to the lack of technology proficiency, as shown in chapter 4. Beyond the issue of access, there is an inability in the learners and educators to use these technologies effectively, to access high-quality and diverse content, to create content of their own, and to communicate, collaborate and integrate ICTs into teaching and learning.

The E-Education policy goal, as stated in the White Paper, reads as follows:

> *"Every South African learner in the general and further education and training bands will be ICT capable (that is, use ICTs confidently and creatively to help develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community) by 2013." (DOE 2003 p. 10)*

The White Paper further suggests that in order to achieve the E-Education goal, schools will have to develop into learning organisations consisting of a community of both educators and learners. In such schools, educators and learners will be able to function across three dimensions:

- **The operational dimension** refers to the skills that are necessary for the use of new information and communication technologies. Demonstrated acquisition of these skills is as important as the process by which they are acquired. **This study will show that the majority of educators in this sample do not have these skills. There is a lack of overall technology proficiency, as well as core proficiency, as defined in chapter 6.** Approaches that employ an elaborate human network of support among educators and learners, and that adopt a collective approach to knowledge acquisition and problem solving, are ideal for developing ICT skills. In order to facilitate collective learning, provincial departments need to establish opportunities for schools to learn with and from each other about ICTs in education. **The questions to pose are: to what extent has this been implemented by Provincial departments to date? And if not, why not?**

- **The cultural dimension** involves stepping into the culture that supports the practice of using ICTs for educational purposes, regardless of one's level of expertise. This requires educators to move beyond a purely instrumental role that views ICTs as an educational add-on, to regarding technology as something that poses interesting and important questions for administration, curricula and pedagogy. **This study will show that educators are positive towards the impact of computers in their everyday lives.**

- **The critical dimension** invites educators and learners to challenge assumptions that are embedded in the success stories about ICTs inside and outside of schools. This requires a critical dialogue, analysis among educators, and research resources to provoke and expand educators' perspectives on the benefits of ICTs. **The benefits of ICTs for educators are addressed in the questionnaire (Appendix A – No.11, 1-12). The results indicate that educators are very positive towards the advantages of computer technology, its compatibility with current practices, and the simplicity/non-complexity of computers.**

3.2.3. The Use of ICTs in Education

Part of the government's strategy to improve the quality of learning and teaching across the education and training system, is the introduction of information and communication technologies (ICTs). The policy aims to focus on learning and teaching for a new generation of young people who are growing up in a digital world, and are comfortable with technology. Schools must begin to reflect these realities.

E-learning is about learning and teaching philosophies, and methodologies, within the context of outcomes-based education, using ICTs in the learning environment. Enriching the learning environment through the use of ICTs is a continuous process; that is, it is a process that takes learners and educators through **learning about ICTs** (exploring what can be done with ICTs), **learning with ICTs** (using ICTs to supplement normal processes or resources), **and learning through the use of ICTs** (using ICTs to support new ways of teaching and learning).

Learning through the use of ICTs is arguably one of the most powerful means of supporting learners to achieve the nationally-stated outcomes (NCS 2003). In particular, the use of ICTs for learning encourages:

- learner-centered learning,
- active, exploratory, inquiry-based learning,
- collaborative work among learners and educators, and
- creativity, analytical skills, critical thinking and informed decision-making.

E-learning needs to be introduced as an integral part of an environment where teaching is transformed and where learning is an ongoing, creative process. This requires transforming teaching and learning methodology, in which educators and learners will have access to:

- high quality, relevant and diverse resources, beyond those currently provided by school libraries,

- a means of communicating and collaborating with other learners and educators, and
- opportunities to create and present new knowledge.

The introduction of learning through the use of ICTs is not only about creating interesting tasks for learners, but rather about deepening their understanding of the subject matter by facilitating the use of higher-order thinking skills. It involves taking learners beyond recall, recognition and reproduction of information, to the evaluation, analysis, synthesis and production of arguments, ideas and performance.

3.2.4. The Policy Framework

3.2.4.1. Equity

Resource allocation has always been a challenge for Departments of Education. The use of ICTs in schools involves choices about resource allocation. The technically-able and well-equipped school can often make more compelling cases for re-equipping than those who have poor, or no, resources. Technology tends to amplify advantage. It is for this reason that the principle of equity should inform the Department of Education's approach for supplying access to information and the allocation of resources. Equal access and equal competence must be the objective of our education system.

3.2.4.2. Access to ICT infrastructure

The impact and effectiveness of ICTs rests on the extent to which end-users (learners, educators, managers and administrators) have access to hardware, software and connectivity. For e-learning to be successful, learners must have regular access to a reliable infrastructure. At least 25% of the respondents in this study indicate that they do not use a computer because of the lack of access. Eighty two percent (82%) of respondents agree that if they had spare money, they would buy a computer.

3.2.4.3. Capacity building

Educators and learners must view ICTs as integral to teaching and learning. ICT integration supports outcomes-based education, which encourages a learner-centered and activity-based approach to education and training. Any ICT integration requires that educators engage in rethinking and reshaping their engagement with the curriculum. Many educators have grown up in environments with limited electronic technology and, therefore, find the adaptation to working with ICTs more difficult than their learners do. A programme that urgently addresses the competencies of educators to use ICTs for their personal work, in their classrooms, must be developed. This will require extensive staff development and support. ICTs will, therefore, be central to the pre-service training of recruits and the ongoing, professional development of practicing educators.

3.2.5. Strategic Objectives

One of the objectives as stated in the White Paper reads as follows:

> *"Every educator, manager and administrator in General and Further Education and Training must have the knowledge, skills and support they need to integrate ICTs in teaching and learning." (DOE 2003 p. 19)*

The Department of Education must develop a national framework for competencies for educators (educators, managers and administrators), and the use of ICTs must be integrated into pre-service and in-service training.

According to the White Paper, each school will have a dedicated educator to manage ICT facilities and champion the use of ICTs in the school. Support, in the form of incentives, will encourage educators, managers and administrators to integrate technology into their daily activities and areas of responsibility. This will facilitate technological change, experimentation with new ideas, and risk-taking. The Department of Education, in collaboration with relevant government departments, needs to ascertain possibilities for subsidies and special loans to encourage educators to purchase computers for personal use. One way of ensuring educator competence in technology, is where the level of proficiency in the use of ICTs needs to become an integral part of the educator appraisal system and whole-school evaluation.

3.2.5.1. ICT Professional Management

To realise the E-Education goal, educational management needs to move beyond the initial stages of ICT planning and experimentation and make focused capital investments. Educational leaders at all levels (national, provincial, district and institutional) must leverage ICTs as a tool for improved educational performance, and re-organise educational institutions accordingly. Ultimately, educational leaders must view ICTs as an essential transformative tool for education and training, and individually promote and support the use of ICTs in their institutions. Institutional development plans must incorporate ICT development plans. The plans must address the initial cost of ICTs, infrastructure upgrades, security, recurring costs, replacement costs, maintenance and support. In addition, plans should address educator development, skills transfer, support, and additional human resource requirements.

Provincial education departments must plan and budget for training district-level subject specialists, in order to provide ongoing professional and technical support. In the Ethekweni region of KwaZulu-Natal, no Computer Studies Subject Advisor has been appointed since the year 2001. The question that arises is: What type of academic support are educators in KZN receiving with respect to ICT, and from whom?

3.2.5.2. The Role of Higher Education

Higher Education institutions and the Department of Education must work together to design and deliver in-service and pre-service training programmes for educators, managers and administrators. It is also necessary for the Department of Education to ensure the inclusion of ICT integration competencies for educators, administrators and managers in accredited, pre-service, educator training programmes delivered by higher education institutions. Accredited pre-service educator training programmes will provide learners with the basic knowledge, skills and attitudes required to integrate ICTs into subjects of specialisation. This will require that each graduating educator is able to combine knowledge of the learning process and instructional systems theory, with various forms of media and learning environments, to create the most effective and efficient learning experiences.

3.2.5.3. Electronic Resources

The White Paper states that:

> *"The school curriculum in General and Further Education and Training must be supported through effective and engaging software, electronic content and online learning resources, and educators, content developers and administrators who contribute effectively to these resources." (DOE 2003 p. 21)*

Conventional print media, as well as the use of devices such as conventional radio broadcast and tape recorders, will continue to be used in schools. However, the system has relatively under-developed digital teaching and learning resources at present. It is crucial, therefore, that an education-industry partnership be developed to enhance innovative, effective and sustainable e-learning resources. In the interim, the Department of Education must initiate the collection and evaluation of existing digital, multimedia material that will stimulate all South African learners to seek and manipulate information in collaborative and creative ways. Digital content is critical to E-Education because it can be easily and randomly accessed, adapted and manipulated, and is accessible from many locations.

3.2.5.4. Indigenous Languages

The Department of Education, in collaboration with the Department of Arts and Culture, must promote the adaptation and development of local content into indigenous languages. While there is a large amount of curriculum material and resources available on the Internet, this online content must be evaluated for educational relevance prior to adaptation and possible translation into indigenous languages.

3.2.5.5. Creating Electronic Content

The Department of Education must promote the generation of new electronic content that is aligned with outcomes-based education.

3.2.5.6. Digital Libraries

School libraries are currently unable to support resource-based learning in outcomes-based education. The Department of Education must promote access to digital libraries. Information available in public libraries, museums and government offices should be made available in digital formats and networked applications. The most recent development in this regard, is the project in which 450 schools will be equipped with 3 computers each to set up a digital library (SABC 2006).

3.2.5.7. National Education Portal

The Department of Education, in collaboration with the provincial education departments, must initiate the development of a national education portal that will be linked with provincial and privately-owned portals. It should be a distributive tool and a content and information-sharing platform, hosting communications and collaboration applications for learners, educators, administrators, managers and parents. It should serve as a nucleus for building web-based resources for educators, learners and the community, making it possible to create new knowledge and add to the existing knowledge base. The national education portal will require hosting services that should be distributed and decentralised in order to maximise efficiency and minimise duplication.

3.2.5.8. Access to ICT Infrastructure

The White Paper states that:

> *" Every educator and learner in General and Further Education and Training must have access to ICT infrastructure." (DOE 2003 p. 22)*

The provincial education departments must establish a desired level of technology resources (hardware and software) for each GET and FET institution, and assess the adequacy of existing equipment and facilities. At the very least, every GET and FET institution should have access to technology in order to:

- manage administrative functions,
- access electronic learning materials,
- connect to information sources outside the classroom,
- communicate with others in and beyond the institutional boundaries,
- collaborate with others in and beyond the institutional boundaries, and
- create and add to the knowledge base.

National and provincial managers and administrators must plan and mobilise funds for provincial, district and institutional resources to support hardware and equipment installation, as well as the maintenance and repair thereof.

Central to equipping schools with an ICT infrastructure is the provision of electricity and a physical infrastructure. Although there are ICT provisions that use alternative sources of energy, the Department of Education must work with the Department of Minerals and Energy to prioritise the electrification programme for GET and FET institutions. Recent advances in solar energy developed by the University of Johannesburg (UJ 2005) have significant potential in this regard.

3.2.5.9. Connectivity

Every educator and learner in General and Further Education and Training must have access to an educational network and the Internet.

3.2.6. Research and Development

The research and development community must continuously assess current practices, and explore and experiment with new technologies, methodologies and techniques that are reliable and will support educators and administrators in e-learning and e-administration. The best way to learn and understand how to improve practices is through research, evaluation, experimentation and collaboration. To this end, Government must bring together educators, researchers and the ICT industry in an action-oriented research and development forum, to evaluate and develop leading-edge applications for e-learning. Research must be linked to practice. The teaching profession has an obligation to play an important role in generating ideas, testing prototypes and implementing strategies. Research for e-learning should be closely linked to other general research on learning. The Department of Education, in collaboration the Departments of Communications and Science and Technology, the teaching profession, higher education institutions and research agencies, must formulate a research agenda on ICTs for e-learning.

3.2.7. Concluding Remarks

Despite the policy as set out in the White Paper above, the reality on the ground must be taken into account. The government must realise that bridging the digital divide and building an integrated E-Education system will require greater investment in the education sector. The initial upfront and long-term outlay of funds for provincial departments of education is going to be huge, if the national goals for E-Education are to be realised. Provincial Departments of Education will be faced with the challenges of ongoing costs of providing access to technology, educator professional development, pedagogical and technical support, digital content and telecommunication charges, as well as maintenance, upgrades and repairs.

3.3. A Synopsis of the Government's Electronic Communications and Transactions (ECT) Act.

3.3.1. Introduction

The ECT Act is one of many sources of law which impact on electronic communications and transactions. It applies to any form of communication by e-mail, the Internet, SMS etc. (and possibly excludes voice communications between 2 people). The Act is also "an enabling" piece of legislation in that it provides functional equivalents for paper-based concepts (including writing, original and signature). Some of these concepts are encountered in over 300 pieces of legislation identified by the Department of Communications in 1999 which were not suitable to the information age, as they all had paper-based concepts within them. The Act is also a very wide piece of legislation which deals with issues which are not related to electronic communications and transactions (such as cyber inspectors, liability of service providers and domain names). In addition, it attempts to provide legal certainty in areas of law where there was legal uncertainty prior to August 2002 (for example, the formation of contracts and the status of so-called "click wrap" agreements).

3.3.2. Key Issues

Key issues that are addressed in the Act include:

- Maximising benefits - creating a national e-strategy around the promotion of universal access to electronic transactions with a view to bridging the digital divide, especially for members from previously disadvantaged communities.

- Legal certainty - providing for the legal recognition of electronic contracts and signatures and facilitating record retention, electronic evidence and automated transactions.
- E-govemment - encouraging electronic communications between Govemment and citizens.
- Security - the registration of cryptography service providers, the accreditation of electronic signature technologies by authentication service providers and the protection of critical databases.
- Protection of individuals - the protection of the consumer (by stipulating minimum information to be provided to consumers) and the protection of personal information and critical data.
- Illegal activities and enforcement - the creation of new "cyber offences" and cyber-inspectors to administer certain provisions of the Act.
- Effective management of Internet-related issues - the establishment of a proper management regime with regard to domain names in the Republic of South Africa, and the limitation of liability of Internet Service Providers.

Educators and school administrators will need to understand the impact of electronic contracts and automated transactions, since many parents will themselves be using electronic communications and they will expect schools to cater for electronic communications.

Some interesting points about the Act that require acknowledgement are:

- No Prescription: Although the Act does contain certain provisions relating to the use of "advanced electronic signatures", the registration of cryptography products and services, essential information that has to be available to consumers of a website where goods or services are offered and certain computer related activities which are now "cyber" crimes, it leaves it up to the individual to decide how he/she wishes to communicate or conclude transactions electronically.

- Relevance: Although the Act comprises 14 chapters and 95 sections, only certain sections of the Act may impact on educators or non-profit organizations.

- Paradigm Shift: The impact of the widespread use of e-mail and electronic documents requires a paradigm shift in the way in which many think about documents. There are new risks associated with the use of electronic documents. As one cannot store an electronic document in a safe (unless it is on a CD ROM) educators and administrators need to start thinking about whether or not their important documents will be electronic or paper-based. Further, they need to decide whether or not the "original" of a document will now be the paper-based version or an electronic version.

3.3.3. Chapter Summaries

The following is a brief description of those aspects of the act which were considered relevant to the school system, as interpreted by Michalsons Attorneys (2002) and Buys (2004).

Chapter I: Interpretation, Objects and Application

This part of the Act defines critical words and phrases and sets out the main objects of the Act.

Chapter II: Maximising Benefits and Policy Framework

The objective is to maximise the benefits offered by the Internet by promoting universal access in under-serviced areas, and ensuring that the special needs of particular communities, and the disabled, are duly taken into account. The Act requires the Minister to develop a 3-year, national e-strategy for the Republic. The national e-strategy must set out the electronic transactions strategy of the Republic, programmes and means to achieve universal access and human resource development. This poses quite a challenge for schools in which there is a lack of resources and technology competence. The Provincial Departments of Education will also need to have an e-strategy to facilitate this "universal access" and "human resource development".

Chapter III: Facilitating Electronic Transactions

This Chapter deals with the removal of legal barriers to electronic transacting and covers the legal requirements of data messages containing electronic signatures. School administrations will need to ensure that their administration is computerized so as to offer the facility of electronic communication and related utilities to parents.

Chapter IV: E-government

This Chapter facilitates electronic access to government services, such as e-filing. It lists the requirements for the production of electronic documents and the integrity of information. Provision is made for any public body to accept and transmit documents in the form of data messages, and to issue permits or licenses in the form of data messages, or make or receive payment in electronic form, or by electronic means. The public body may specify any requirements (such as security and authentication) in the Government Gazette.

Chapter V: Cryptography Providers

The Internet presents security challenges which, without an effective regulatory framework, would pose a threat to the security of users. School administrators must ensure proper care is taken when selecting cryptography providers for confidential transactions.

Chapter VII: Consumer Protection

Website categories of information: Suppliers of goods or services must provide consumers with a minimum set of information, including the price of the product or service, contact details and the right to withdraw from an electronic transaction before its completion. The Act also seeks to place the responsibility on businesses trading on-line to make use of sufficiently secure payment systems. If a payment system is breached, the supplier must reimburse the consumer for any loss suffered.

Chapter VIII: Personal Information and Privacy Protection

Personal information includes any information capable of identifying an individual. Collectors of personal information may subscribe to a set of universally accepted data protection principles.

Chapter XII: Cyber Inspectors

The cyber inspectors may monitor School websites and investigate whether or not they comply with the relevant provisions of the act.

Chapter XIII : Cyber Crime

Chapter XIII of the Act seeks to make the first statutory provisions on cyber crime in the South African Justice system. The Act seeks to introduce statutory criminal offences relating to the following:

- unauthorised access to data (for example, so-called "hacking" and trading in passwords used to commit an offence),
- interception of data (for example, tapping into data flows),
- interference with data (for example, viruses), and

- computer related extortion, fraud and forgery (for example, where someone gains financially by undertaking to cease something using a computer).

Any person aiding or abetting another in the performance of any of these crimes will be guilty as an accessory. The Act prescribes the penalties for those convicted of offences, which render a person liable to a fine or imprisonment for periods not exceeding 12 months in certain circumstances, or five years in other circumstances.

3.3.4. Concluding Remarks

Eventually, educators and school administrators will become daily users of electronic communication and the Internet. It is imperative that they are aware of legislation that governs e-communication. Documents that were once paper-based could now very easily be electronic-based and, therefore, issues of electronic signatures and what constitutes an original document will be of utmost importance to educators and school administrators. Educators will need to be highly aware of cryptography services or products, in order to send and receive examination papers securely via the net. Because of the extensive use of email and the Internet, educators must also be conscious, and make their learners aware, of unsolicited communications (Spam). Educators need to make learners aware of cyber crimes, such as hacking, which are now easily prosecutable. Finally, schools will need to cater for parents using electronic communications and offer them all the utilities that accompany it, such as electronic payment, email and e-reports, among others.

4. Design & Methodology

4.1. The study

Given the importance of educators' attitudes and the relationship of their attitudes to the variables discussed in the literature review, the purpose of this study is, therefore, to determine the secondary school educators' attitudes toward ICT in South African education. Furthermore, this study aims to explore the relationship between their attitudes and factors that are thought to be influencing them, including perceived computer attributes, cultural perceptions, perceived computer competence and general computer use. The different constructs that were extracted from the different IS theories/models on technology adoption, were also used to determine the best predictor of educators' attitudes and thus technology adoption. The researcher also attempted to ascertain to what extent ICT is being used by educators when access and computer competence is not an issue, as well as the reasons for non-usage. Finally, the study considers challenges facing the Provincial Department of Education with respect to ICT integration in their schools in KZN.

4.2. Methodology

This is a descriptive study of an exploratory nature. Creswell (2003, p.30) suggests that exploratory studies are most advantageous when ''not much has been written about the topic or the population being studied''. The target population in this study is secondary school educators in the Ethekwini Region of KZN. The list of educators is based on the Deparment of Education's, Education Management and Information Systems (EMIS) list, which is maintained and updated on an annual basis by the Provincial Education Management and Information Systems Department of Education. The total number of secondary schools in the Ethekwini Region on the Department of Education's EMIS list is 403, as of the 30 March 2004. Of these schools, 382 have staff ranging from 2 to 60, and the balance of 21 schools show 0 staff members. The researcher chose, at random, every alternate school and has a sample of 191 schools. The Ethekwini region is made up of three districts viz. Ilembe, Pinetown and Umlazi. Once the sample has been chosen, the number of schools per district is as follows:

DISTRICT	**NUMBER OF SCHOOLS**
Ilembe	57
Pinetown	68
Umlazi	66
TOTAL	191

Table 3: Distribution of Schools

Gay and Airasian (as *cited* in Leedy & Ormrod , 2005) have offered the following guidelines when selecting a sample size:

- For small populations (with fewer than 100 people), there is little point sampling, therefore, one should survey the entire population.
- If the population size is around 500, one should sample at least 50% of the population.
- If the population size is around 1500, then one should sample at least 20% of the population.
- Beyond a certain point (at about 5000 or more), one should sample at least 400 of the population.

The researcher holds that the sample is a truly representative sample, because every alternate school in a district has been chosen and this represents 50% of the secondary schools in the Ethekweni region. Secondary schools have been chosen because the White Paper on E-Education (DOE 2003) has made access to ICT infrastructure a priority in secondary schools: "Every educator and learner in General and Further Education and Training (FET) must have access to ICT infrastructure" (p. 22). Computer related subjects namely: Computer Studies and Compu-Typing are offered in the FET phase as specializations and one felt that this would be a good place to start.

Questionnaires were distributed to the above 191 schools. A letter of recruitment (Appendix B) and a letter (Appendix C) indicating that permission had been granted by the Department of Education (KZN) accompanied the questionnaires (Appendix A) to schools. Letters (Appendices D & E) to the Directors of the different districts, and to the Circuit Managers of the different circuits, were issued before the process of accessing schools and educators. The average number of staff in schools in the Ilembe and Umlazi districts is 15 and the average number of staff in schools in the Pinetown district is 20. Therefore, 15 questionnaires were sent to each school in Ilembe and Umlazi and 20 questionnaires were sent to each school in Pinetown. Some schools received their questionnaires via the circuit office and others received them via post. Most Circuit Managers were cooperative in assisting in the distribution and collection of these questionnaires. However, there were a few who emphatically did not want to assist with this study and this made collection of questionnaires from these schools very difficult.

It is interesting to note that in the Ethekwini region, 135 (33%) of the 403 secondary schools have computer rooms with 10 or more computers. Of the 191 schools there are 18 schools that indicate that they did not receive the questionnaires, 2 indicate that they had misplaced them and another 3 refuse to participate in the study. Returns from 93 schools were received. This gives a 55.4% rate of return. In total, 1237 questionnaires were received from schools. There are 15 questionnaires that were considered to be spoilt because they were partially completed, were illegible, or had contradictory entries. Data from 1222 questionnaires has been used. This sample size adequately satisfies Leedy & Ormrod's (2005) requirements (as stated above) as the total number of secondary educators in the Ethekwini region stood at 8026 as per EMIS database. The 1222 responses that were used will represent a total of 15.23% of our sampling frame.

Table 4 gives a frequency analysis of respondents according to gender, Table 5 gives a frequency analysis of respondents according to age and Table 6 gives a frequency analysis of respondents according to race.

	Frequency	Percent	Cummulative Percent
Female	704	57.6	57.6
Male	512	41.9	99.5
NoEntry	6	.5	100.0
Total	1222	100.0	

Table 4: Gender Distribution

	Frequency	Percent	Cumulative Percent
21&under	7	0.6	0.6
22-30	210	17.2	17.8
31-40	494	40.4	58.2
41-50	395	32.3	90.5
51-60	96	7.9	98.4
61&Older	7	0.6	98.9
NoEntry	13	1.1	100.0
Total	1222	100.0	

Table 5: Age Distribution

	Frequency	Percent	Cumulative Percent
African	486	39.8	39.8
Coloured	23	1.9	41.7
Indian	573	46.9	88.5
White	123	10.1	98.6
No Entry	17	1.4	100.0
Total	1222	100.0	

Table 6: Race Distribution

Of the schools that responded, 44 (47%) of the 93 had computer rooms for teaching and learning. However, results will show that a very small percentage of educators in these schools are using technology in their teaching. In order to understand why educators do, or do not, use technology, perceptual control theory will be used. Perceptual Control Theory (PCT) provides a comprehensive model for understanding technology infusion (Zhao & Cziko 2001). This is elaborated on in Chapter 8. According to PCT (McClelland 1998 and Powers 1973), the activation of purposeful agents (such as human beings) towards the success of their objectives occurs when a discrepancy is detected between what is perceived, and what is internally established as a standard of reference. Discrepancies could emerge either as a result of changing perceptions about conditions of the external environment, or as an alteration of an internal reference condition. As a result, the individual begins to vary his/her behaviour, trying to minimize the discrepancy and its consequences.

4.3. Questionnaire

The questionnaire was created with items validated in previous research (Davis 1989, Davis *et al.* 1989, Venkatesh & Davis 2000, Vannatta & O'Bannan 2002, Abdulkifi Albirini 2004, and Venkatesh *et al.* 2003) and adapted for this study. The TRA scales were adapted from Davis *et al.* (1989), the TAM scales were adapted from Davis (1989) and Venkatesh and Davis (2000), the TPB scales were adapted from Taylor and Todd (1995) and the DOI scales were adapted from Moore and Benbasat (1991). All other scales were adapted from Venkatesh *et al.* (2003). A five point scale was used for all of the constructs' measurement, with 1 being the strongly negative end of the scale and 5 being the strongly positive end of the scale.

The development of the questionnaire was guided by an extensive review of the literature. The questionnaire (Appendix A) consists of 17 elements. The elements comprise demographic and perceptual data. The instrument was also evaluated by the Department of Education's Research, Strategy and Policy Development unit and the

University of KwaZulu-Natal's ethical clearance committee (see Appendices F & G). Feedback was mainly used to ensure that the scales measure the content areas of investigation, and are culturally and technically appropriate for the context of the study. The Cronbach's reliability coefficients for elements 10, 11, 12 and 14 are: computer attitude = 0.87, computer attributes = 0.71, cultural perceptions = 0.77, and computer competence = 0.95.

The data was analyzed using the statistical package SPSS®. Descriptive statistics are used to describe and summarize the properties of the mass of data collected from the respondents (Diamantopoulos & Schlegelmilch 2000). Regression analysis was used to determine the proportion of the variance in the attitudes of educators toward ICT in education which could be explained by the selected independent variables, and the relative significance of each in explaining the dependent variable. By convention, a level of 0.05 was used for determining statistical significance. Prior to conducting the analysis, the scoring of all negatively stated items was reversed.

5. Attitudes of Educators

5.1. Introduction

According to Rogers (1995) peoples' attitudes towards a new technology are a key element in its diffusion. As explained in the literature review (chapter 2) peoples attitudes are made up of three components namely, affective, cognitive and behavioural. Kersaint *et al.* (2003) have shown that the successful implementation of educational technologies depends largerly on the attitudes of educators. For this study educators' attitudes were analysed according to the affective, cognitive and behavioural domains.

5.2. Research Question One: What are the attitudes of high school educators in KZN toward ICT in education?

Participants were asked to respond to 20, Likert-type statements dealing with their attitudes toward ICT in education (Appendix A No. 10). The items are designed to measure the affective domain of computer attitude (items 1–6), cognitive domain (items 7–15), and behavioural domain (items15–20). Computer attitudes of KZN educators is represented by a mean score on a 5-point scale, where 5 (Strongly Agree) represents the maximum score of the scale and 1 (Strongly Disagree) represents the minimum score. A zero indicates no entry.

For each of the above categories (affective, cognitive and behavioural), a variable is computed to represent an individual's average score. The polarity for negative statements is reversed to achieve a correct and meaningful score when using SPSS®

	Affective	Cognitive	Behavioural	Average Score
Mean	4.162	4.367	4.376	4.301
Median	4.333	4.444	4.600	4.459
Mode	5.000	5.000	5.000	
Standard Deviation	0.7175	0.5533	0.7348	0.668

Table 7: Educators' attitudes towards ICT in Education

Table 7 illustrates the distribution of mean, median, mode, and standard deviation (SD) scores on the attitude toward ICT scale. As Table 7 illustrates, educators' overall attitudes toward ICT are very positive, with an overall mean score of 4.3 (SD = 0.66). The respondents' positive attitudes are evident within the affective (mean = 4.16), cognitive (mean = 4.37) and behavioural (mean = 4.38) domains. This augurs well for enhancing computer integration and avoiding educators' resistance to computer use in the classroom as noted by Watson (1998). These positive attitudes will encourage the less technologically capable educators to learn the skills necessary for the implementation of technology based activities in the classroom (Kluever *et al.* 1994).

Figure 6 represents the attitudes of educators towards ICT within the affective domain, cognitive and behavioural domain. Within the affective domain, eighty-four percent (84%) of the respondents have a positive affect toward computers. These respondents report that they have no apprehension of computers, are glad about the increased prevalence of computers, consider using computers enjoyable, feel comfortable about computers, and like to talk with others about computers and to use them in teaching. The "increased prevalence of computers" receives the most favourable responses in this category (affective). The affective component, which represents an individual's emotional response or liking to a person or object, is very positive for our respondents. That is, they seem to have an affinity towards computers.

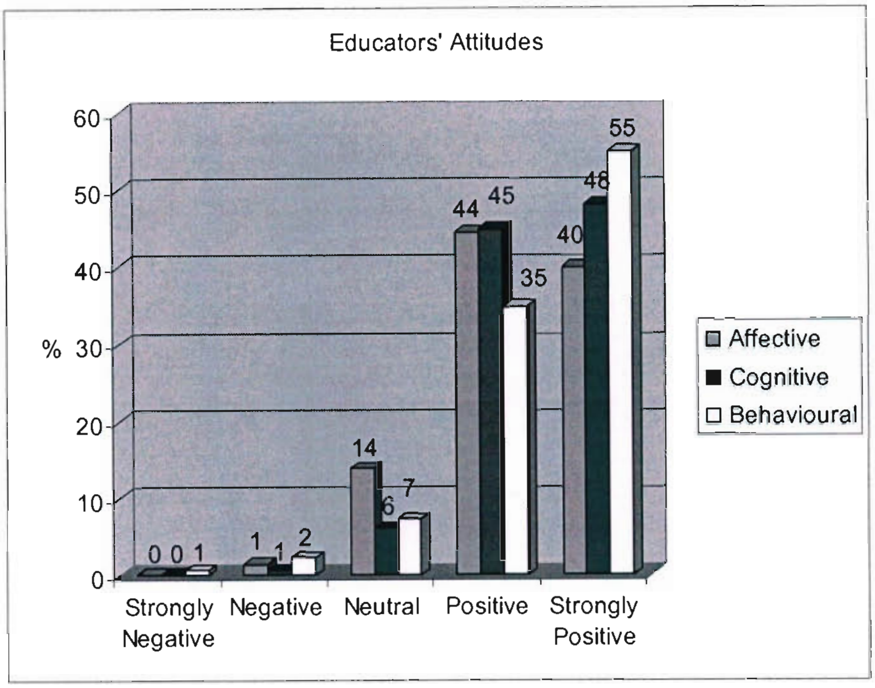

Figure 6: Educators' Attitudes

Within the cognitive domain, 93% of the respondents are of the opinion that computers save time and effort, motivate learners to do more study, enhance learners' learning, are a fast and efficient means of getting information, must be used in all subjects, make schools a better place, are worth the time spent on learning them, are needed in the classroom, and, generally, do more good than harm. "Schools will be a better place" receives the most favourable responses in this category (cognitive). This tells us that respondents do have factual knowledge of computers.

In the behavioural domain, 90% of the respondents express positive behavioural intentions in terms of buying computers, learning about them, and using them in the near future. The behavioural component represents a person's overt behaviour towards a person or object (Zimbardo *et al.* 1997). Ninety five percent of our respondents are very positive towards the statement "I would like to learn more about computers" as expressing their opinion. This supports the need for retraining of these educators to acquire technology proficiency. This is sadly lacking in the present environment.

5.3. Discussion of above Results

The study investigates the attitudes of secondary school educators in a large region of the KwaZulu-Natal province, toward ICT and the relationship of educators' attitudes to a selected set of independent variables. Educators' attitudes toward ICT have been universally recognized as an important factor for the success of technology integration in education (Rogers 1995, Watson 1998, Woodrow 1992). Findings from this study suggest that participants have positive attitudes toward ICT in education. The respondents' positive attitudes are evident within the affective, cognitive and behavioural domains. Such optimism cannot simply be attributed to the novelty of computers in South African education. The participants seem to have totally accepted the rationale for introducing ICT into schools and are able to base their judgments on understandable reasons. The majority of respondents (90%), therefore, consider computers as a viable educational tool that has the potential to bring about different improvements to their schools and classrooms.

Educators' positive attitudes show their initiation into the innovation-decision process (Rogers 1995). It seems that educators have already gone through the Knowledge and Persuasion stages (Rogers 1995) and are probably proceeding to the Decision phase. As many theorists have indicated, attitudes can often foretell future decision-making behaviour (Ajzen & Fishbein 1980). Having formed positive attitudes toward ICT in education, participants are expected to be using ICT in their classrooms once computers become more readily available to them. However, it must be noted that participants in this study must also obtain the core proficiency in order to use computers. In fact, the behavioural subscale of the computer attitude scale shows that the majority of educators (93%) have the intention to learn about computers and to use them in the near future. This relationship between attitudes toward ICT, and its use in the classroom, has been widely reported in the literature (for example, Blankenship 1998, Isleem 2003).

5.4. Conclusion

Given the recent presence of technology in their schools, developing countries have the responsibility not for merely providing computers for schools, but also for fostering a culture of acceptance of these tools among the end-users. Hence, the study of educators' attitudes becomes indispensable to the technology implementation plans. As Sheingold (1991, *cited* in North Central Regional Educational Laboratory, 2003) notes, the challenge of technology integration into education is more human than it is technological. The findings of this study may be specific to KZN educators in South African education, but the implications are significant to other educators as well. Educators' positive attitudes in the current study have a special significance given the limitations characterizing the current status of ICT in South African schools: insufficient computer resources and educators' lack of computer competence. It is, therefore, essential for policy-makers to sustain and promote educators' attitudes as a prerequisite for deriving the benefits of costly technology initiatives. Since positive attitudes toward ICT usually foretell future computer use, policy-makers can make use of educators' positive attitudes toward ICT to prepare them better for incorporating ICT into their teaching practices.

6. Perceptions' of Educators

6.1. Introduction

One of the major factors affecting people's attitudes toward a new technology is the attributes of the technology itself (Rogers 1995). Rogers went on to identify five main attributes of technology that affect its acceptance and subsequent adoption: relative advantage, compatibility, complexity, observability and trailibility. Rogers and Shoemaker (1971) found that relative advantage, compatibility and observability are positively related to adoption whereas complexity is negatively correlated. As stated in the literature review, the importance of cultural/social norms of a given country is relevant to the acceptance of technology among its people. In addition to cultural norms and computer attributes, the literature also identified educators' computer competence as being related to their attitudes toward computer technologies. Finally, information systems literature has a number of IS models/theories that can be used to predict technology acceptance/adoption. Here researchers can either choose a particular model or "pick and choose" constructs across models to enable them to predict technology acceptance/adoption. In this chapter the perceptions of educators are analysed for all of the above variables. Research question two is subdivided into 4 sub-questions for ease of reading and analysis.

6.2. Research Question Two

6.2.1. What are the Educators' Perceptions of Computer Attributes?

Participants are asked to respond to 16, Likert-type statements (Appendix A No. 11) dealing with their perceptions about the relative advantage of computers (items 1–4), the computers' compatibility with educators' current practices (items 5–8), the simplicity/non-complexity of computers (items 9–12), and their observability (items 13–16). A more detailed explanation of this concept may be found in the literature review (Chapter 2).

Computer attitudes of KZN educators, in terms of the computer attributes, is represented by a mean score on a 5-point scale, where 5 (Strongly Agree) represents the maximum score of the scale and 1 (Strongly Disagree) represents the minimum score. A zero indicates no entry.

For each of the above categories (advantages (ADVAN), compatibility (COMPAT), non-complexity (COMPLEX) and observability (OBSERV)) a variable is computed to represent an individual's average score. The polarity for negative statements is reversed to get a correct and meaningful score when using SPSS®.

	ADVAN	COMPAT	COMPLEX	OBSERV	AVERAGES
Mean	3.94	3.32	3.63	2.56	3.36
Median	4.00	3.00	4.00	3.00	3.50
Mode	4.00	3.00	4.00	3.00	
Standard Deviation	0.837	0.618	0.841	0.633	0.732

Table 8: Educators' perceptions in terms of factors related to attitudes toward ICT.

Overall, the respondents' perceptions of computer attributes are somewhat positive, with an overall mean score of 3.36, and a standard deviation of 0.73 (Table 8).

According to Rogers (1995), a new technology will be increasingly diffused if potential adopters perceive that the innovation has an advantage over previous innovations, is compatible with existing practices, is not complex to understand and use, and shows observable results. Respondents' positive perceptions vary across the four computer attributes examined in this study. Educators' responses are most positive about the relative advantage of computers as an educational tool (mean = 3.94; SD = 0.84) (Figure 7). Less positive are educators' perceptions of the compatibility of computers with their current practices (mean = 3.32; SD = 0.62) (Figure 7). While the majority of respondents indicate that computer use suits their learners' learning preferences, and level of computer knowledge, and is also appropriate for many language learning activities, most of them are uncertain about whether or not computer use fits well in their curriculum goals, and the majority report that class time is too limited for computer use. Similarly, educators' perceptions of the simplicity of computers (i.e., ''non-complexity'' before the negative items are reversed) are also midway between neutral and positive (mean = 3.63; SD = 0.84) (Figure 7). Most of the educators' responses are split between positive and neutral about whether or not it is easy to understand the basic functions of computers, operate them, and use them in teaching. Lastly, educators' responses on the observability subscale indicate somewhat neutral to negative perceptions (mean = 2.56, SD = 0.63) (Figure 7). Most of the respondents report that they had not seen computers at work as educational tools in general, and in the South African educational context in particular.

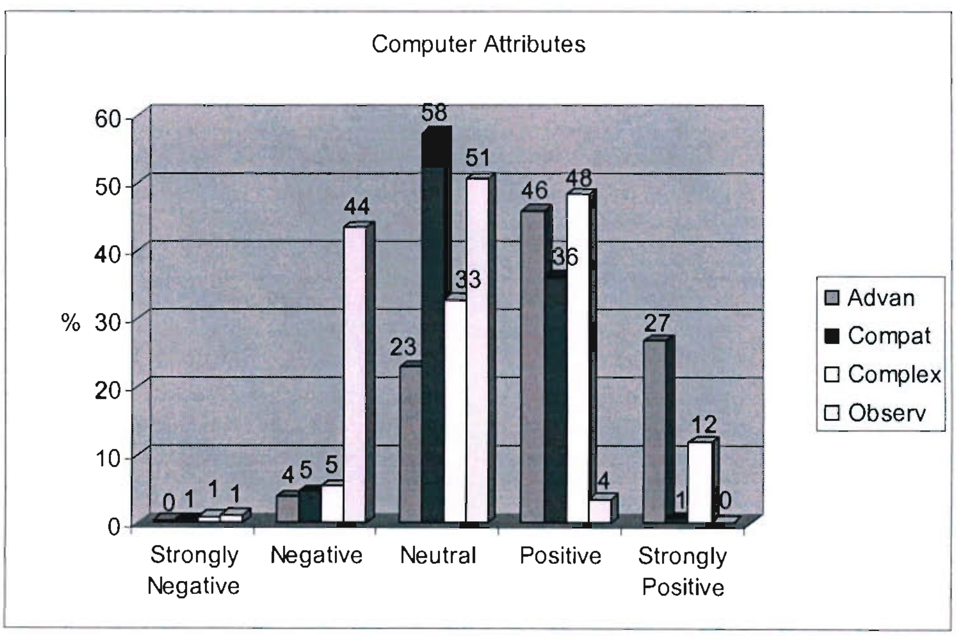

Figure 7: Computer Attributes

6.2.2. What are the educators' perceptions of the cultural relevance of computers to the South African society and schools?

Thomas (1987) argues that the acceptability of a new technology in a society is dependent on how well the proposed innovation fits the existing culture. To investigate this, participants were asked to respond to 16 Likert-type statements (Appendix A No.12) dealing with their perceptions about the value, relevance, and impact of ICT as it relates to cultural norms in the South African society and schools.

Computer attitudes of KZN educators in terms of cultural norms is represented by a mean score on a 5-point scale, where 5 (Strongly Agree) represents the maximum score of the scale and 1 (Strongly Disagree) represents the minimum score. A zero indicates no entry.

A variable is computed to represent an individual's average score. The polarity for negative statements is reversed to achieve a correct and meaningful score.

In general, participants' responses to the 16 items on the Cultural Perceptions scale are neutral to positive (mean = 3.62, SD = 0.60) (Table 9).

Mean	3.62
Median	4.00
Mode	4.00
Standard Deviation	0.602

Table 9: Cultural Perceptions

The majority of the respondents have neutral to positive perceptions about the relevance of ICT to South African society and schools (figure 8). Notably, most of the respondents indicate that learners need to know how to use computers for their future jobs. Moreover, most of them state that computers will contribute to improving their standard of living, and that knowing about computers earns one the respect of others and ensures privileges not available to others. In addition, the majority of the respondents indicate that computers do not increase their dependence on foreign countries, dehumanize society, or encourage unethical practice.

However, the fact that respondents see ICT as culturally appropriate for South African schools and society does not prevent them from indicating that there are other social issues that need to be addressed before implementing computers in education, that computers are proliferating too fast, and that alternative computers which better suit the African culture and identity are needed (Appendix A).

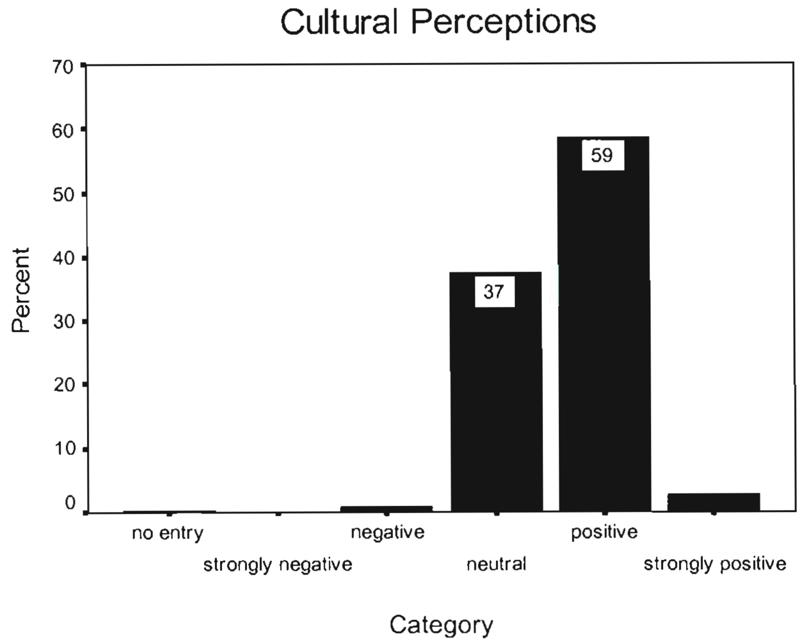

Figure 8: Cultural Perceptions of Computers

6.2.3. What are the educators' perceptions of their level of computer competence?

As noted in the literature review, Francis Pelton & Pelton (1996) have commented that while educators believe that computers are an important component of a learner's education, their lack of knowledge and experience leads to a lack of confidence in their attempt to integrate computers into their classroom instruction. To determine computer competence, participants were asked to rank their technology proficiency on 17 items (Appendix A No. 14) using a scale from 1 to 4 where 1 represented no proficiency, 2 represented less proficiency, 3 represented moderate proficiency and 4 represented high proficiency.

Computer competence for KZN educators is then computed using all 17 items to give an overall competence score. The score is then averaged to give an overall proficiency/competency score between 4 (high proficiency) and 1 (no proficiency). Further to the overall score, a core competence score was calculated using only 4 items to get a score between 4 and 16. The 4 items are: the computer, word processing, email and Internet. The use of the computer for word processing, email and the Internet by educators is seen as core to facilitating the integration of ICT into the school curriculum. Without these basic skills, it is unlikely that an educator will be able to start to integrate ICT successfully into the school curriculum. For each of the 4 items, at least a level of moderate proficiency (score 3) is required to determine whether an educator has the core competence (score >11) or not. This score is also averaged to give a score between 4 & 1.

Table 10 illustrates the distribution of mean, median and standard deviation scores for overall proficiency and core proficiency, as defined above, and Table 11 is a frequency analysis of the calculated overall proficiency score of educators.

	Overall Proficiency Score	Core Proficiency (YES/NO)
Mean	2.12	2.23
Median	2.00	2.00
Standard. Deviation	0.854	1.07

Table 10: Technology Proficiency

	Frequency	Percent	Cumulative Percent
No Proficiency	302	24.7	24.7
Less Proficiency	558	45.7	70.4
Moderate Proficiency	281	23.0	93.4
High Proficiency	81	6.6	100.0
Total	1222	100.0	

Table 11: Overall Proficiency Score

The majority of the respondents have no (24.7%) or little (45.7%) computer competence in handling most of the computer functions needed by educators. Only twenty three percent (23.0%) of the respondents have moderate computer competence, and less than 7% (6.6%) possess high computer competence (Table 11 & Figure 9). These findings are similar to results found in a study done by Angeli 2005.

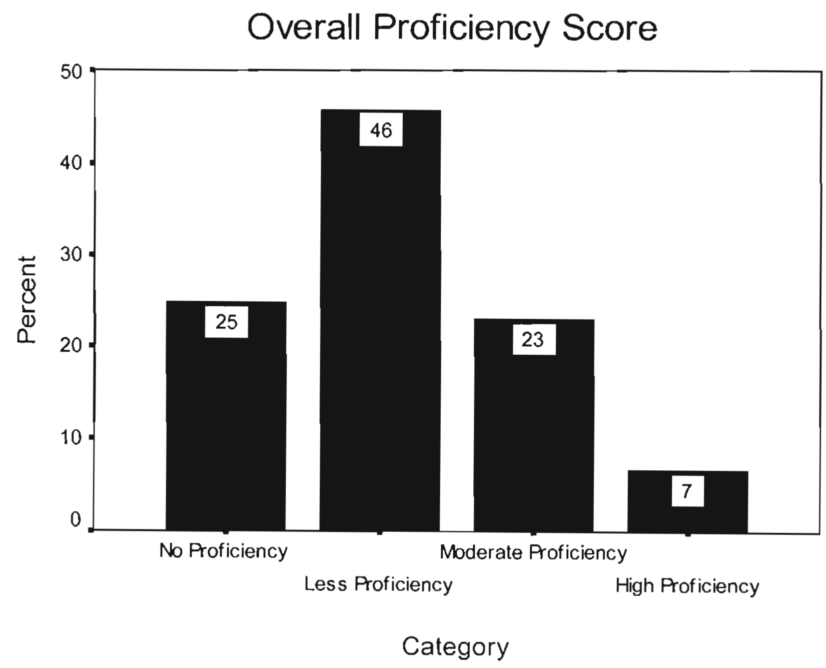

Figure 9: Overall Proficiency Score

Table 12 is a frequency analysis of the calculated core proficiency score of educators.

	Frequency	Percent	Cumulative Percent
No	832	68.1	68.1
Yes	390	31.9	100.0
Total	1222	100.0	

Table 12: Core Proficiency

It is quite alarming to find that 68.1% of respondents have no core competence (Table 12). This poses a significant challenge to The Department of Education (KZN). If only 32% of educators (Figure 10) in the Ethekwini region have core competence in using technology, how will the issues of ICT integration be addressed as outlined in the Draft White Paper on E-Education? The Department of Education (KZN) needs to design a strategy that will address this lack of computer competence.

For ICT integration to take place in the curriculum, educators themselves must first be technologically competent. A start would be to ensure that each school has at least 2 to 3 computers for administrative purposes. Educators will need to be trained to do their administrative work on the computer first, and become comfortable with the technology, before using it in the classroom.

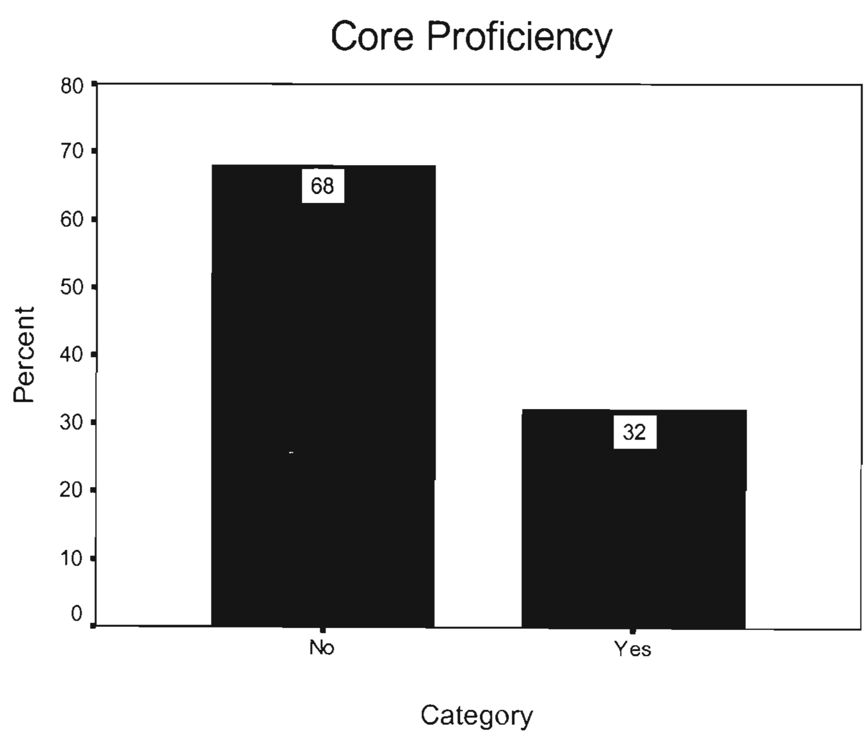

Figure 10: Core Proficiency

The issue of core and overall proficiency is further analysed in chapter 8.

6.2.4. What are educators' perceptions of the different constructs extracted from different IS theories/models on technology adoption?

The Unified Theory of Acceptance and Use of Technology Model (UTAUT) (Venkatesh *et al.* 2003) is a recent attempt to improve the different IS models on technology adoption. The constructs that were common to UTAUT and other models were extracted and used for this study.

The relationship of the Unified Theory of Acceptance and Use of Technology Model (Venkatesh et al. 2003) with other models and this study follows:

According to Venkatesh *et al.* (2003) seven constructs appeared to be significant direct determinants of intention or usage in one or more of the individual models examined. Of the seven, Venkatesh *(ibid)* theorizes that four constructs will play a significant role as direct determinants of user acceptance and usage behaviour. These four are: performance expectancy, effort expectancy, social influence and facilitating conditions. Each of these four constructs has similarities with constructs from other models as reviewed in the literature (chapter 2) and by Venkatesh *et al.* (2003). These similarities are discussed below.

- *Performance Expectancy* is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance (Venkatesh *et al.* 2003). Other constructs from different models that pertain to performance expectancy are perceived usefulness (TAM/TAM2, TPB – see chapter 2), extrinsic motivation (Davis *et al.* 1992) and relative advantage (DOI).

- *Effort Expectancy* is defined as the degree of ease associated with use of the system (Venkatesh *et al.* 2003). Three constructs from other models capture the concept of effort performance: perceived ease of use (TAM/TAM2), complexity (Thompson *et al.* 1991) and ease of use (DOI).

- *Social Influence* is defined as the degree to which an individual perceives that important others believe he or she should use the new system (Venkatesh *et al.* 2003). Social influence as a direct determinant of behavioural intention is represented as subjective norm in TRA, TAM2, TPB and as image in IDT. Thompson *et al.* (1991) used the term social norms in defining their construct and acknowledge its similarity to subjective norm in TRA.

- *Facilitating Conditions* are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system (Venkatesh *et al.* 2003). This definition encompases concepts captured in three different constructs: perceived behavioural control (TPB), facilitating conditions (Thompson *et al.* 1991) and compatibility (DOI). Each of the above constructs were operationalised in the questionnaire for this study.

The following table shows how these constructs were operationalised using items from the questionnaire (Appendix A).

Construct	**Definition**	**Items from Questionnaire**
Perceived Usefulness (Davis 1989)	The degree to which a person believes that using a particular system would enhance his/her job performance.	1. Computers save time and effort. 2. Students must use computers in all subjects. 3. School will be a better place without computers. 4. Learning about computers is a waste of time. 5. Computers are a fast and efficient way of getting information. 6. Computers would motivate learners to do more study. 7. Computers can enhance a learner's learning.

Construct	Definition	Items from Questionnaire
Extrinsic Motivation (Davis *et al.* 1992)	The perception that users will want to perform an activity because it is perceived to be instrumental in achieving valued outcomes such as improved job performance.	Extrinsic motivation is operationalised using the same items as perceived usefulness from TAM as well as, 1. I would like to learn more about computers. 2. I would avoid computers as much as possible. 3. I have no intention to use computers in the future.
Perceived Ease of Use (Davis *et al.* 1992)	The degree to which a person believes that using a system would be free of effort.	1. It would be difficult for me to learn to use a computer 2. I have no difficulty in understanding the basic functions of computers. 3. Computers complicate my tasks in the classroom. 4. Everyone can easily learn to use a computer.
Complexity (Thompson *et al.* 1991)	The degree to which a system is perceived as relatively difficult to understand and use.	1. Computers complicate my tasks in the classroom. 2. Schools will be a better place without computers. 3. Computers do more harm than good. 4. I would rather do things by hand than with a computer.
Ease of Use (Moore & Benbasat 1991)	The degree to which using an innovation is perceived as being difficult to use.	1. I have no difficulty in understanding the basic functions of computers. 2. Computers complicate my tasks in the classroom. 3. It would be difficult for me to learn to use the computer in teaching. 4. Everyone can easily learn to operate a computer.

Construct	Definition	Items from Questionnaire
Subjective Norm (Ajzen 1991; Davis *et al.* 1989; Fishbein & Ajzen 1975; Mathieson 1991; Taylor & Todd 1995)	The person's perception that most people who are important to him think he should or should not perform the behaviour in question.	1. Learners prefer to learn from teachers rather than the computer. 2. Learners need to learn how to use computers for their future jobs. 3. Working with computers does not diminish peoples' relationships with one another. 4. Computers should be a priority in education.
Perceived Behavioural Control (Ajzen 1991; Taylor & Todd 1995)	Reflects perceptions of internal and external constraints on behaviour and encompasses self-efficacy, resource facilitating conditions, and technology facilitating conditions.	1. Computers do not scare me. 2. I used technology to keep track of learner grades. 3. I used technology to create worksheets and or assignments. 4. I used technology to keep track of learner attendance. 5. I have no difficulty in understanding the basic functions of computers.
Facilitating Conditions (Thompson *et al.* 1991)	Objective factors in the environment that observers agree make an act easy to perform, including the provision of computer support.	1. I have never seen computers at work. 2. Computers have proved to be effective learning tools worldwide. 3. I have never seen computers used as an educational tool. 4. I have seen some KZN teachers use computers for educational purposes.
Compatibility (Moore & Benbasat 1991)	The degree to which an innovation is perceived as being consistent with existing values, needs, and experiences of potential adopters.	1. Computers have no place in schools. 2. Computer use fits well into my curriculum goals. 3. Class-time is too limited for computer use. 4. Computer use suits my learners' learning preferences and their level of computer knowledge.

Table 13: Constructs from IS Technology Adoption Models/Theories

Variables were computed for each of the above constructs. A score of 5 was awarded for strongly agree, 4 for agree, 3 for neutral, 2 for disagree and 1 for strongly disagree. The polarity for negative statements were reversed. For each construct the sum of the values was divided by the number of items per construct to give a score out of 5. The frequency analysis is as follows:

	Perceived Usefulness	Extrinsic Motivation	Relative Advantage	Perceived Ease of Use	Complexity	Ease of use
Mean	4.38	4.50	4.21	3.94	4.24	3.93
Median	4.43	4.67	4.25	4.00	4.25	4.00
Mode	5.00	5.00	5.00	4.00	5.00	4.00
Std.Deviation	0.56	0.76	0.71	0.75	0.65	0.75

Table 14: Educators' Perceptions of IS Theories/Models Constructs

	Subjective norm	Image	Perceived Behavioural Control	Facilitating conditions	Compatibility
Mean	3.81	3.81	2.70	2.88	3.67
Median	3.75	4.00	2.60	3.00	3.75
Mode	3.75	4.00	1.60	3.00	4.00
Std.Deviation	0.62	0.74	1.11	0.52	0.53

Table 14 : Continued

Overall the respondents perceptions are somewhat positive across most constructs with the notable exception of Perceived Behavioural Control and Facilitating Conditions where the means are below 3.5 (Table 14) .

If these results are compared to Roger's (1995) attributes (Table 8), one finds that the constructs from the IS models are somewhat more positive.

The frequencies for the different constructs were grouped and analysed according to UTAUT's 4 main determinants of user acceptance and usage behaviour namely, Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions.

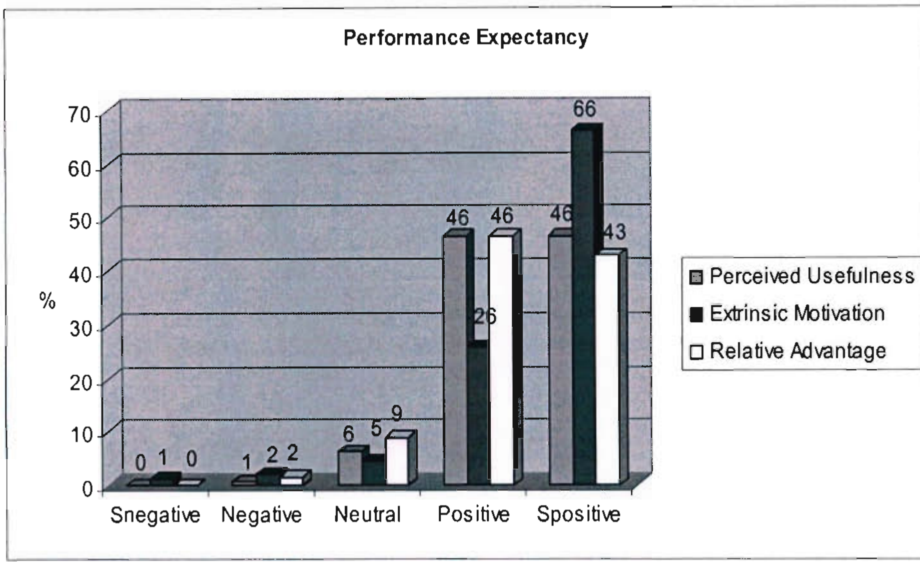

Figure 11: Performance Expectancy

For the construct "Perceived Usefulness, 92% of our respondents were quite positive that using a computer would enhance their job performance. Educators were most positive about schools being a better place with computers. This should contribute positively towards their intention of using computers in the classroom (Venkatesh & Davis 2000). Perceived usefulness is one of the constructs evident in the TAM/TAM2 models.

For the construct "Extrinsic Motivation", 92% of respondents perceive computers as being instrumental in achieving valued outcomes such as improved job performance. Educators were most positive about wanting to learn more about computers. A significant body of research in psychology has supported general motivation theory as an explanation for behaviour or intended behaviour. Several studies (Vallerand 1997, Davis *et al.* 1992, Venkatesh & Speier 1999) have examined motivational theory and adapted it for specific contexts.

The degree to which a computer is perceived as being better than what exists (e.g. traditional methods of teaching) was positively supported by 89% of the respondents.

This supports Roger's (1995) Innovation Diffusion theory in which one of the many constructs is relative advantage.

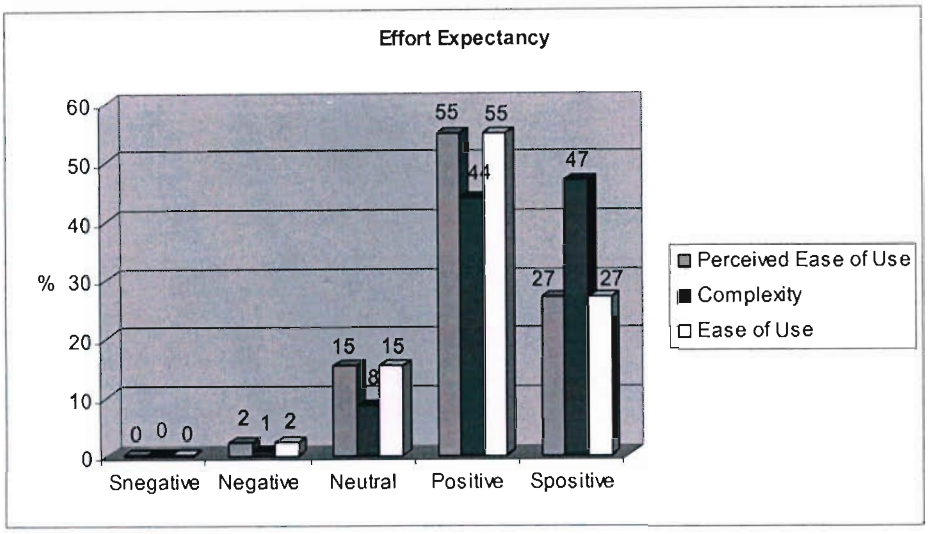

Figure 12: Effort Expectancy

For the construct "Perceived Ease of Use", at least 83% of respondents were of the opinion that using a computer will be free from effort. TAM2 retains "perceived ease of use" from TAM as a direct determinant of perceived usefulness (Davis *et al.* 1989), since all else being equal, the less effortful a system is to use, the more using it can increase job performance. There is extensive empirical evidence that perceived ease of use is significantly linked to intention, both directly and indirectly via its impact on perceived usefulness (for example Davis *et al.* 1989, Venkatesh 1999).

Closely linked to "Perceived Ease of Use" is "Complexity" where 91% of respondents felt that it is not difficult to understand and use a computer.

"Ease of Use", "Perceived Ease of Use" and "Complexity" all form part of "Effort Expectancy" from the UTAUT model (Venkatesh *et al.* 2003). 82% of respondents were positive about the degree to which using a computer would not be difficult. As can be seen from figure 12, there are substantial similarities in the results. There are also similarities among the construct definitions and measurement scales as noted in previous research (Davis *et al.* 1989; Moore & Benbasat 1991; Plouffe *et al.* 2001; Thompson *et al.* 1991).

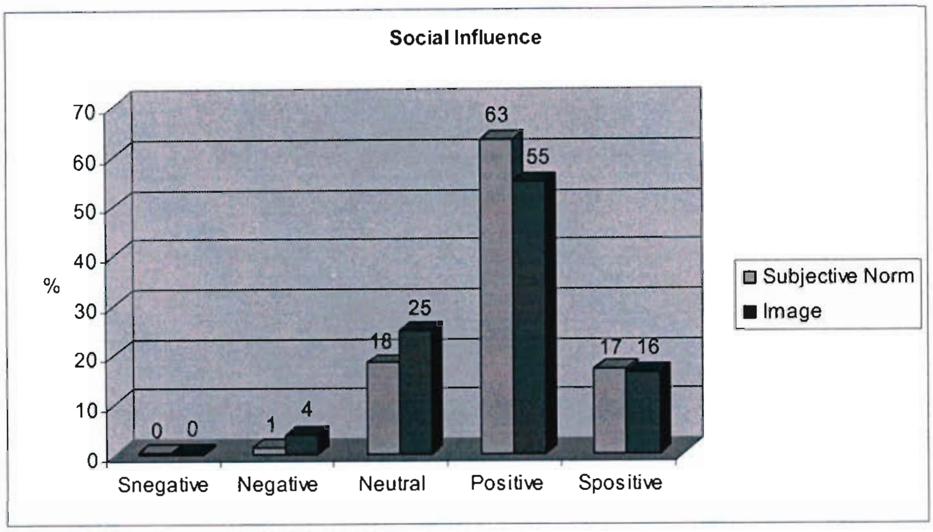

Figure 13:Social Influence

For the construct "Subjective Norm", 80% of respondents were positive about learners using computers to prepare them for future jobs, and that computers should be a priority in education. "Subjective Norm" from TAM2 and TRA as well as "Image" (Moore & Benbasat 1991) is represented as "Social Influence" in UTAUT. While they have different labels, each of these constructs contain the explicit or implicit notion that the individual's behaviour is influenced by the way in which they believe others will view them as a result of having used technology. Seventy one percent felt that using a computer will enhance their image in their social system.

As is noted in figure 14, for the construct "Perceived Behavioural Control" (Behavioural Control), 45% of respondents were neutral to positive about their perceptions of internal and external constraints on their behaviour including self efficacy, resource facilitating conditions and technology facilitating conditions. It seems that the majority of educators are not overly confident with aspects of "Perceived Behavioural Control". This may be as a result of their perceived lack of technology competence.

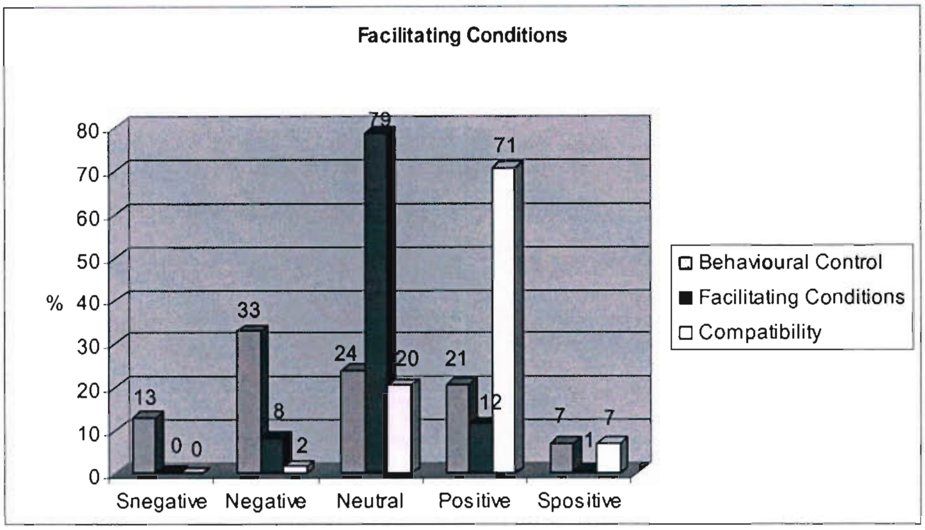

Figure 14: Facilitating Conditions

For the construct "Facilitating Conditions", 91% of respondents were neutral to positive (but mostly neutral) towards factors in the environment that make an act easy to perform, for example seeing computers being used as an educational tool.

Seventy eight percent of respondents were quite positive towards the degree to which they perceive computers as being consistent with existing values, needs, and experiences. The "compatibility" construct from DOI and the "perceived behavioural control" construct from TPB are seen as concepts embodied in "Facilitating Conditions" of UTAUT.

6.3. Discussion of above Results

The findings of the study indicate a very strong positive correlation between educators' attitudes toward ICT in education and their perceptions of computer attributes. The findings are consistent with Roger's Innovation Attributes sub-theory. An examination of individual computer attributes shows that respondents are most positive about the relative advantage of computers as an educational tool. Educators' perceptions of the compatibility of ICT with their current teaching practices followed, is also very positive. Twenty five percent (25%) of participants are neutral / uncertain about whether or not computers fit well into their curricular goals. The disparity between technological demands and the existing curricula has often been a major hindrance for technology integration (Ojo & Awuah 1998). As the responses of the participants indicate, the KwaZulu-Natal educational landscape seems to be no exception. Besides, 45% of the participants consider that the class time is too limited for computer use. This problem has also been emphasized in the literature (Becker 1998). Educators' concerns about the incompatibility of computers with the existing curricula, as well as the lack of time for computer use, indicate that educational change cannot simply be attained by placing computers in schools (Hodas 1993). For a change to occur, many renovations need to be made at the structural level, as well as the pedagogic level. Hence, the introduction of ICT innovations into education requires equal innovativeness in structural, pedagogical and curriculum approaches.

Interestingly, cultural perceptions are the second most important predictor of computer attitudes in this study as will be shown in the first regression analysis in chapter 7. This conclusion points to the need for considering cultural factors in studies conducted in developing countries. The majority of respondents regarded computers as pertinent to both South African schools and society, and as a viable means for improving education and standards of living in general. What should not go unnoticed, however, is that 40% of the respondents feel the need for computers that better suit the African culture and identity. It has often been noted that people who have not been quite influential in the design and development of ICT would prefer a localized version of these technologies (Damarin 1998). In addition, 49% of the respondents believe that there are more important social issues to be addressed before implementing computers in education. Therefore, it is not surprising to find that 45% of the respondents agree that computers are proliferating too fast. The above conclusion implies that balancing resource allocation among the competing areas of need is a critical issue in developing countries.

Previous research has pointed to educators' lack of computer competence as a main barrier to their acceptance and adoption of ICT in developing countries (Al-Oteawi 2002, Na 1993, Pelgrum 2001). The majority of respondents in this study report having little or no competence in handling most of the computer functions needed by educators. This finding does not support the assumption that educators with a low level of computer competence usually have negative attitudes toward computers (Summers 1990). The fact that computer competence is related, to a limited extent, to educators' attitudes, supports the theoretical and empirical arguments made for the importance of computer competence in determining educators' attitudes toward ICT (Al-Oteawi 2002, Berner 2003 & Na 1993). In addition, the relationship between computer attitudes and competence suggests that higher computer competence may foster the already positive attitudes of educators, and eventually result in their use of computers within the classroom.

An analysis of the frequencies for the different constructs from the IS theories/models shows that there is definitely a lack in "Perceived Behavioural Control" and "Facilitating Conditions" (Figure 14). This neutral to negative response from educators may hinder technology adoption. In IS terms it means that there are "perceptions of internal and external constraints on behaviour" (Taylor & Todd 1995, p. 149). There may be objective factors in the environment that educators believe that make technology adoption easier that they have not encountered – for example "seeing computers being used as an educational tool". Also, "provision of support for users of PCs may be one type of facilitating condition that can influence system utilization" (Thompson *et al.* 1991, p. 129). These are areas where the Department of Education must focus on so that "Perceived Behavioural Control" and "Facilitating Conditions" can be improved which could result in a better chance of technology adoption by educators.

6.4. Conclusion

One of the main barriers to technology implementation perceived by the educators in this study, is the mismatch between ICT and the class time frame of the existing curricula. It follows that placing computers in schools is not enough for attaining educational change. The introduction of ICT into education requires equal innovativeness in other aspects of education. Both policymakers and educators share this responsibility. Policy-makers should provide additional planning time for educators to experiment with new ICT-based approaches. This may be attained by reducing the teaching load for the educators.

Other barriers reported in this study are educators' low level of access to computers, which may have played a role in educators' computer competence and which is essential to future computer use. Such a conclusion points to the invariable importance of technology resources for the success of technology initiatives across the world. This also implies that technology initiatives should include measures for preparing educators to use computers in their teaching practices.

Educators' preparation necessitates not merely providing additional training opportunities, but also aiding them in experimenting with ICT before being able to use it in their classrooms. If decision-makers want to involve educators in the process of technology integration, they have to find ways to overcome the barriers perceived by the educators.

7. Best Predictor of Educators' Attitudes

7.1. Introduction

To determine the best predictor of educators' attitudes, multiple regression analysis was performed. The general purpose of multiple regression is to learn more about the relationship between several independent or predictor variables and a dependent or criterion variable. Multiple regression allows the researcher to ask (and, hopefully, to answer) the general question "what is the best predictor of ...?". In this study, the researcher asks "What is the best predictor of educators' attitudes toward ICT in education?" Since one expected the independent variables to influence the dependent variable (educators' attitudes toward ICT) the researcher was interested in the combined ability of the independent variables in explaining the variation in the dependent variable. Two sets of regression analysis are done using "Educators' attitudes" as the dependent variable. In the first analysis, the independent variables were: "Computer attributes", "Cultural Perceptions", "Proficiency Score" (that is technology competence) and "General Computer use". In the second analysis constructs from the different IS theories/models were used as independent variables.

7.2. Research Question Three: What is the best predictor of educators' attitudes toward ICT in education?

7.2.1. Regression One – Educator attitudes as a function of computer attributes, cultural suitability and computer competence.

Following Diamantopoulous & Schlegelmilch's (2000) recommendations, simple correlations (using Spearman analyses) were first performed to identify independent variables that individually correlate with the dependent variable (educators' attitudes toward ICT). These variables are used in the multiple regression analysis to make a more accurate prediction of the dependent variable and to show the proportion of variance in the dependent variable explained by the selected independent variables. The independent variables that individually correlate with the dependent variable (computer attitude) are: computer attributes (which comprise "advantages of computers", "compatibility with current practices", "simplicity of computers", and "observability of computers"), cultural perceptions and computer competence.

Using cross-tabulation (as produced by SPSS®), the data is summarized in the following tables. All of the following analysis of data is based on a 95% confidence interval.

Attitude	Advantages Of Computers						Total
	no entry	strongly negative	negative	neutral	positive	strongly positive	
Negative	1	0	1	2	0	1	5
Neutral	0	0	4	19	12	2	37
Positive	0	1	13	58	271	62	405
Strongly Positive	0	0	1	30	285	459	775
Total	1	1	19	109	568	524	1222

Table 15: Computer Attitude * Advantages of Computers - Cross tabulation

	Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal: Spearman Correlation	0.572	0.021	24.376	0.000(c)
Number of Valid Cases	1222			

Table 16: Symmetric Measures for Computer Attitude * Advantages of Computers

(a) Not assuming the null hypothesis.

(b) Using the asymptotic standard error assuming the null hypothesis.

(c) Based on normal approximation.

Requesting the Spearman rank-order coefficient, a value of 0.572, with a standard error estimate of 0.021 is obtained (Table 16). The corresponding t-value comes to 24.376, which is highly significant ($p = 0.000$, the three zeros arise from the rounding, the exact probability may have been p = 0.000004). This means that the observed correlation is unlikely to have come about if there is no association between the two variables (that is if the correlation coefficient is equal to zero). Thus, it is possible to reject the null hypothesis that there is no relationship between respondents' "computer attitude" and response to "advantages of computers" as a computer attribute. In fact, according to the findings the two variables are positively related, and the strength of the relationship is neither weak nor very strong (as indicated by the magnitude of the coefficients).

Attitude	Compatibility With Current Practices						Total
	no entry	strongly negative	negative	neutral	positive	strongly positive	
Negative	1	0	1	1	1	1	5
Neutral	0	0	1	23	12	1	37
Positive	1	0	8	120	265	11	405
Strongly Positive	0	1	11	106	584	73	775
Total	2	1	21	250	862	86	1222

Table 17: Computer Attitude * Compatibility with Current Practices - Cross tabulation

	Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal: Spearman Correlation	0.335	0.027	12.420	0.000(c)
Number of Valid Cases	1222			

Table 18: Symmetric Measures for Computer Attitude * Compatibility with Current Practices

(a) Not assuming the null hypothesis.
(b) Using the asymptotic standard error assuming the null hypothesis.
(c) Based on normal approximation.

The Spearman rank-order coefficient gives a value of 0.335, with a standard error estimate of 0.027 (Table 18). The corresponding t-value comes to 12.420, which is highly significant ($p < 0.0001$). According to the findings, the two variables are positively related although the strength of the relationship is neither weak nor strong (as indicated by the magnitude of the coefficients).

Attitude	Complexity Of Computers						Total
	no entry	strongly negative	negative	neutral	positive	strongly positive	
Negative	1	0	1	0	2	1	5
Neutral	0	0	5	19	11	2	37
Positive	2	1	19	101	244	38	405
Strongly Positive	4	1	2	67	413	288	775
Total	7	2	27	187	670	329	1222

Table 19: Computer Attitude * Non-Complexity of Computers - Cross tabulation

	Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal: Spearman Correlation	0.493	0.024	19.793	0.000(c)
Number of Valid Cases	1222			

Table 20: Symmetric Measures for Computer Attitude * Non-Complexity of Computers

(a) Not assuming the null hypothesis.
(b) Using the asymptotic standard error assuming the null hypothesis.
(c) Based on normal approximation.

The Spearman rank-order coefficient gives a value of 0.493, with a standard error estimate of 0.024 (Table 20). The corresponding t-value comes to 19.793, which is highly significant ($p < 0.0001$). It is possible to reject the null hypothesis that there is no relationship between respondents' "computer attitude" and response to the "complexity of computers" as a computer attribute. The findings indicate that the two variables are positively related, although the strength of the relationship is neither weak nor very strong (as indicated by the magnitude of the coefficients).

Attitude	Observability Of Computers						Total
	no entry	strongly negative	negative	neutral	positive	strongly positive	
Negative	1	0	0	3	1	0	5
Neutral	0	0	6	27	2	2	37
Positive	3	3	37	310	51	1	405
Strongly Positive	5	0	58	620	88	4	775
Total	9	3	101	960	142	7	1222

Table 21: Computer Attitude * Observability of Computers – Cross tabulation

	Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal: Spearman Correlation	0.081	0.028	2.846	0.004(c)
Number of Valid Cases	1222			

Table 22: Symmetric Measures for Computer Attitude * Observability of Computers

(a) Not assuming the null hypothesis.
(b) Using the asymptotic standard error assuming the null hypothesis.
(c) Based on normal approximation.

The Spearman rank-order coefficient gives a value of 0.081, with a standard error estimate of 0.028 (Table 22). The corresponding t-value comes to 2.846, which is significant at ($p < 0.05$). This means that there is some correlation between the two variables.

The four computer attributes are combined to give a single variable called "computer attributes". Figure 15 is a scatter-plot of "computer attitude" and perceptions of computer attributes. The graph shows clearly that most respondents are positive (from 3 to 5) towards computer attributes, as well as their computer attitude. Because of the concentration of points, this further supports the use of a linear regression line analysis.

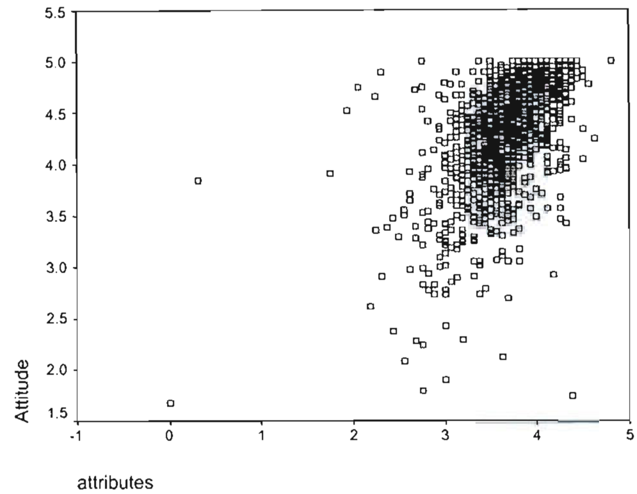

Figure 15: Scatter-plot of Attitudes against Computer Attributes

Figure 16 is a scatter-plot of computer attitude and cultural perceptions. The graph shows clearly that most respondents are positive (from 3 to 5) towards cultural relevance of computers, as well as their computer attitude. Again, because of the concentration of points, this supports the use of a linear regression line analysis.

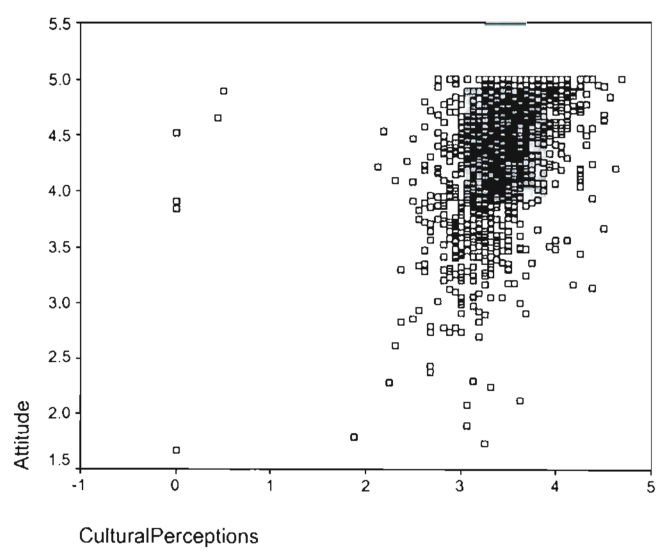

Figure 16: Scatter-plot of Attitudes against Cultural Perceptions

Table 23 and Table 24 show the results of the cross-tabulation between computer attitude and cultural perceptions.

Attitude	Cultural Perceptions						Total
	no entry	strongly negative	negative	neutral	positive	strongly positive	
Negative	1	0	1	2	1	0	5
Neutral	0	0	4	26	7	0	37
Positive	2	0	3	227	168	5	405
Strongly Positive	2	1	2	202	539	29	775
Total	5	1	10	457	715	34	1222

Table 23: Computer Attitude * Cultural Perceptions – Cross tabulation

	Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal: Spearman Correlation	0.458	0.024	17.974	0.000(c)
Number of Valid Cases	1222			

Table 24: Symmetric Measures for Computer Attitude * Cultural Perceptions

(a) Not assuming the null hypothesis.
(b) Using the asymptotic standard error assuming the null hypothesis.
(c) Based on normal approximation.

The Spearman rank-order coefficient gives a value of 0.458, with a standard error estimate of 0.024 (Table 24). The corresponding t-value comes to 17.974, which is highly significant ($p < 0.0001$). According to the findings, the two variables are positively related, although the strength of the relationship can be considered as medium.

Table 25 and Table 26 show the results of the cross-tabulation between computer attitude and computer competence, using the overall proficiency score.

Attitude	Proficiency Score				Total
	No Proficiency	Less Proficiency	Moderate Proficiency	High Proficiency	
Negative	2	1	2	0	5
Neutral	18	14	3	2	37
Positive	122	199	71	13	405
Strongly Positive	160	344	205	66	775
Total	302	558	281	81	1222

Table 25: Computer Attitude * Proficiency Score – Cross tabulation

	Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal: Spearman Correlation	0.240	0.028	8.625	0.000(c)
Number of Valid Cases	1222			

Table 26: Symmetric Measures for Computer Attitude * Proficiency Score

(a) Not assuming the null hypothesis.
(b) Using the asymptotic standard error assuming the null hypothesis.
(c) Based on normal approximation.

The Spearman rank-order coefficient gives a value of 0.240, with a standard error estimate of 0.028 (Table 26). The corresponding t-value comes to 8.625, which is highly significant ($p < 0.0001$). Although there seems to exist a positive correlation between respondents' "computer attitude" and "computer competence", the strength of the relationship is weak, as indicated by the coefficient.

The last variable used for cross tabulation is "General Use of Computer", as explained in chapter 8. Table 27 indicates a significant correlation between educators' attitudes and general computer use; however, the strength of the correlation is weak, as indicated by the correlation coefficient (0.128).

	Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal: Spearman Correlation	0.128	0.028	4.466	0.000(c)
Number of Valid Cases	1203			

Table 27: Symmetric Measures for Computer Attitude * General Use

(a) Not assuming the null hypothesis.
(b) Using the asymptotic standard error assuming the null hypothesis.
(c) Based on normal approximation.

Spearman rank correlations yield no significant relationships between educators' attitudes and educators' computer use in the classroom.

The summary of the multiple regression analysis appears in Table 28 and Table 29. The model used is only able to account for 34% of the variance in computer attitude. However, the test statistic is very significant at the 0.05 level of significance, ($F_{(4,1202)} = 152.55$; $p < 0.0001$).

R	R Square	Adjusted R Square	Std. Error of the Estimate	Sum of Squares	Df	Mean Square	F	Sig.
0.581(a)	0.337	0.335	0.43931	117.763	4	29.441	152.546	0.000(a)

Table 28: Regression One analysis Model Summary(b)

(a) Predictors: ProficiencyScore, CulturalPerceptions, Computer Use - General, Attributes
(b) Dependent Variable: Attitude

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
Attributes	0.631	0.038	0.472	16.750	0.000
CulturalPerceptions	0.162	0.035	0.128	4.586	0.000
ProficiencyScore	0.004	0.001	0.098	3.473	0.001
General Computer Use	6.190E-05	0.004	0.000	0.014	0.988

Table 29: Coefficients(a) for Regression One analysis .

(a) Dependent Variable: Attitude

From the above table, the results of the regression analysis indicate that only three variables affect the educators' attitudes toward ICT at the 0.05 level of significance. The standardized estimates of these factors from largest to smallest are: computer attributes (b = 0.631, t = 16.750, $p < 0.05$), cultural perceptions (b = 0.162, t = 4.586, $p < 0.05$) and proficiency score ie. computer competence (b = 0.04, t = 3.473, $p < 0.05$). The analysis suggests that the independent variables explaining the greatest amount of variance in computer attitudes are in order of predicative value: computer attributes, cultural perceptions and computer competence (Table 29)

7.2.2. Regression Two – Educator attitudes as a function of the different IS constructs from IS models/theories.

In the first regression analysis (Table 28 and Table 29) Roger's (1995) "attributes", Thomas's (1987) "cultural suitability factor" and Vannatta and O'Bannon's (2002) "technology competence" were used to determine the best predictor of educators' attitudes and thus technology adoption.

In the regression analysis that follows, a combination of different constructs as extracted from the different IS technology adoption models/theories are used to try to determine the best predictor of educators' attitudes and thus technology adoption.

R	R Square	Adjusted R Square	Std. Error of the Estimate	Sum of Squares	Df	Mean Square	F	Sig.
0.913(a)	0.834	0.832	0.220	289.276	10	28.928	596.406	.000(a)

Table 30: Regression Two Analysis Model Summary

(a) Predictors: Compatibility, Facilitating conditions, Perceived Behavioural Control, Image, Extrinsic Motivation, Subjective norm, Perceived Usefulness, Ease of use, Relative Advantage, Complexity

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
Perceived Usefulness	0.394	0.016	0.407	24.235	0.000
Extrinsic Motivation	0.288	0.010	0.404	27.826	0.000
Relative Advantage	0.027	0.013	0.035	2.149	0.032
Complexity	0.208	0.015	0.248	14.032	0.000
Ease of use	0.003	0.012	0.004	0.230	0.818
Subjective norm	0.009	0.013	0.010	0.676	0.499
Image	-0.006	0.010	-0.008	-0.553	0.581
Perceived Behavioural Control	0.038	0.006	0.079	6.115	0.000
Facilitating conditions	-0.014	0.013	-0.013	-1.046	0.296
Compatibility	-0.025	0.014	-0.023	-1.783	0.075

Table 31:Coefficients for Regression Two

(a) Dependent Variable: Attitude

From the above tables, the results of the regression analysis indicate that five variables affect the educators' attitudes toward ICT at the 0.05 level of significance. The standardized estimates of these factors from largest to smallest are: extrinsic motivation, ($b = 0.288$, $t = 27.826$, $p < 0.05$), perceived usefulness ($b = 0.394$, $t = 24.235$, $p < 0.05$) complexity ($b = 0.208$, $t = 14.032$, $p < 0.05$), perceived behavioural control ($b = 0.038$, $t = 6.115$, $p < 0.05$) and relative advantage ($b = 0.027$, $t = 2.149$, $p < 0.05$) . The analysis suggests that the independent variables explaining the greatest amount of variance in computer attitudes are in order of predicative value: extrinsic motivation, perceived usefulness, complexity, perceived behavioural control and relative advantage (Table 31).

In this regression analysis the model was able to account for at least 83% of the variance. This is a very strong and significant result.

Venkatesh *et al.* (2003) reviewed eight models that predict user acceptance of technology. The eight models were: theory of reasoned action, the technology acceptance model (TAM), the motivational model, the theory of planned behaviour (TPB), a model combining TAM and TPB, the model of PC utilization , the innovative diffusion theory, and the social cognitive theory. The eight models were able to explain between 17% and 53% of the variance in user intention to use technology. Thereafter, Venkatesh *et al.* (2003) used a combination of different constructs from the eight models and formulated the Unified Theory of Acceptance and Use of Technology (UTAUT) model made up of four core determinants of intention and usage. UTAUT was then tested and found to outperform the eight individual models. UTAUT was able to account for 69% of the variance in user intention to use technology.

In an education scenario our research model (Figure 17) has shown (Table 30 and Table 31) that it can account for as much as 83% of the variance in predicting educator attitude towards technology and thus technology adoption. Therefore the researcher proposes that a better predictor of educators' attitudes towards technology adoption can be based on the following research model.

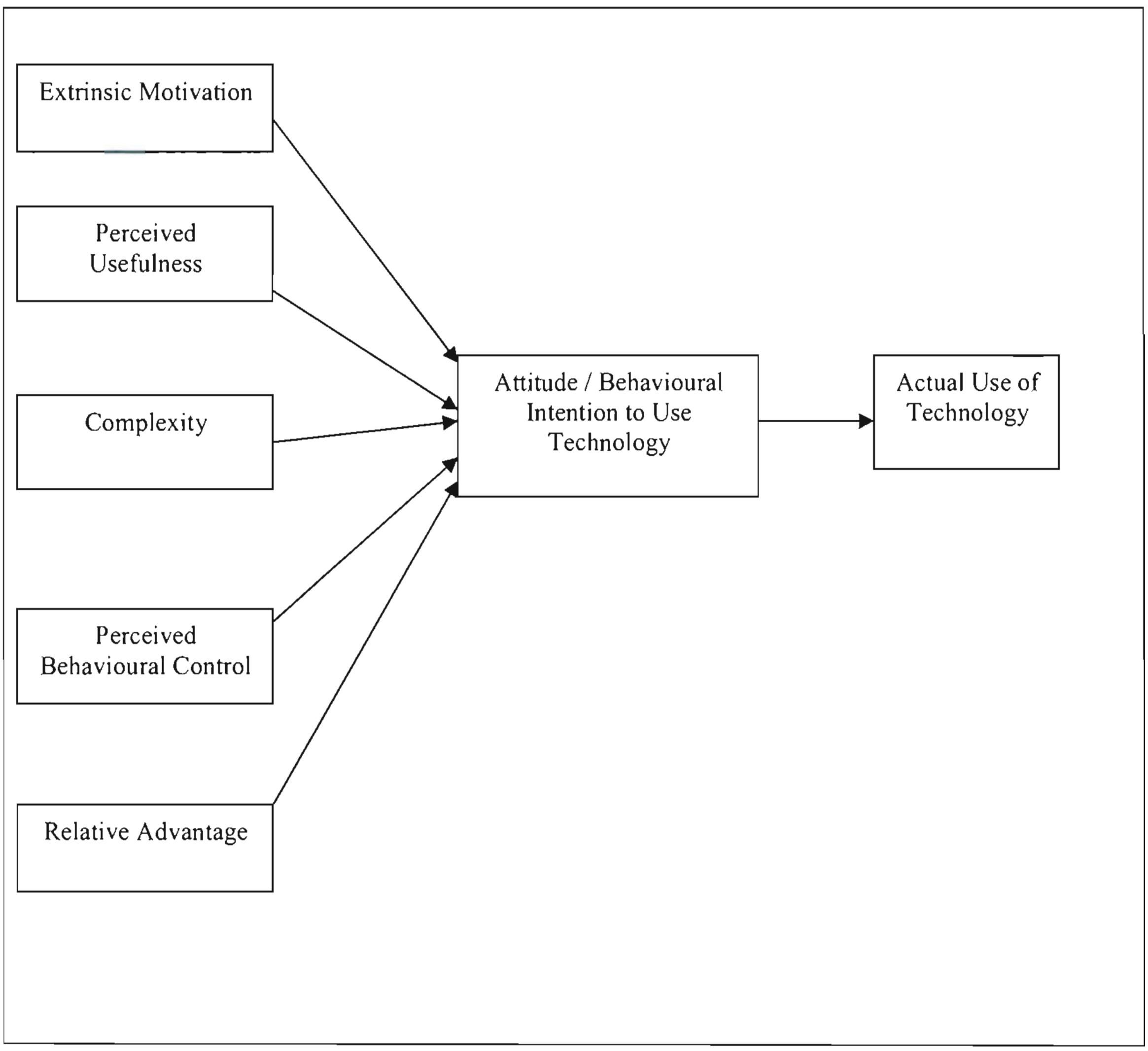

Figure 17: Research Model : Educator Technology Adoption Model

7.3. Concluding Remarks

In the first regression analysis (Table 28 and Table 29) Roger's (1995) "attributes", Thomas's (1987) "cultural suitability factor" and Vannatta and O'Bannon's (2002) "technology competence" were used to determine the best predictor of educators' attitudes and thus technology adoption. The analysis suggests that the independent variables explaining the greatest amount of variance in computer attitudes in order of predicative value are : computer attributes, cultural perceptions and computer competence (Table 29). However, the model was only able to account for 34% of the variance in computer attitude.

In the second regression analysis, a combination of the different constructs as extracted from the different IS technology adoption models/theories is used to try and determine the best predictor of educators' attitudes and thus technology adoption. The researcher has shown statistically that the constructs can be used to predict educator's attitudes towards technology and thus technology adoption. Venkatesh *et.al* (2003) has shown that eight different IS models together with UTAUT can only account for between 17 % to 53% and 69% of the variance in user intentions to use technology respectively. Our research model (which may be confined to education) has shown that the model can account for as much as 83% of the variance in teacher attitudes toward technology and thus technology adoption. This is quite a significant result that advances the body of knowledge on technology adoption by educators.

8. Using Perceptual Control Theory to Analyse Computer Usage

8.1. Introduction

In some classrooms of today, learners are able to collaborate, use critical thinking and find alternatives to solutions with the aid of computers. However, this requires a shift from teacher-centered delivery to a learner-centered model which can lead to a resistance to change. Learner-centered teaching is challenging educators to rethink their teaching methods and their perceptions as to how the learner learns. Dwyer *et al.* (1991) indicate that computers can be used in collaboration for all subject areas, but that educators have to take into account the different styles of teaching and the learners involved in this learning. This type of teaching requires a change in the educator's method of teaching and learning, the amount of time needed to learn how to use the technology and the identification of models that work with technology (Sheingold and Hadley 1990). Further, it must be noted that educators who have access to technology and have the computer competence may still not use computers for teaching and learning. What follows in this chapter is an analysis of reasons why educators may not be using computers in their teaching and learning even though access and competence is not an issue.

8.2. Research Question Four: To what extent are educators using computers for general administrative use and /or in their teaching, and are there reasons for this use or non-usage?

For this research question, the data was split into respondents in schools with computer rooms for teaching and respondents in schools without computer rooms for teaching. Firstly, an analysis on all respondents' general computer use was performed, irrespective of whether they were in a school with a computer room or not. General computer use means that a respondent uses a computer for simple word processing for example, creating worksheets or keeping track of learner's marks electronically (Appendix A, No. 15, items 1 & 4).

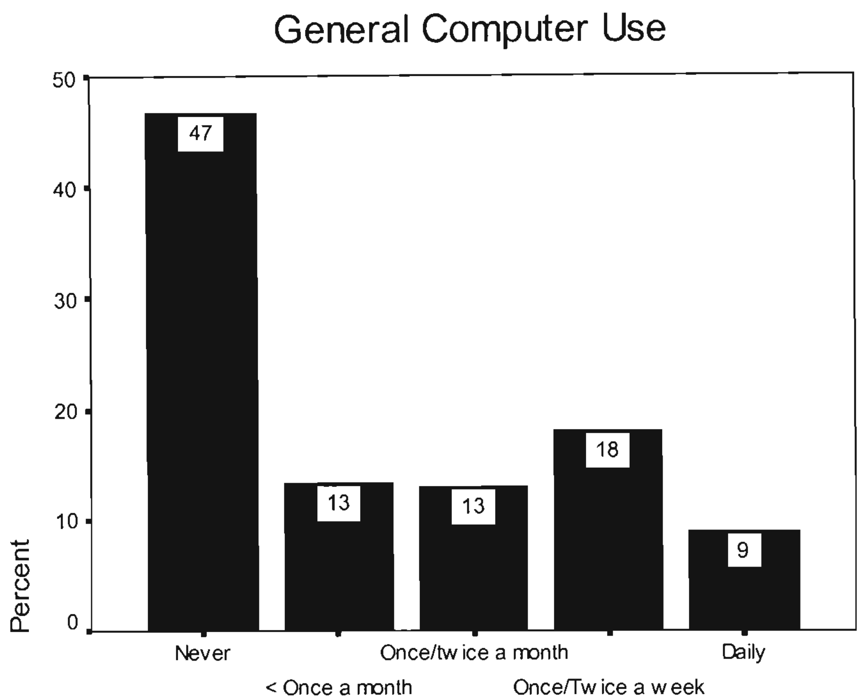

Figure 18: General Computer Use

It should be noted that at least 47% of educators from this sample do not use the computer for simple word processing. This is strongly supported by the fact that 68% perceive themselves not to have the core proficiency, as defined in chapter 6. At least 53% are using the computer in a general capacity. However, only 9% use a computer daily (Figure 18).

In schools where there are no computer rooms for teaching, a much higher percentage (66%) of educators are not using a computer for simple word processing (Figure 19). This could be attributed to the lack of core proficiency, as well as the lack of access as reported by 25% of respondents. However, it should be noted that there are at least 50% of respondents in schools with computer rooms, who are not using computers for simple word processing. For some of these respondents, this is attributable to the lack of core competence, as established in chapter 6, and in this case, there is a need for suitable training programmes.

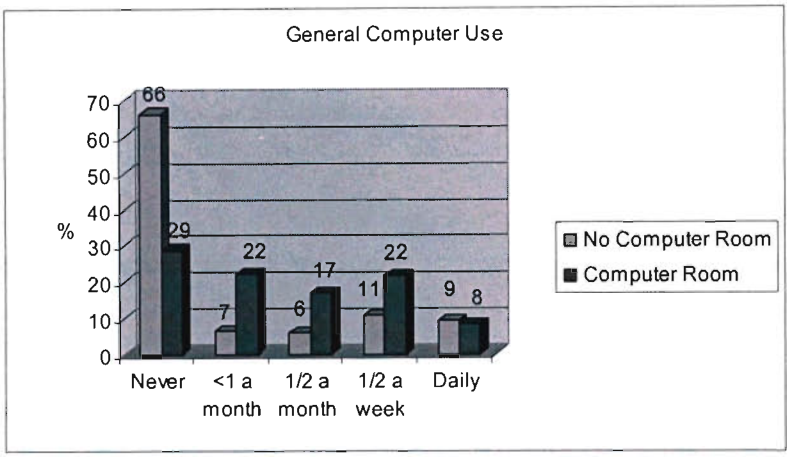

Figure 19: General Computer Use

It is quite evident that the lack of general computer use can be attributed to the fact that many of these educators have responded negatively or neutrally to the constructs Perceived Behavioural Control and Facilitating Conditions. From this one may assume that the majority of educators perceive that the organizational and technical infrastructure does not exist to support the use of computers in education and that there are constraints that prevent computer use. These constraints can encompass self efficacy, resource facilitating conditions and technology facilitating conditions. Also, educators have not seen computers being used as an educational tool and this is a factor they feel may facilitate their using a computer in the classroom.

An analysis of the data for respondents with core competence and who are in schools with computer rooms shows that even though computers are available for teaching, only a maximum of 16% of educators are using them in their teaching (Figure 20). The question to ask is: **Why are these educators (84%) not using computers in their teaching?**

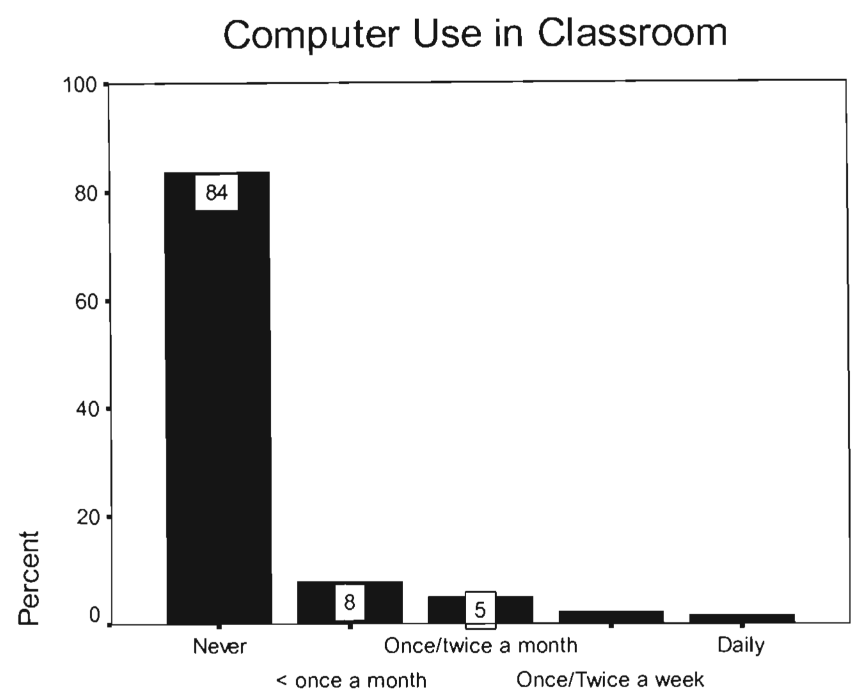

Figure 20: Computer Use in Classroom

Interestingly, in spite of the widespread recognition of the under-utilisation of technology, and the central role of educators in the effective use of technology (Harper 1987, OTA 1995), "there has been relatively little research on how and why educators use technology" (OTA 1995 p.51). There is even less research on why educators do not use technology. Most research about educational technology has focused on the impact of technology on learners. The few studies conducted on educators have typically focused on a special subset, the successful "accomplished" technology users (Sheingold & Hadley 1990), rather than the majority, those who do not use technology.

A set of assumptions about why educators do not use technology does exist and is currently the theoretical base underlying many efforts to help educators integrate technology with their teaching. Some are: lack of suitable training, lack of technical and administrative support, lack of systemic incentives (for example, tenure and promotion), traditional pedagogical beliefs, and resistance to change (OTA 1995). In order to help more educators use technology in their teaching, educational institutions internationally have begun to invest in providing sufficient professional development opportunities for educators to develop technical skills, while enhancing access to technological resources. However, there could still be problems of non-usage.

Perhaps one problem is the assumption that the lack of educator involvement in technology has been caused by the lack of suitable training, therefore leading to the perception that providing more opportunities to develop educators' technological skills will lead to more technology integration. At first consideration this may seem quite reasonable; however, upon closer examination this assumption becomes problematic, because the assumed direction of the relationship between use of technology and training could be the reverse. That is, it would be as reasonable to assume that educators do not want to receive training in technology because they see no need to use it. In this study one finds that while 81% of respondents disagree with the statement "I'd rather do things by hand than with a computer", 19% did agree with this statement. It may be that, in response to educators' needs, the educator training system does not provide training opportunities or when training is provided, these 19% of educators "who would rather do things by hand" (Appendix A, No. 10 statement 16), do not take the opportunity to develop the needed skills.

What is missing in the above assumptions is the recognition of educators as active, goal-oriented, living organisms (Cziko & Zhao 2001). Although some of the current assumptions take into consideration educators' pedagogical beliefs (Cuban 1994 as *cited* in Mumtaz 2000), attitudes toward technology, and understanding of technology, the essential logic underlying these assumptions is that the lack of educator use of technology is caused by the lack of a conducive environment to technological integration. Therefore, by creating a better environment (more workshops, on-site technical expert, more computers, and rewards to technology users), all educators will eventually use technology in their teaching. As good as it may sound the "if-you-built-it, they-will-use-it" approach would not work for the 19% educators who agree that they would rather do things using their hands than with a computer.

The failure to recognise educators as purposeful human beings whose behaviours are goal-oriented makes it impossible really to understand why, under the same circumstances, some educators would spend their own money to bring computers to their classrooms (Garner & Gillingham 1996), while others would not use the computers provided for them, or would intentionally miss the time slots assigned for their learners to work in the computer laboratory (OTA 1995). To understand why the same demonstration would encourage some and discourage others, one must consider the perceptual world of the educators. What follows is a framework that attempts to look at educator adoption of technology from the inside. The framework provided here is based on Perceptual Control Theory (PCT) and examines this issue by considering the goals of educators, and how the use of technology might help or hinder their goals. This framework has been well supported by Cziko and Zhao (2001) and what follows is an interpretation of their work, and how it applies to our respondents.

The remainder of this chapter is divided into three sections. The first section presents a brief introduction to PCT. The second section outlines a framework for understanding educator adoption of technology from the perspective of PCT. The last section presents some concluding remarks.

8.3. Understanding Purposeful Behaviour: Perceptual Control Theory

PCT is a model of behaviour based on control theory (details of the theory can be found in Powers 1973, 1989). Essentially, PCT maintains that human-beings and all other living organisms control perceptual input, or reference condition, not motor output. In other words, they have internal goals which they strive to meet. As control systems, human beings act to keep their perceptions matching these reference conditions.

They do this by acting on the environment, producing effects which, when combined with prevailing disturbances from the environment, produce the desired perceptions. Human goals are hierarchical. In order to maintain a higher-level goal, it is necessary to vary lower-level goals. In other words, lower-level goals serve as a means to achieve higher-level goals (Powers 1989).

A simple example[2] of a control system with which many of us may be familiar, is the Auto-Pilot speed cruise control system in an airplane, and this example will be used here to introduce the basic properties and functioning of a control system.

8.3.1. The Control System

An Auto-Pilot speed cruise control system in an airplane is used to keep the plane moving steadily at a speed set by the pilot. When engaged, the system will increase or decrease the amount of fuel it delivers to the engine as needed to maintain the desired speed. It achieves this through a process of sensing, comparing and acting, with all three processes occurring simultaneously. However, the action of providing the calculated amount of fuel will not have a completely predictable effect on the sensed speed (the input), because environmental disturbances, which are not under the control of the system

[2] For the purpose of convenience and ease of reading the male gender was used without any prejudices in this example.

(for example: the condition of the air and wind direction), will also influence the speed of the plane. The output of the Auto-Pilot speed cruise control system will also affect other variables (for example; engine temperature, noise, and vibration), which are not under the control of the system.

An Auto-Pilot speed cruise control system shares a number of characteristics with all control systems. Firstly, a control system does not control what it does, it controls what it senses. This means that the system maintains some sensed variable at or near a specified reference condition (representing a goal), despite the influence of environmental disturbances that would otherwise cause the sensed variable to vary. The system can only control what it senses to be the speed of the plane and it does so by changing its output as required. As a result, the use of an Auto-Pilot speed cruise control system allows one fairly accurately to predict how long it will take to cover a certain distance, but not how much fuel it will take to get there as fuel is not under control (varying as it must to compensate for unpredictable disturbances met along the way). Since a control system controls what it senses, and since an organism's sensing of the environment is generally referred to as perception in psychology, the application of control theory to the behaviour of living organisms is now referred to as Perceptual Control Theory to distinguish it from the control theory applied by engineers and physicists to non-living control systems, such as the Auto-Pilot speed cruise control system.

Secondly, a control system's behaviour is clearly influenced by its environment, but its behaviour is not determined by its environment. Instead, its behaviour is a function of what it perceives (senses) compared with its internal goal, which can change over time. Here lies the crucial difference between living organisms and engineered control systems: while engineered control systems are often designed so that their goals can be manipulated by the operator, it is usually impossible directly to manipulate the goal of a living control system. We can certainly ask an educator to use computers in his teaching or to attend a workshop on instructional technology, but we can never be certain that another person will comply with our wishes and actually behave as requested.

Finally, the relationship between perception (input) and behaviour (output) is what Runkel (1990, p.92) has referred to as "circular causation" with neither the perception, nor the behaviour, serving as the independent variable, as each influences the other reciprocally, and simultaneously. In other words, while perception influences the responses in a control system, the system's response also influences its perception. Therefore, what ultimately determines how the system behaves is the reference condition (which in living organisms can be considered a perceptual preference), not the perception or the behaviour.

The understanding of how a basic control system functions already provides some insights into understanding human behaviour, but it is not complete. For a more complete account of complex goal-oriented human behaviour, such as educators using technology, it is necessary to consider a hierarchy of perception and control.

8.3.2. A Hierarchy of Perception and Control

The Auto-Pilot speed cruise control system example would probably be called a "homeostatic" (Cziko & Zhao 2001) system; a system that maintains a one-dimensional variable at a constant level, matching a fixed reference condition. This system might behave very energetically as disturbances come and go, but the result of its action would be an outcome that is held constant. While it should be clear that the control system's action focuses on keeping its own perceptual signal matching its perceptual reference, it is not clear what specifies the value of that reference condition, which can also vary.

The Auto-Pilot speed cruise control system example can be concretized by placing a human pilot into the picture. The Auto-Pilot speed cruise control system, while able accurately to maintain a steady speed once activated, cannot by itself determine what this speed should be, nor can it vary this speed to comply with varying traffic and air conditions. It is the human pilot who decides whether or not to turn it on and what the desired speed should be. This is an example of a hierarchy of control, whereby the reference conditions of any one control system are determined by the goals and subsequent output of higher levels in the hierarchy. In this example, the reference condition of the Auto-Pilot speed cruise control system is supplied by the pilot, whose goal, in normal situations, should be more than maintaining a steady speed. We might assume that he has the goal of getting to his destination as fast as safety and legal considerations permit, and that this takes precedence over maintaining a constant speed. In order for the pilot to maintain his higher-level goal of perceiving himself as flying safely and legally, he will need to vary the lower-level goal of flying speed.

In order to maintain this higher-level goal, the pilot needs to vary not only the speed, but also other lower-level goals, such as the position of the control stick and even the route he takes. That is, to maintain a higher-level goal in a hierarchy of control might require varying the reference conditions (goals) of multiple lower-level control systems. Varying one goal does not necessarily affect the control of another. But sometimes these goals are related. In other words, the act to maintain one goal can function as a disturbance to another one, necessitating action on the other system. For example, the goal of maintaining a certain speed can affect the goal of staying at a certain height. When the pilot needs to make a turn, he has to vary the speed. But since both lower-level goals are subject to the higher-level goal of flying safely and legally, they are not necessarily in conflict with each other.

Nevertheless, it is quite possible that varying a lower-level goal to maintain a higher-level goal may disturb other higher-level goals. In this case, one needs to decide which of the higher-level goals is more important. The importance of a goal is often determined by its capacity in maintaining even higher-level goals. Continuing with the flying example, it is possible to add another level of goal in addition to the one of flying safely and legally. At this level, the pilot's goal is to get to his destination on time. Because of a snowstorm, he needs to lower his speed dramatically in order to maintain the goal of flying safely, which makes it impossible for him to arrive at his destination on time. Conversely, in order for him to maintain the goal of arriving on time, he will have to ignore his goal of flying safely. In this case, he will need to decide which is more important.

The concept of a hierarchy of perception and control reveals the other source of error signals in a control system. A control system acts to compensate for disturbances in order to maintain its reference condition, since environmental disturbances would otherwise cause the perceived input to depart from the reference condition. In a hierarchy of control, a higher-level goal also causes a lower-level reference condition to depart from the sensed input. There are, therefore, two reasons for a lower-level system to vary its behaviour: environmental disturbances and higher-level goals. In the Auto-Pilot speed cruise control system example, while air conditions cause the system to vary the amount of fuel delivered to the engine, variation of the goal speed (as a result of the pilot's perception of flying safely and legally) has similar effects on the system.

Powers (1973) has conceptualised an 11- level hierarchy of human control systems which is labeled (from the bottom up): intensity, sensation, configuration, transition, event, relationship, category, sequence, program, principle, and systems concept. Such a hierarchy of goals and control systems provides a useful framework for pursuing answers to the question of why some educators do, or do not, use technology? The following section examines the issue of educator adoption of technology within this framework.

8.3.3. The Integration of Technology: Why and Why Not?

To apply PCT to the understanding of educators' uses of technology, it is important to understand that educators[3], as all living organisms, are considered to have a hierarchy of

[3] For the purpose of convenience and ease of reading the male gender was used without any prejudices in the write up.

goals. They vary lower-level goals to attain higher-level ones. Technology can be viewed as a possible means to achieve goals at a higher level. What then determines whether, or to what extent, an educator uses technology in his teaching? Answers to this question can be pursued by examining three aspects of educators' perceptions of technology, in relation to their hierarchy of goals:

8.3.3.1. The Effectiveness of Technology in Maintaining Higher-Level Goals

PCT argues that human beings vary means to produce consistent ends. When there is a discrepancy between the reference condition (goal) and the perceived state of the controlled variable, means are varied to reduce the discrepancy to regain the desired control. In other words, no action will be taken if there is no error signal in the system. We assume an educator has the goal of delivering quality instruction to his learners. One reason for him to start thinking about using technology might be that he feels that somehow his teaching can, and should, be improved. If he perceives that his instruction is excellent, his perceived input matches his reference condition (goal), he will not change anything he is currently doing.

An error signal results from comparing the perceived input with the reference condition. Thus, either a change in the reference condition or perceived input due to environmental disturbances will result in a discrepancy between the reference condition and perceived input that calls for the system to act. In this case, such a discrepancy could occur when the educator raises his standards for good teaching (perhaps as the result of reading a book, attending a workshop, or serious reflections on his teaching). It could also take place when learners fall asleep or otherwise appear disinterested during the class periods, if learners' evaluation becomes increasingly negative, or if the school starts to reform the curriculum. For whatever reason, the educator realises that what he has been practicing for many years no longer sufficiently maintains his goal. He needs to vary his teaching practices.

While for an Auto-Pilot speed cruise control system there are only three possible variations of behaviour (increase, decrease, or maintain the same amount of fuel delivered to the engine), there are far more choices for an educator to improve his teaching. These choices are influenced by the goal and lower-level control systems. If, for example, an educator reads a book about learners who are learning much more than in traditional classes because their educators use the Internet in their teaching, he realises that his teaching can actually be much better than he has believed possible, and his definition of good teaching has changed from delivering excellent lectures, to encouraging learner-centered collaboration. To maintain this newly set reference condition he needs to vary his teaching practices. Finding key-pals (the Internet equivalent of pen-pals) for the learners and having them work collaboratively with learners in other schools is certainly an option. Having the learners work on a project and publish the results on the Web is another. Since his goal is to encourage learner-initiated learning, having learners writing essays collaboratively would also help to maintain the goal. Assuming that the educator is creative and experienced, there are many more options available to him. Faced with these possible options, the educator needs to make a decision on which one he should choose. Unlike the much simpler Auto-Pilot speed cruise control system, the choice is often not very clear. However, the criterion for selection is essentially the same: the availability (discussed below) and effectiveness in maintaining the goal. For the Auto-Pilot speed cruise control system, when a decrease in speed is sensed, the most effective way to act is to increase the amount of fuel; it does so and the goal is maintained. The educator needs to make exactly the same decision, based on the effectiveness of the possible variation.

The "effectiveness of a possible variation is the result of a series of vicarious trial-and-error" (Cziko 1995, p. 140) or to use Powers' (1989, p.277)) term "imagination connection" based on his knowledge of and experience with each particular choice. That is, because a human being that can think abstractly, he does not need to act physically on the environment to see the result. The educator applies the different variations to the situation in his mind to see if one better achieves the goal than others.

The perceived effectiveness of a possible lower-level control system is an important parameter in this model, not only because it decides whether it is selected to achieve a higher-level goal, but also because it can often act as a disturbance, causing the individual to change. In the hierarchy of control, there are often more than one lower-level systems that can be varied to maintain higher-level goals. These systems can differ regarding their effectiveness in maintaining the higher-level goal, in terms of factors such as speed and overall quality. An Auto-Pilot speed cruise control system can be used to maintain a steady speed, and so can a human pilot. But in terms of accuracy and the amount of disturbances caused to other higher-level goals (to be discussed below), an Auto-Pilot speed cruise control system will usually do a better job. So, it is selected over a human pilot, on a highway in the air, when air-traffic is light. However, it is less flexible, therefore, in heavy air-traffic, the human pilot takes over. When a new, more effective lower-level control system is available, it presents a disturbance to a higher-level system that is often in search of better control.

Therefore, the knowledge that technology can more effectively maintain a current reference condition can create an error signal in the system. An educator may start to think about using email, not necessarily because he has decided to change his pedagogy, nor because his learners ask him to do so but rather because he finds email enables him to collect and give feedback to learners' essays faster and he does not have to carry stacks of paper around the school. In fact, many educators use technology for the reason that it maintains the current goal more effectively than the traditional method, rather than because it helps to maintain a new goal (Olson 1995). Since technology use is at a lower-level of the hierarchy than pedagogical beliefs and teaching approaches, and because lower-level goals are easier to vary, it is no surprise that many educators adopt technology without changing their pedagogy (Bruce, Peyton, & Batson 1993, Veen 1995). Although this practice has been seriously criticized (OTA 1995), it should be encouraged if the promotion of the use of technology among educators is of importance.

8.3.3.2. Potential Disturbances to Other Goals

While the perceived effectiveness of a system is an important consideration, perceived possible disturbance to other goals is another one that influences a educator's decision about using technology. A control system's actions on the environment can have side effects.

An Auto-Pilot speed cruise control system, while varying the amount of fuel provided to the engine in order to maintain a steady speed, varies engine noise, temperature, and vibration. While these variables are not under the control of the Auto-Pilot speed cruise control system, they can cause disturbance to other systems, which may result in action on the current control system. For example, if the pilot dislikes noise and yet the engine noise is very high when the Auto-Pilot speed cruise control system increases fuel to the engine while ascending, the pilot may decide not to use the system. Similarly, using technology can have side effects on other higher-level goals unrelated to the desired one.

A further hypothetical scenario regarding the example of the educator who has started to think about changing his teaching, could be that he has to decide about using email, the Web, or just in-class collaboration. After considering the effectiveness of all three options (assuming all are available), he ranks them in order of perceived effectiveness. It is assumed, for this illustration, that his ranking was: publishing on the Web, email collaboration, in-class collaboration. However, he eventually decides to use in-class collaboration, without involvement of any technology instead of the more effective Web or email solution. The question is why, and the answer may simply be, because it is easier. "Easier", interpreted within the current framework, means two things. Firstly, it causes less disturbances to other goals, and secondly, it requires less resources, which may be used to maintain other goals. For an educator, delivering quality instruction is not the only goal he wants to maintain. In addition, there are many other goals he needs to control. For instance, he may want to be seen as a competent educator, an intelligent person, the authority of knowledge, and a humanist instead of a computer nerd. At the same time, he is working on an article for a journal and he is also the father of a newborn baby. Using either email or the Web requires him to deal with computers, about which he is not particularly confident although he has been using email and surfing the Net. He is afraid that he might not know enough to answer the learners' questions, which would disturb his goal of maintaining the image of being competent and knowledgeable.

Moreover, using email or the Web would require him to spend more time learning the technology – time that he needs to spend with his new baby and on his article. Moreover, he may be concerned that the parents might be upset if the learners, as he has heard from other educators, are exposed to indecent materials on the Web. After weighing up these possible side effects of using the more effective means, he decides to use the less effective option, because it does not cause as much disturbance to many other important variables. In reality, many educators do not use technology for precisely this reason.

Therefore, for various reasons, using technology may create more disturbances for many educators, than not using technology. In addition to being afraid of being incompetent in front the learners, using technology may also require pedagogical changes, which could be a disturbance to many educators who do not share the same philosophy embedded in the changes. For instance, the use of technology often means more individualised, learner-centered classrooms in which educators are no longer the sole source and authority of knowledge. This could be very disturbing to many educators who are used to teacher-centered approaches because it requires them to abandon their routines and learn new ways of teaching. Not all educators will be able to do so and, even if they can, it would take time and energy that has already been committed to other activities. Studies have suggested that "high-tech" educators tend to hold a learner-centered approach to learning (Cuban 1994, Honey & Meoller 1990). This is because, for these educators, using technology does not create as much disturbance to other goals as it does to those who hold a different view of teaching.

8.3.3.3. The Ability to Control

The final aspect of technology adoption by educators that this framework considers is the educator's ability to control, or phrased interrogatively, does the educator have the technology competence? According to PCT while a higher-level control system supplies the goal (reference condition) to lower-level systems, it does not tell lower-level systems what to do to achieve the goal. The lower-level control systems have to be able to act on the environment to attain the goal on their own. Again, in the case of the Auto-Pilot speed cruise control system example, the pilot sets the speed, but it is the cruise control system that senses the current speed, compares it to the reference speed (set by the human pilot), and acts on the difference (by varying the amount of fuel) to maintain the goal. The Auto-Pilot speed cruise control system can perform this task because it has the ability to control, which means two things:

1. the system has a functioning structure (or capacity) that enables it to perceive, compare, and act when necessary, and

2. the system has access to the necessary resources with which to act, otherwise, control would be impossible. If, for example, the speedometer is malfunctioning, the cruise control system would not work. Or, if there is no fuel to deliver, the system would certainly not be able to maintain a steady speed.

While an Auto-Pilot speed cruise control system is designed to accomplish the type of control the task requires, an educator may not have a functioning control system when it comes to technology. In order to use email with his class, the educator needs to be able to perceive whether or not his learners receive his messages, and if not, he should be able take actions to enable email communications. If he perceives himself as not having such a capacity, it is unlikely that he will use email as a means of communicating.

As technology progresses, computers have become increasingly easier and "friendlier" to work with. Moreover, a human educator does not actually have to have a personal computer-specific control system in order to use technology, because he can utilise other peoples' control systems to accomplish the same task. This is another fortunate consequence of human society, which allows members in effect to share one another's control systems. While an educator does not have the control system that enables him to use technology, he can "borrow" such a system from a technical expert, or even, from a computer savvy learner.

Another component of the ability to control, is the availability of external resources. Just as an Auto-Pilot speed cruise control system needs fuel to function, an educator needs hardware and software to use technology. While what is specifically needed depends on the available technology and the activities the educator plans to use, the educator needs to perceive that it is, or will be, available to him when needed. While most current assumptions about factors that facilitate or prevent wider use of instructional technologies seem to emphasise educators' technical skills, and external resources, as the primary variables affecting educators' decisions to use technology, in the current model they are considered secondary to the effectiveness and potential costs of technology. This is because, from a PCT perspective, the ability to control a piece of technology is lower in the hierarchy of goals of an educator than the use of technology, and lower-level systems can be varied to maintain a higher-level goal. In other words, if an educator decides to use technology because it can more effectively maintain the goal of delivering quality instruction, he can vary other lower-level systems to bring about that goal. Educators can learn to use technology if they do not already know how, or they can ask for help from technical experts if available, alternatively, they can ask learners to help. In terms of hardware and software, if it is unavailable, they may consider using their own, personal equipment, or asking the management to invest in technology.

8.4. Concluding Remarks

According to this framework in spite of the perceived effectiveness of technology, educators may not use technology because it interferes with other higher level goals they may have. When will technology become a high enough priority for the majority of educators so that they pursue it as a regular part of their professional responsibilities? Data gathered in this study indicate that while educators are increasingly citing the benefits that learners derive from computer use, educators must weigh the costs in terms of their time and their lack of competence. It is therefore important to reduce the perceived disturbance to other goals resulting from using technology.

There are a number ways that one can help to reduce these perceived and other potential disturbances. First, pedagogical changes should not be required when promoting the use of technology. Pedagogical beliefs and practices are more difficult to change and many educators do not want to change them. Technology should fit the existing beliefs of educators (Olson 1995). If using technology also requires educators to adopt new teaching approaches as many have argued for (Means 1994), educators may well resist adopting technology. So although the argument that new pedagogy should be encouraged is well grounded, it should not accompany the introduction of new technology. Once technology is integrated into the curriculum, it will introduce disturbances that will on its own necessitate pedagogical changes.

A second way to reduce potential disturbances is to develop easy-to-use tools so that educators do not need to spend extra time and energy trying to master the technology. Easy-to-use tools can also reduce the potential disturbance to the goal of "being in control" before learners since it is less likely that technical problems will arise. An example of a tool that could be used is WebCT®. If costs are a problem, then an in-house tool like the Open-Learning System (OLS) used at the University of KwaZulu-Natal can be used. OLS has offered staff (even with limited ICT knowledge) on all campuses the opportunity of offering their courses on the web (OLS 2004). A final way to reduce disturbances is to provide on-site support to educators so that when a technical problem arises, they have someone they can turn to for help.

The basic considerations of a PCT-based framework for understanding issues in educator adoption of technology have been discussed here. This framework suggests that in order to understand why educators do or do not use technology, we must attempt to look at educators from their perspective, rather than from an imposed paradigm.

The framework discussed here views technology as a possible way for educators to achieve their higher-level goals. However, the goal of using technology needs to be maintained by varying lower level systems.

This framework outlines three conditions required to ensure the use of technology by an educator:

1. the educator must believe that technology can more effectively maintain a higher-level goal than what has been used,

2. the educator must believe that using technology will not cause disturbances to other higher-level goals that he thinks are more important than the one being maintained, and

3. The educator must believe that he has, or will have, the ability and resources to use technology.

It is the opinion of this researcher that for an educator to use technology, the above three conditions must be met, otherwise, it is unlikely that he will use technology in his teaching.

Condition 3 above can be directly related to the construct "Perceived Behavioural Control", where 45% of respondents (Figure 14) were neutral to positive about their perceptions of internal and external constraints on their behaviour including self efficacy, resource facilitating conditions and technology facilitating conditions. It seems that the majority of educators are not overly confident with aspects of this construct which may be as a result of their perceived lack of technology competence.

For the construct "Facilitating Conditions", 91% of respondents (Figure 14) were neutral to positive (but mostly neutral) towards factors in the environment that make an act easy to perform, for example seeing computers being used as an educational tool. The research model (Figure 21) that is proposed also shows an overall lack of positive response for the construct "Perceived Behavioural Control".

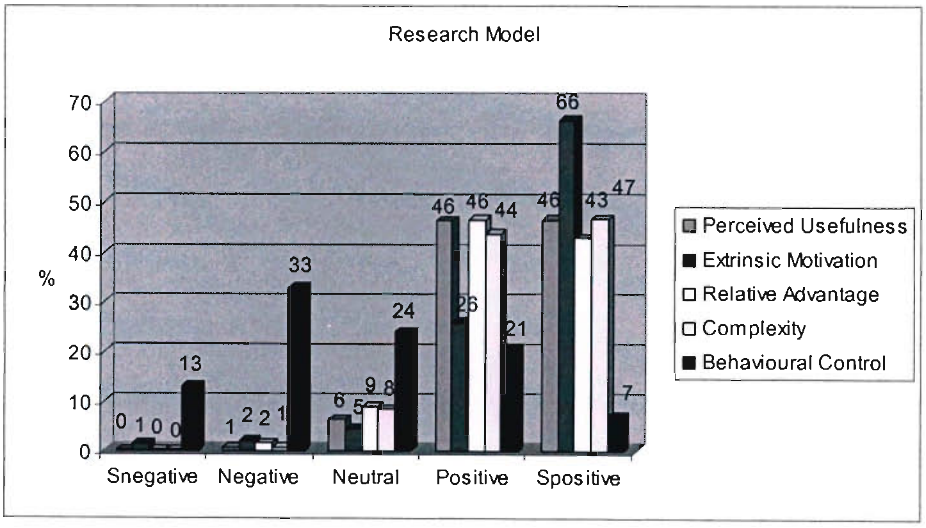

Figure 21: Educator Research Model for Technology Adoption

An analysis of the frequencies for the different IS models/theories constructs shows that there is definitely a lack of positive responses for "Perceived Behavioural Control" and "Facilitating Conditions". This neutral to negative response from educators may result in hindering technology adoption. In IS terms it means that there are "perceptions of internal and external constraints on behaviour" (Taylor & Todd 1995, p. 149). There may be objective factors in the environment that educators believe that make technology adoption easier that they have not encountered – for example "seeing computers being used as an educational tool". Also, "provision of support for users of PCs may be one type of facilitating condition that can influence system utilization" (Thompson *et al.* 1991, p. 129). These are areas where the Department of Education must focus on so that "Perceived Behavioural Control" and "Facilitating Conditions" can be improved which could result in a better chance of technology adoption by educators.

9. Challenges for KZN Department of Education

9.1. Introduction

While it may be argued that the demise of the minority government and the introduction of universal franchise in 1994 has given the present government ample time to address and redress the inequalities in the education system, the researcher argues that this is not the case. In fact, the obvious strategy of leapfrogging the normal development trajectory and addressing the existing problems through the introduction of information technology solutions, is bound to fail unless significant interventions are first put into place (Van der Berg 2002). These problems are illustrated by concentrating on just one dimension of the technology introduction paradigm; that is, the attitudes, knowledge and skills of educators currently in the system. The primary organizational challenges faced by the KwaZulu-Natal Department of Education in trying to redress the legacy of the inequitable political dispensation of the past decades, as characterized by the apartheid policies of South Africa are addressed in the following discussion.

9.2. Research Question Five: What are the ICT related challenges faced by the KwaZulu-Natal Department of Education in trying to redress the legacy of unequal education of the past decades, as characterized by the apartheid policy?

Three hundred years of de facto segregation, followed by 40 years of systematic suppression of the Black majority population through a stated policy of "separate but equal" has left South Africa with a legacy it is finding hard to rid itself of. Under the Apartheid policies the education of the different population groups was managed by different government departments. Naturally, these departments practiced separate and very unequal policies. Just prior to the dismantling of Apartheid, the education of the major racial groupings was managed by the National Education Department (Ex-NED-

White), House of Delegates (Ex-HOD-Indian), House of Representatives (Ex-HOR-Coloured) and the Department of Education and Training (Ex-DET-African).

Post 1994 has seen the integration of the various provincial education departments and their consolidation under the National Department of Education. Each of the 9 provinces in the country takes responsibility for primary and secondary education within the provinces, through provincial departments of education, while higher education is still managed by the National Department of Education.

The legacy of apartheid continues to be felt in the education system. Institutions were established along racial lines and, therefore, saturated with the doctrines of apartheid and entrenched inequalities. This resulted in unequal distribution of resources; historically white schools tend to be well-resourced, while historically black institutions tend to be poorly resourced. This impacts negatively on the quality of teaching and learning, presenting our new democracy with quite a daunting challenge.

The inequalities/differences were enforced by acts and regulations. The Bantu Education Act (1953) introduced inferior education, unequal distribution of resources, poor training and unacceptable educator-learner ratios. Various laws, namely the Correspondence College Act (1965) and the Technical Colleges Act (1981), amended in 1989, also regulated technical colleges. This fragmentation was further evident in the subjects and programmes schools and colleges offered. There was neither articulation of programmes nor portability of learning between these institutions. The negative effect of this fragmentation was evident in the nature and quality of programmes and subject offerings. Employers and the Higher Education (HE) sector had no confidence in the programmes offered at all levels of Further Education and Training (FET) institutions.

The Education White Paper 1 of 1995 provides a policy framework for the development of alternate curricula to the apartheid curricula. The Education White Paper 4 of 1998 provides a policy framework for the transformation of the FET system. It identifies 4 central features that underpin the new FET system, namely: governance, programmes and qualifications, quality assurance and funding. The FET band is situated between the General Education and Training (GET) and Higher Education and Training (HET) bands and comprises grades 10, 11 and 12 or National Qualifications Framework (NQF) levels 2, 3 and 4. It historically served the interest of the privileged racial minority, through its' racially and gender skewed curriculum design, which resulted in the historically disadvantaged majority failing to access either higher education or skilled employment.

With the opening up of political and socio-economic space in 1990 and the birth of a democratically elected Government in 1994, the stage was set for a non-racial, non-sexist and democratic system of education. In 1995, the Minister of Education took the first step towards concretizing the transformation of the apartheid FET curriculum by establishing the National Education and Training Forum (NETF). The forum rid the FET syllabi of its racist and insensitive gender undertones.

The first White Paper of 1995 proposes the development of alternative curricula based on principles of access, redress and equity. The decision to replace the Apartheid Education by an Outcomes–Based Education (OBE) in the GET and FET bands was taken by the Council of Education Ministers (CEM) on 26 February 1997. The decision envisaged the phasing in of OBE into the GET and FET bands by 2005. Hence the brand name Curriculum 2005.

The implementation of Curriculum 2005 took place in an environment characterized by enormous infrastructural backlogs, resource limitations, inadequate supply of quality learner support materials and the absence of national standards for learning and assessment. In 1999, the Minister of Education, initiated a project that solicited views from society at large on the progress made since 1994 and the challenges facing the emerging post-Apartheid system of education. An overwhelming majority of views expressed frustration with the design and implementation of this curriculum. In response to these views, the Minister set up a Committee to review its design and implementation. The Curriculum 2005 Review Committee recommended its streamlining by reducing its overload, simplifying its design and language. The South African Cabinet and the Council of Education Ministers (CEMs) approved this recommendation in the year 2000. Thereafter, a Ministerial Project Committee was tasked with streamlining and strengthening the Curriculum. The revised Curriculum 2005 was approved by Cabinet and published as the revised National Curriculum Statement Grades R-9 (schools) as policy on 20 March 2002. On 15 April 2002, the CEM approved the implementation of OBE into grades 10, 11 and 12 in 2004, 2005 and 2006 respectively. However, because of lack of learner support materials and training of educators, OBE was only implemented in grade 10 as of 2006.

Organizational Issues in E-Education

The KwaZulu-Natal provincial department of education (KZN DOE) faces various organizational hurdles in its implementation of an E-Education paradigm within its schools. The sheer physical size of the province, together with its approximately 6200 schools (some accessible to the outside world only by four wheel drive vehicle or helicopter), means that any interventions must be well-planned and executed. This requires a dedicated management team, both at the provincial government and at the school. Unfortunately, this is not always forthcoming. Being late adopters of technology, the KZN DOE must ensure that it does not repeat the mistakes of others by bypassing the "Initiation Stage" as defined by Rogers (1995), which demands information gathering and planning. A significant part of this information gathering must be an analysis of the readiness of the school educators to embrace and adopt technology for the benefit of South African learners, since, as pointed out by Baylor and Ritchie (2002), regardless of the amount of technology and its sophistication, it will not be used unless staff have the necessary skills, knowledge and attitude. Ultimately, as they point out, educators are the most important agents of change within the classroom. As will be shown later in this chapter, educators in secondary schools in the Ethekwini region have a positive attitude towards technology, but sadly lack in the skills necessary to ensure successful adoption of technology. As premised by Bullock (2004) and earlier by Kersaint *et al.* (2003) and Watson (1998), a positive attitude is a major enabling/disabling factor in the adoption of technology and for avoiding resistance to computer use. It is the opinion of the researcher that a positive attitude is a necessary, but insufficient, condition for the successful adoption of technology. However, it is clear that a positive attitude will often enable a less technologically capable educator to learn the skills necessary for the implementation of technology-based initiatives within the classroom.

As noted in the literature review, according to the U.S. Senate's Office of Technology Assessment (OTA 1995) most education leaders believe the under-utilization of technology in education results from at least four factors:

- inadequate educator training,
- a lack of vision of technology's potential for improving teaching and learning,
- a lack of time to experiment, and
- inadequate technical support infrastructure.

Within the KZN environment the researcher has identified the lack of knowledge and skills of educators as the major impediment against the department attaining their ICT goals, as identified in the White Paper on E-Education (DOE 2003). This research shows that the greatest intervention by the DOE is required in those schools where little, or no, technological proficiency exists. The government White Paper on E-Education, called "Transforming Learning and Teaching through Information and Communications Technologies" (ICTs), was released in September 2003 by the National Department of Education, and provides the foundation upon which the KZN DOE must build.

The E-Education policy goal as stated in the White Paper (which is covered in chapter 3) states that every learner in the GET and FET bands will be ICT capable by the year 2013. The document also outlines several key issues with respect to the use of ICTs in society and education. This chapter focuses on one of these issues, namely, the challenges of integrating ICT into the teaching and learning processes within the KwaZulu-Natal province by investigating, within the Ethekwini region, the

1. attitudes of secondary school educators towards technology, and
2. the technology proficiency of these educators,

based on the historically racially separated Departments of Education.

9.3. Results

In what follows, various results from the analysis of the data is presented. As pointed out earlier, the education system in the country was split along racial lines. It is the researcher's contention that, while the legislated segregation of schools, together with the unequal distribution of resources, is no longer applicable, the imbalances of the system are still evident. To illustrate this, one begins by dividing the respondents into three categories: Ex-NED school, Ex-HOD schools and Ex-DET schools. These schools are then analised in relation to the questions being researched. In the sample, there were no schools from the previously Ex-HOR Department of Education, hence there are only 3 categories. In the Ethekwini region of KwaZulu-Natal there is a very small minority of Coloured people. In this sample, many of the Coloured educators from the former Ex-HOR schools are now teaching in one of the other former ex- department schools.

	Frequency	Percent
Ex-DET	485	39.7
Ex-HOD	533	43.6
Ex-NED	204	16.7
Total	1222	100.0

Table 32: Classification of educators by historical ex-departments

As expected, the majority of respondents are now employed at Ex-HOD schools. This is easily explained by the fact that Durban, which forms the major part of Ethekwini, was originally the primary residential location for people of Indian origin.

9.3.1. Attitude towards Technology

To determine the respondents' attitudes towards technology, they were required to respond to 20 Likert-type statements. The data was collated and analyzed in SPSS according to the following categories: historical school department (Ex-DET, Ex-HOD, Ex-NED), Race, and Socio-economic category of school based on the Department of Education's "deciles" rankings (Low, Medium & High). In attempting to justify the assertion that the low socio-economic schools are predominantly the African schools (Ex-DET), primarily staffed by African educators who are, for the most part, not yet proficient in ICT, the researcher first defines unambiguously what is meant by a low socio-economic school. The Department of Education's definition which defines schools according to economic deciles is used. Without loss of any generality, one aggregates the lower four deciles (1 – 4) and define these as low socio-economic schools, while deciles 5 to 7 are defined as medium socio-economic schools, and deciles 8 to 10 are considered to be high socio-economic schools.

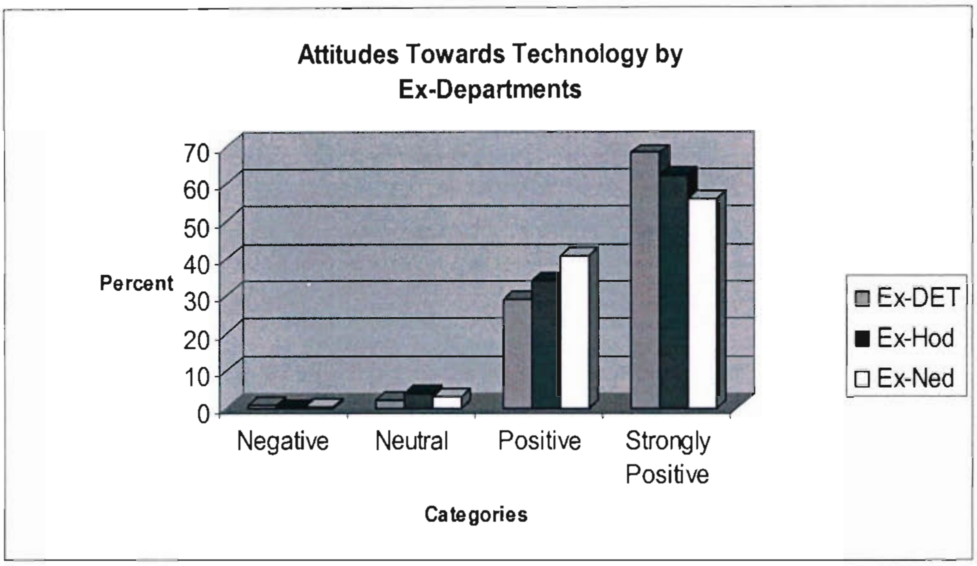

Figure 22: Overall Attitudes Towards Technology based on Ex-Departments.

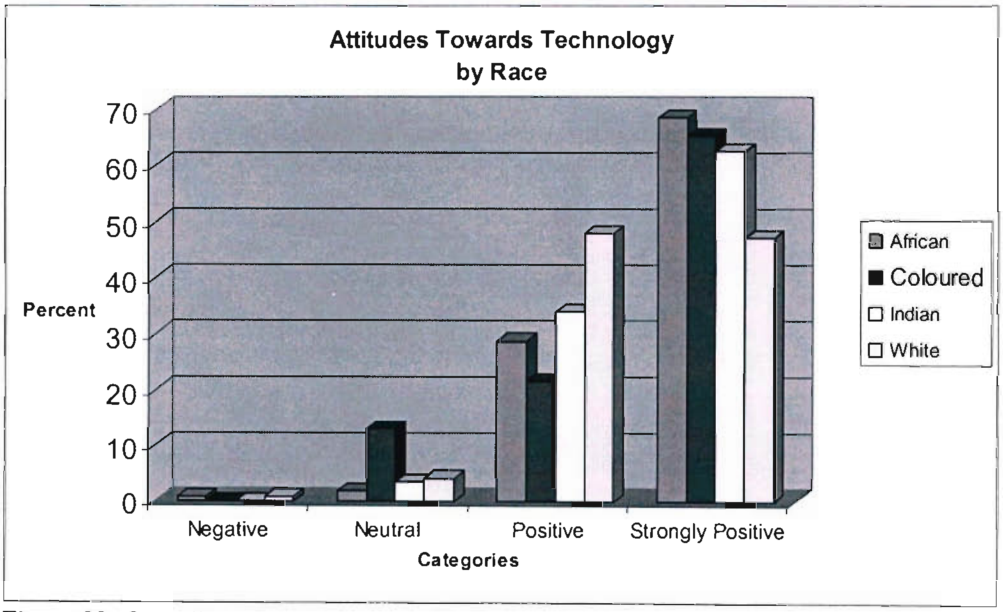

Figure 23: Overall Attitudes Towards Technology based on Race.

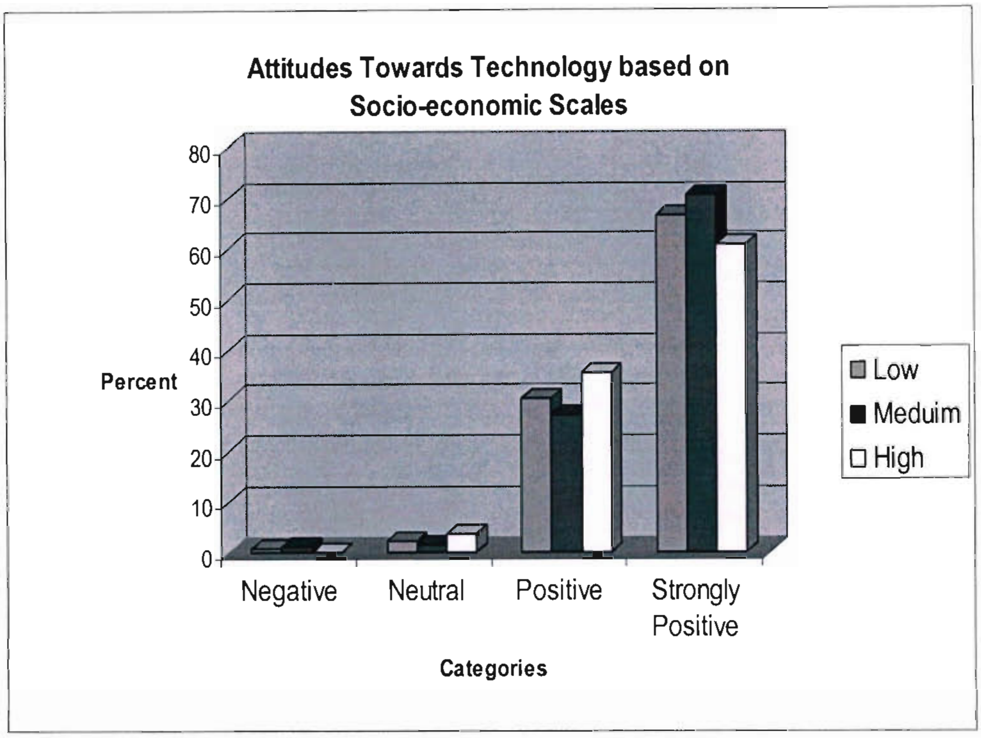

Figure 24: Overall Attitudes Towards Technology based on Socio-Economic scales.

9.3.2. Discussion

It is interesting to note what may be considered as a counter-intuitive result: the attitude towards technology is far more positive in the both educationally and economically historically disadvantaged schools (Ex-DET) than in the historically advantaged Ex-NED schools (Figure 22). However, the researcher believes that this trend reflects the national political trends in which Black people in general, and African people in particular, are much more positive about the future of the country than other race groups. This is reinforced by the fact that, when considered according to Race, only 45% of White people (Figure 23) are strongly positive, while 55% of the educators in Ex-NED schools (Figure 22) are strongly positive. The difference is apparent because a significant number of Indian educators and approximately 10% of African educators are teaching in these schools. It is noteworthy that very few of the respondents are neutral or negative about technology, which provides a sound basis upon which the KZN DOE can build.

9.3.3. Overall Proficiency in Technology

To determine the educators' readiness to adapt to, and to adopt technological interventions within their schools a variable called "technology competence" was computed (as is explained under methods in chapter 4). This is represented in figures 25, 26 and 27. Again, the technological proficiency of educators is illustrated as a function of several variables.

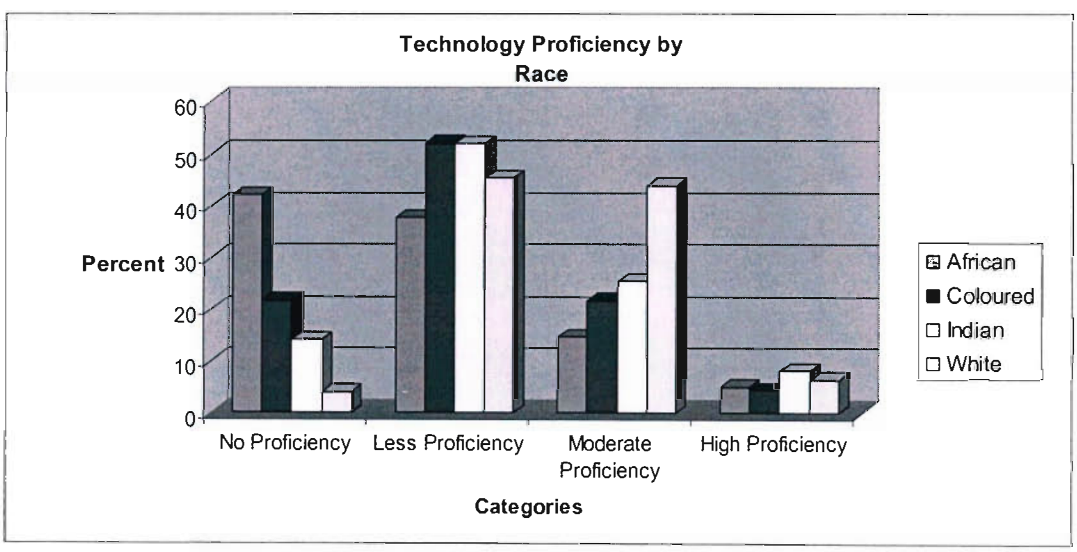

Figure 25: Overall Technology Proficiency based on Race

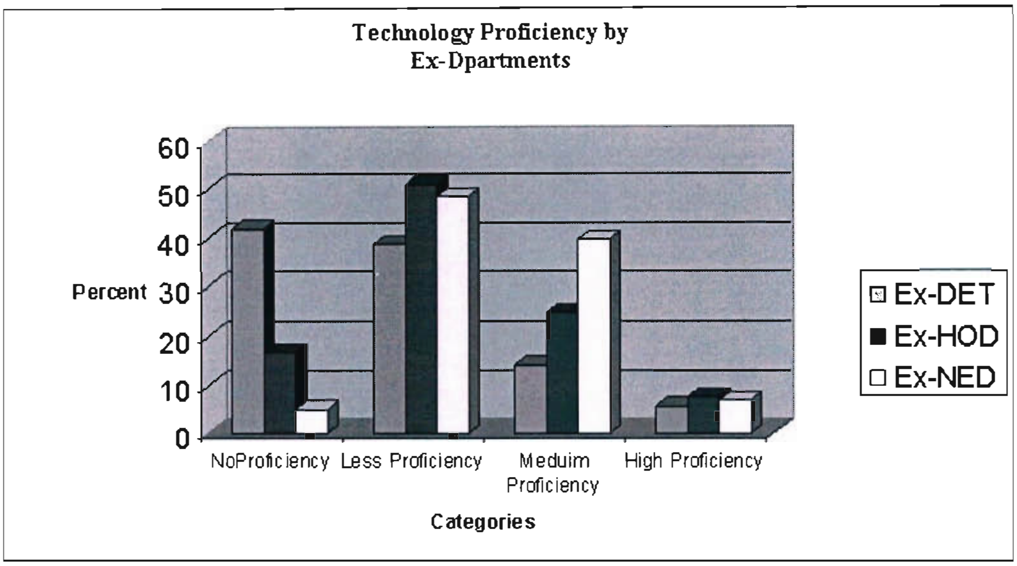

Figure 26: Overall Technology Proficiency based on Ex-Departments

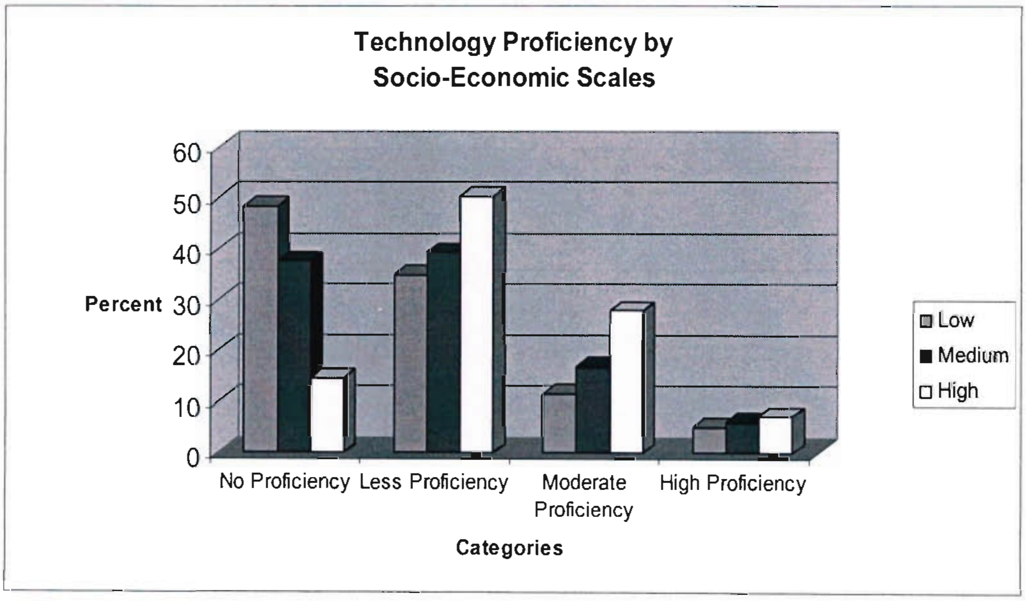

Figure 27: Overall Technology Proficiency based on Socio-Economic Scales

9.3.4. Discussion

Figures 25, 26 and 27 illustrate clearly that the overall proficiency in technology is unsatisfactory, with the majority of respondents across all categories showing little, or no, proficiency in technology. This trend is only reversed for the White Race group and the Ex-NED schools. The situation is by far worse for the African Race group and the Ex-DET schools, than for any other category. This trend is exacerbated by the fact that most of these schools fall within the low and medium economic sector.

9.3.5. Core Proficiency in Technology

The core proficiency measures the absolute minimum skills required by the respondents to begin implementation of ICT, and is calculated using only 4 from the 17 items investigated for the overall proficiency in technology. These are: computer knowledge, word processing, email and Internet. The results are illustrated in figures 28, 29 and 30.

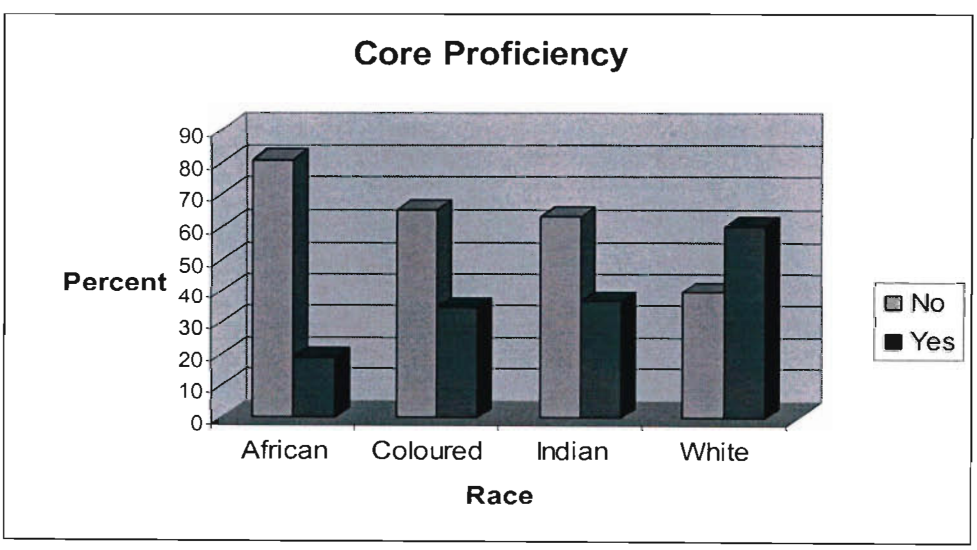

Figure 28: Core Proficiency by Race

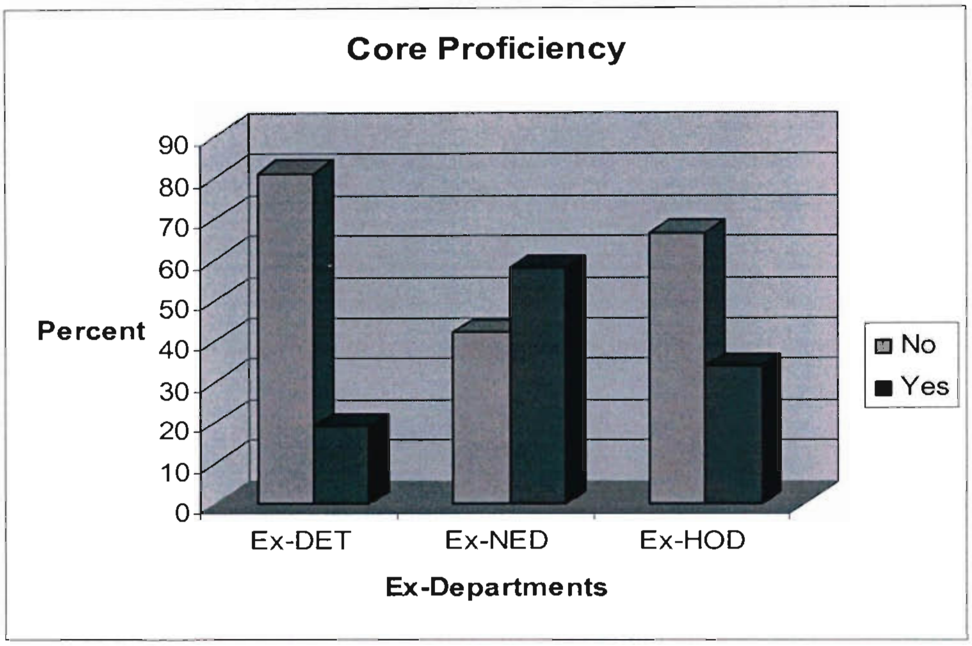

Figure 29: Core Proficiency by Ex-Departments of Education

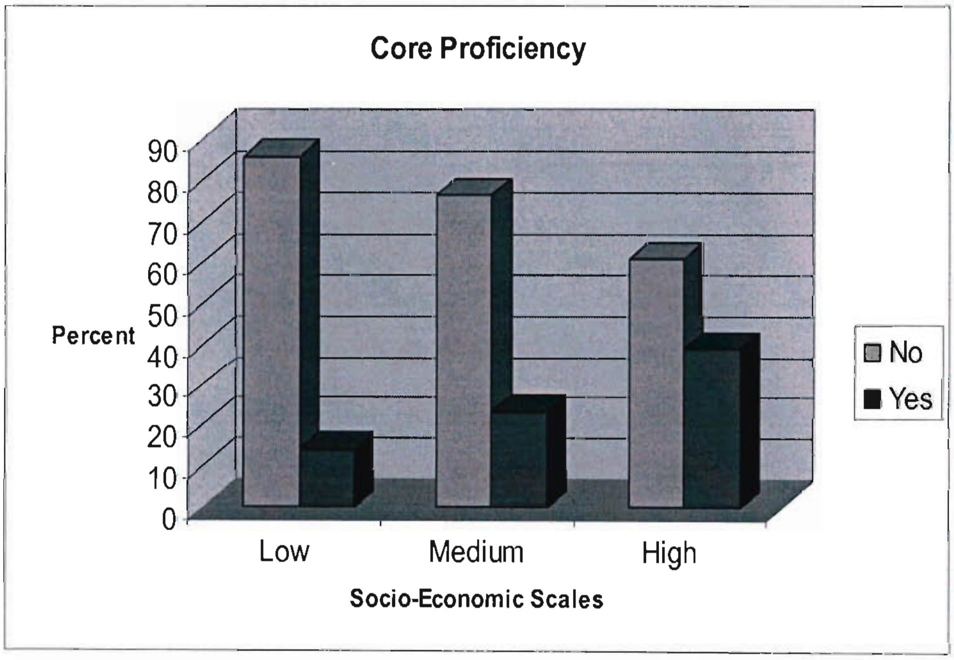

Figure 30: Core Proficiency by Socio-Economic Scales

9.3.6. Discussion

The researcher has found that, in the schools that most need technological intervention, the core computational skills are sorely lacking. This brings into question the attempts by the KZN DOE to implement ICTs in these schools, without other non-technological interventions such as educator training programmes and educator relocation exercises. The trend, as illustrated by historical education departments, is reflected when one considers core proficiency by race group. This is not surprising since, as shown later, the educator population is still largely distributed as it was historically, with the exception of the Indian race group whose educators may now be found almost equally in the Ex-NED, as well as the Ex-HOD schools. As a result of the fact that the learner population is still primarily distributed along historical grounds (again with the exception of the Indian learners), the lack of significant ICT intervention in the Ex-DET schools further exacerbates the economic divide in the country.

9.3.7. Socio-economic Distribution

Based upon the definitions of "socio-economic scales", provided previously in this chapter, one obtains the relationships contained in figures 31 and 32 which illustrate the racial distribution of educators according to the socio-economic scales, and the distribution of schools according to the same scales.

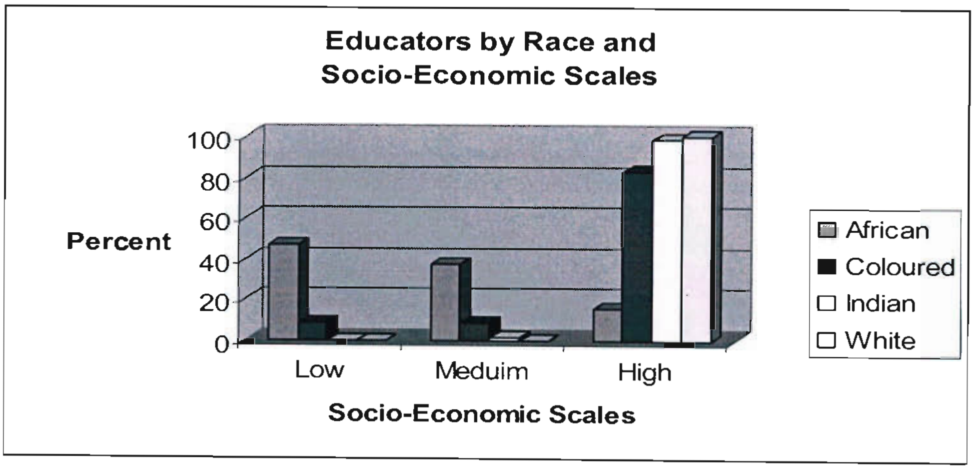

Figure 31: Distribution of educators by Race and Socio-Economic scales

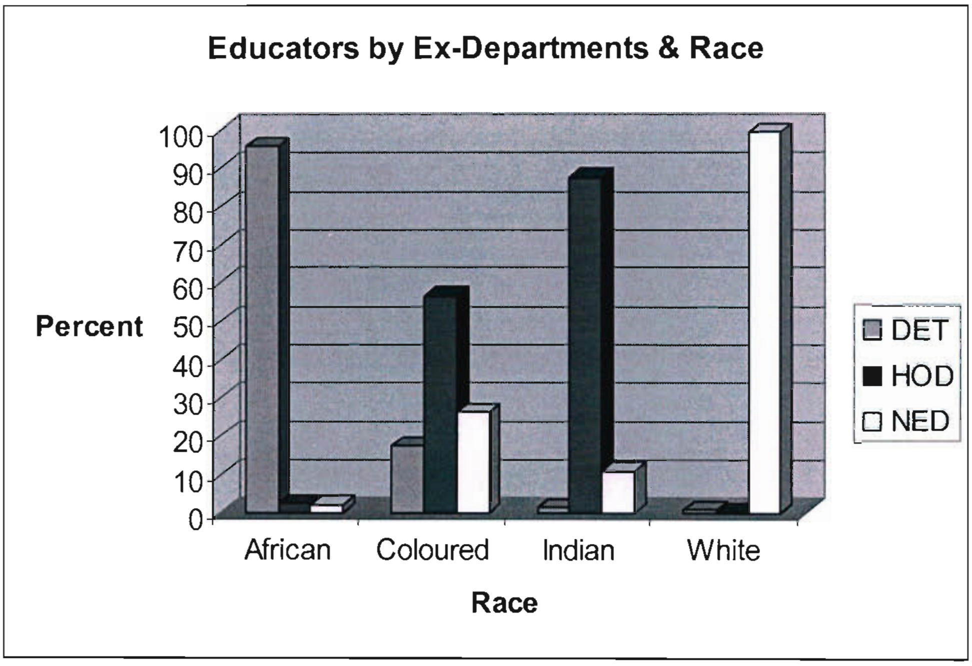

Figure 32: Distribution of Educators by Ex-Departments & Race

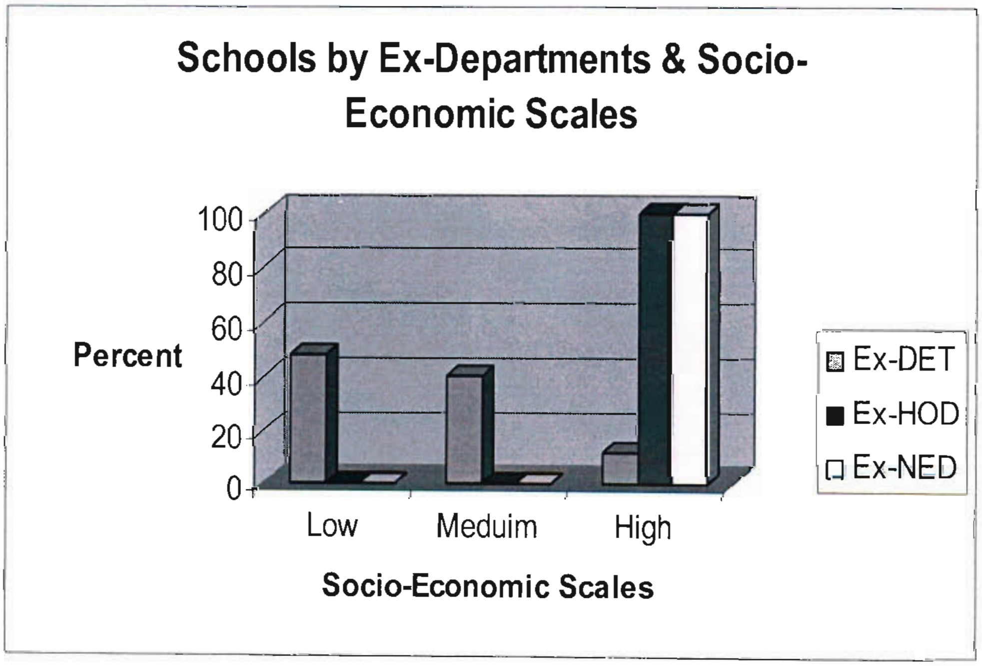

Figure 33: Distribution of schools into socio-economic classes

9.3.8. Discussion

As can be seen from figures 31 and 32, Indian and White educators are almost exclusively employed in schools classified in the high socio-economic scales, which are mostly the Ex-HOD and Ex-NED schools, while the majority of African educators are employed within the low and medium socio-economic schools. Figure 33 shows that previously Indian and White schools are all classified as privileged. It is important to recognize that this classification does not, in any way, reflect on the learner population in these schools. The Department's classification attempts merely to categorize the schools by variables such as access to electricity, water, paved roads and telephones, amongst others.

9.4. Conclusion

The researcher's assertion that placing computers into previously disadvantaged schools will not succeed without other non-technological interventions, is supported by the results described above. While it is clear that the vast majority of educators in this study all possess the basic ingredient of a positive attitude towards ICT, it is equally clear from the data that the very same educators are under-equipped to take full advantage of computers if they are installed in their schools. The researcher contends that that the KZN Department of Education at times makes political, rather than rational, decisions. While under the present circumstances one cannot criticize these decisions, the researcher believes that it will not lead to the ultimate goals of the White Paper on E-Education.

Previous research has pointed to educator's lack of computer competence as a main barrier to their acceptance and adoption of ICT in developing countries. The results of this study support previous research findings. The majority of respondents reported have little or no competence in handling most of the computer functions needed by educators. This research has also reveled that when educators do use computers in class, this is invariably for computer-related subjects, like Computer Studies and Compu-Typing, and computers are not generally used for curriculum enhancement and development. The researcher believes that the only way to make lasting and meaningful change in KZN schools from the ICT viewpoint, is firstly to provide intensive training programmes for the recipient educators. However, having provided this training, the department must then put into place strategies that will retain these skills within the school sector. One strategy may be to encourage educators to use computers for their administrative tasks first and, once they gradually become comfortable with technology, they will deliberate on the potential learning benefits of using computers in the classroom.

Educators' positive attitudes in the current study have a special significance given the limitations in the current status of ICT integration in KZN schools, which results from educators' lack of computer competence. It is essential for policy makers of the DOE to sustain and promote educators' attitudes as a prerequisite for deriving the benefits of costly technological initiatives. Positive attitudes towards ICT usually foretell future computer use. Policy makers must make use of educators' positive attitudes toward ICT better to prepare them for integrating ICT into their teaching.

The results, as pertaining to the Ethekwini municipality presented here, are significant for the KZN Province as this municipality is the most economically and technologically advanced region in the province. It can be expected that results for other regions will present a more negative scenario.

10. Issues and Recommendations in Educator Professional Development

10.1. Introduction

As the educational investment in computer and telecommunications technologies increases, so too must the efforts to provide training and support to educators in the effective use of these technologies (Galanouli *et al.*, 2004). The increase in the number of technology-based models for developing and delivering educational programmes challenges the department of education to enhance the emphasis on educator professional development. This challenge is heightened by the size of the educator workforce, the need to retrain educator trainers, the ever-moving target of the technologies themselves, as well as the disparity of access to hardware, software and technology support. For educators, the central concern must be the demonstrated effectiveness of ICTs in promoting the success of the learners, coupled with a shift in their own attitudes, from an educator-centered approach, to a learner-centered approach.

The objective of this chapter is to examine some of the problems and opportunities in educator professional development related to ICTs and provide recommendations as well as a proposed process for educator professional development to the Department of Education. These may be grouped into 7 main themes, namely:

- access to technology and learning resources,
- the degree of educator preparedness,
- questions of motivation and sustainable educator professional development,
- educator assessment,
- quality of resources,
- new educational structures, and
- availability of research.

10.2. Access

10.2.1. Connectivity

Without access to the Internet and without sufficient quantity and quality of equipment, educators are not likely to be highly motivated to participate in professional development activities related to ICTs. As a result, technologically enhanced learning cannot occur within the classroom setting. Being connected, both within the school and to resources outside the school, is a critical issue in educator professional development. As much as 75% of our respondents indicated that they do not have access to the internet.

10.2.2. Software Tools

Easy access to productivity tools and associated learning resources is an equally crucial issue. Included in this is the need for:

1. interconnected databases to demonstrate and promote the use of ICTs across, and within, all disciplines in the curriculum, and
2. resources designed to promote professional development.

Another positive step would be the promoting of educator development, through sharing and exchange of resource materials and strategies by schools. Databases of available curricular resources and strategies would further enhance access to information and communications among educators.

10.2.3. Curriculum Resources

An important consideration for educator professional development, is the availability of quality educational resources that will help educators move beyond simple personal use of ICT, to fully integrating ICTs into the curriculum. There is also a need to provide educators with discipline specific resources related to the curriculum outcomes of that subject.

10.2.4. Rural Schools

Strategies that would capture the rural educator population who cannot access urban educator professional development activities, must be developed. In urban areas where most professional development courses are held, there are well-serviced learning centres (called Teacher Centres), educator training institutions, institutions of higher learning and other institutions to take up the challenge of educator professional development, whereas in remote areas, these facilities are not normally available. Therefore, we find that educators are either left to cope on their own, or must travel long distances to urban destinations to participate in professional development training activities. Results in chapter 9 (figure 26) show that no technology proficiency is found mostly in schools from the former ex-DET – which comprises mostly rural schools.

10.2.5. Overloaded Curriculum

In many schools where ICT is treated as a specialist subject and is taught by a professional computer educator, access to the computer room is restricted to the ICT specialist subject and, therefore, other subjects requiring time in the computer room are left with the problem of an overloaded timetable. If other subjects do not have access to the computer room, educators of these subjects will find it difficult to model the effective use of ICTs in their teaching programmes.

10.3. Educator Preparedness

10.3.1. Skills and Knowledge

As shown in the results in chapters 4, 5 and 6, educators knowledgeable in ICTs are in short supply in KZN. Educators' basic skills and knowledge in the use of ICTs must, therefore, be upgraded or developed, and should include practical knowledge and first-hand experiences in using and operating technologies to support teaching and learning. While the White Paper on E-Education (DOE 2003) is challenging educators to integrate ICTs into the curriculum and to facilitate new forms of teaching and learning, it is very difficult for educators to accept this responsibility before mastering basic computer literacy skills and demonstrating a high degree of confidence in the general use of ICTs. Educators must first begin to use ICTs for simple administrative tasks before they can implement it in their teaching and learning.

10.3.2. Higher Order Teaching and Learning Theories

To enable educators to move from a "chalk and talk" methodology to adopting an ICT integrated approach, educators need to develop an in-depth knowledge of learning and instructional theories. The benefits of ICTs will be reflected when ICTs are integrated throughout the curriculum and are used to construct new models of teaching and learning. While having access to computers and being able to communicate electronically may be easily achievable, being able to fulfill the objectives of permeating all aspects of teaching with ICT is quite another matter that requires attention and experimentation.

10.4. Sustainable Educator Professional Development

10.4.1. Modeling Behaviour

Academics in faculties of education often do not model the application of ICTs in their teaching and learning environments. Ironically, some of these institutions may have fewer and more antiquated resources than some schools. The situation is further exacerbated by the mismatch between existing curriculum at these institutions, and classroom educators' expectations with respect to ICTs. In pre-service educator education, the requirement for a facility with instructional and communications technologies is a missing component in the training and accreditation process. Even in limited cases where ICT integration is taught, there is poor alignment between what is taught in the pre-service education about ICT integration and the practicum placements that students receive. Staff in Faculties of Education will need to change their practices to include the use of ICTs, with more emphasis on partnerships with technology proficient educators in local districts and incorporating field experiences focused on teaching with technology.

10.4.2. Mentoring

Professional development in ICTs has to be an integral part of an educator's career. It must be ongoing, intensive, well planned, effective and sustainable. There should be some sharing of experiences and discussions of new technologies and contemporary issues, so that educators receive support in trying to keep abreast of new developments in ICTs. One of the best ways to stimulate and support such sharing may be the provision of regularly scheduled and on-demand access to peers, mentors and a network of experts, where expertise can be obtained and discussion can take place in relation to pedagogy and technology.

10.4.3. Practical Examples

The DOE KZN needs to lead the way in facilitating access to peers for educators. Coupled with the need for easy and regular access to a knowledgeable and experienced peer group is the requirement for on-demand access to rich databases. These databases should contain sample lesson plans, examples of exemplary practice, and strategies for the integration of ICTs into the curriculum and the learning and teaching environment. Ideally these databases would be networked locally, regionally and nationally.

10.4.4. Technology Support

Due to the rapid pace at which technology changes, there is the need for ongoing technical support to ensure that school-based technology and networks are serviced and are operational at all times. An educator could also be trained to offer elementary technical support on site, but a specialist technician would be required for more complex problems.

10.4.5. Magnitude

The size and scope of the challenge of providing educators with the resources needed to integrate ICTs effectively into their teaching and learning practice, is significant. The number of educators needing retraining will be massive. In this sample alone, at least 70% require retraining to acquire basic computer literacy skills and many more will require training in ICT integration. Time and budget constraints will surely restrict what the DOE can do to achieve their E-Education goal. To add to this problem, there is a diminishing number of applicants for the teaching profession. Declining numbers of new educators entering the system, coupled with large numbers of educators requiring retraining, results in a net negative gain with an ever-widening gap between supply and demand.

10.4.6. System Change

While this study considers only educators in secondary schools, the shift in learning models and practice is not unique to these schools. There will be a similar impact on tertiary educators and on educator trainers as well as on learners/students at all levels. ICT training should be designed as a career-long continuum and should become part of the "teaching day". Professional development training in learning technologies should be less of an event, and more of an on-going program.

10.4.7. Educator Overload

Finding adequate time in a regular timetable for an educator to learn how to use ICTs, to experiment with technology, and to integrate it into the curriculum, is an issue that management needs to address. There is a need to incorporate sessions into the existing timetable, that would allow educators an opportunity for experimenting with technology and using technology to do simple administrative tasks. As much as 45% of educators felt that "class-time is too limited for computer use", whilst 22% were neutral towards this statement.

10.5. Educator Assessment

10.5.1. Competency

Presently, the only form of formal assessment in terms of teaching competence is done during the probation period (1^{st} two years) of an educator which aids in the confirmation process. The DOE must start a process of reviewing existing educator assessment and accreditation models and take into account the need for technology competency. There may be a need for a model that defines different levels of competency and a need to develop corresponding assessment tools. Regular assessment of performance linked to the defined competencies, will be a positive step towards establishing and maintaining currency in ICT knowledge and applications.

10.5.2. Educator Motivation

Sufficient motivation and confidence levels in educators need to be developed and maintained. Apart from the obvious financial incentives, another way to do this is to align training to system reform agendas and for educators to see this as part of a national government strategy. The White Paper on E-Education (DOE 2003) becomes relevant in this instance. Regardless of the strategy used, the desired end result should be a well-trained, motivated educator workforce.

10.6. Quality of Resources

10.6.1. Behaviour Modeling

The use of ICTs to deliver professional development and in-service programmes to educators; that is, the use of technology to teach technology is core to ICT integration. This approach further reinforces the need for current, relevant software resources on ICTs that are easily accessible by educators as professional development tools. There should be sharing of experiences and discussions on new technology so that educators can keep up-to-date regarding new developments in ICTs.

10.6.2. Content

Creating appropriate content, networked databases and providing ongoing easy electronic access to lesson plans, ideas for technology integration and quality content to support educators, must all be seen as important. Web sites are currently being developed locally; however, the next step would be to open these up to the wider communities across regions and provinces.

10.7. New Educational Structures

10.7.1. Virtual Learning Communities

"Virtual learning communities" of experienced educators support the sharing of ideas, resources and best practices among colleagues. An important element to an ongoing system of professional development is easy access to communities of experienced educators, mentors, peers or colleague networks where discussions can take place on issues related to pedagogy and/or technology. These networks need to be far-reaching and could even span international spaces.

10.7.2. Specialised Resource Centres

In most urban areas (for example, Chatsworth, Durban and Phoenix) "Teachers' Centres" have proven to be a good resource for educators in that area. Cluster meetings, sharing of resources and professional development usually take place at these centres. There should be more "Teachers' Centres" that could be used as local resource centres housing resources for groups of educators, providing individual support and mentoring.

10.8. Availability of Research

10.8.1. Educator Success

One of the more successful approaches to educator development is the use of educator-led networks (Hadley & Sheingolds 1993). However, more research is needed on this model. Maximising the effectiveness of educator professional development must be seen as an ongoing priority. Therefore, feedback on effective new methods resulting in educator success in using ICTs should be available as a matter of routine.

10.8.2. Learner Success

Professional development should demonstrate a positive correlation with improved educator effectiveness and learner success. Research must be able to demonstrate to educators that their work with ICTs will benefit the learner. If educators begin to see the direct advantages that accrue to the learner, they will use ICTs more frequently.

10.9. Other Points of Concern

The following points indicate the context in which schools are operating, and must be considered when planning educator professional development.

10.9.1. Knowledge-based Society

The exponential growth in the use of ICTs internationally has led to the creation of "knowledge-based societies". This has direct implications for schools. School education needs to be aware of, and susceptible to, the various opportunities and changing needs of the information age.

10.9.2. Equity

If technology is introduced to the classroom unevenly, the gaps between the "have" and the "have not" communities would widen. It is already true that not all educators have access to the same level of technology in their schools or homes. This "digital divide" could translate into a "knowledge divide", resulting in great disparities among both learner groups and educator groups. This is supported by results as indicated in figures 25, 26 and 32. Equity of access to ICTs for the disadvantaged rural schools and communities are resource issues with both technical, and financial, implications.

10.9.3. Rate of Change

No one will dispute that ICTs are no longer a thing of the future, but of the present. Owing to the natural resistance against change, care must be taken when introducing ICTs to educators and into the classroom. Educators may first need to focus on ICTs as administrative tools, as well as the development of basic computer literacy skills. Once educators are comfortable with technology, they will be more willing to introduce it into the classroom.

10.9.4. Planning

Sequenced educator professional development, including regular refresher courses over an educator's lifetime, requires planning at grassroots level. If the school management does not already involve educators in its planning processes, or if education reform and renewal do not involve educators, creating a framework for educator professional development may be unduly challenging. For example, effective professional development training programmes must be relevant to the educator, and must be linked to the educator's current competency level. If the training is imposed from top down, with little assessment of the needs about where educators are in their knowledge and skills levels, educators may choose to focus on other issues with which they feel more comfortable, and technology training may suffer.

10.9.5. Funding

It is extremely challenging to locate funding to connect, maintain and keep current the technologies in the classroom. Educator professional development has always been under – funded. Since government sources of funding are limited, the problem warrants new sources and models of funding. Public and private partnerships for equipment acquisition and content development need to emerge.

10.9.6. Local versus Global

There is always a question of whether professional development resource material should be developed in the "home" country, or acquired from external sources. Questions, such as whether the Internet is a threat or a benefit, are also being asked in many contexts. The disappearance of important cultural differences, and the loss of local and national identities, is seen as real challenges in the wider debate about the role and function of ICTs (Rogers 1995 and Thomas 1987). Some of these concerns are implicit in some of the comments in this study. Forty two percent (42%) of respondents agree with the statement "we need computers that better suit the African culture and identity" and 23% feel that "computers encourage unethical practices". However, we must bear in mind that internationally networked databases can provide the opportunity for educators to share materials across cultural borders, while simultaneously contributing to the information base of their own country.

10.9.7. Education Reform

New educator professional development models must be built into the current educational reform processes. In integrating professional development with educational reform processes, the following questions need to be addressed:

1. Are the learning models for effective use of ICTs so different from current practice that the old education systems cannot survive?
2. If one is an advocate of the use of ICTs, should one simultaneously advocate systemic reform if ICTs are to have a chance of being adopted?

System-wide planning and educational reform are not the focus of this study, but these areas do merit mention. The energies and investments devoted to upgrading any one part of an educational system may well be most effective if they are seen to contribute to a larger vision. The new National Curriculum Statement for the FET band has been implemented, as of January 2006, in grade 10. The new subject statements provide very limited aspects of ICT integration. However, it is not known how educators who do not have access to computers in their schools will implement this. For example, subjects like Engineering Graphics and Design require the use of Computer Aided Drawing (CAD), and Accounting requires the use of PASTEL Accounting, an accounting package. Where educators who are teaching these subjects find themselves in schools that do not have computer rooms, alternate means need to be found to expose their learners to ICT aspects of these subjects.

10.9.8. Quality Assurance

Quality assurance in the use of ICTs is a topic of debate in many tertiary institutions. Some view it as an issue of "consumer protection" in learning, particularly as increasing number of learners access the World Wide Web. Many institutions are struggling with the development of quality assurance standards and guidelines that will provide some guarantee of a quality product and service to the learner (Galanouli *et al.*, 2004).

10.10. A Proposed Process for Educator Professional Development

ICT introduction into the new National Curriculum Subject Statements (NCS) has basically been centrally administered. The National Department of Education was responsible for setting up of writing teams and giving criteria to the writing teams for the writing of the NCS for each subject. What is currently required, is a centrally administered project that will take responsibility for the educator professional development programme, which will, in turn, ensure ICT integration into the new curriculum at schools.

Within this project, there should be a series of sub-projects to cater for (among others), installation of computer laboratories, connecting to the Internet, development of educational software and educator training. For the training of existing educators on the educational use of ICT, an in-service educator-mentor model can be used. This will make use of an educator-mentor in-school training scheme with the objective of providing both basic ICT knowledge, along with advanced training regarding the use of specific educational software.

Educator-mentors who are subject specialist, and who will initially attend a year-long course on the educational use of ICT, must be selected. These courses must be administered and delivered by cooperating university departments. Subsequently, educator-mentors must be allocated to selected schools, which are already equipped with appropriate infrastructure (for example computer laboratories), to work as facilitators transferring and sharing their experiences with colleagues.

For example, 20 in-service educators (10 Mathematics educators and 10 Biology educators) could be selected to attend this year-long course at a cooperating university. The course could be administered jointly by the Computer Science, Mathematics, Science, Information Systems & Technology and the Educational Studies departments.

The course could be divided into technology, pedagogical and subject specific studies. Technology studies would cater for the general use of technology (for example, word processing, electronic presentations, Internet communication), the different disciplines would cater for the use of subject specific software, and the Educational Studies department would cater for the pedagogical studies aspects.

There would be three distinct training phases. Firstly, educator-mentors would receive training in the general use of technology. Thereafter, they would attend lectures and participate in laboratory sessions, group discussions and team projects. Academics and other highly specialized educators would deliver these lessons, emphasizing ICT-supported, didactic approaches (interactive learning environments, project based learning, collaborative learning). The Didactic phase would be followed by an apprenticeship phase. Educator-mentors would visit selected schools in an area, supervised by their course tutors, and they would deliver initial training sessions to school educators. This phase could last for 4 weeks and educator-mentors would work in small groups of mixed specialties. They would be introduced to the practical aspects of their mission and gain hands-on experience during this session.

During the next semester each educator-mentor would be assigned practice work. Each one of them would be responsible for 3 or 4 schools, and administer in-school training sessions for the respective school educators. The main objective would be twofold:

1. training of educators of the same specialization (for example, Mathematics) to use discipline specific educational software including off and on-line resources, and

2. the training of educators in the use of general ICT tools (i.e. word processing, electronic presentations, Internet communications etc.)

During their practice, educator-mentors would be supported by their course tutors using web-based communication facilities (discussion forum and email on OLS). Educator-mentors would receive regular reporting from their tutors on their training efforts, problems encountered and possible solutions.

A question related to this process is whether or not educator-mentors would be relieved from their school didactical duties, in part or completely, once they return to their schools. At least a reduced work load would need to be considered for this to prove successful.

A diagrammatical representation of the above process is presented in the form of a flowchart in Figure 34.

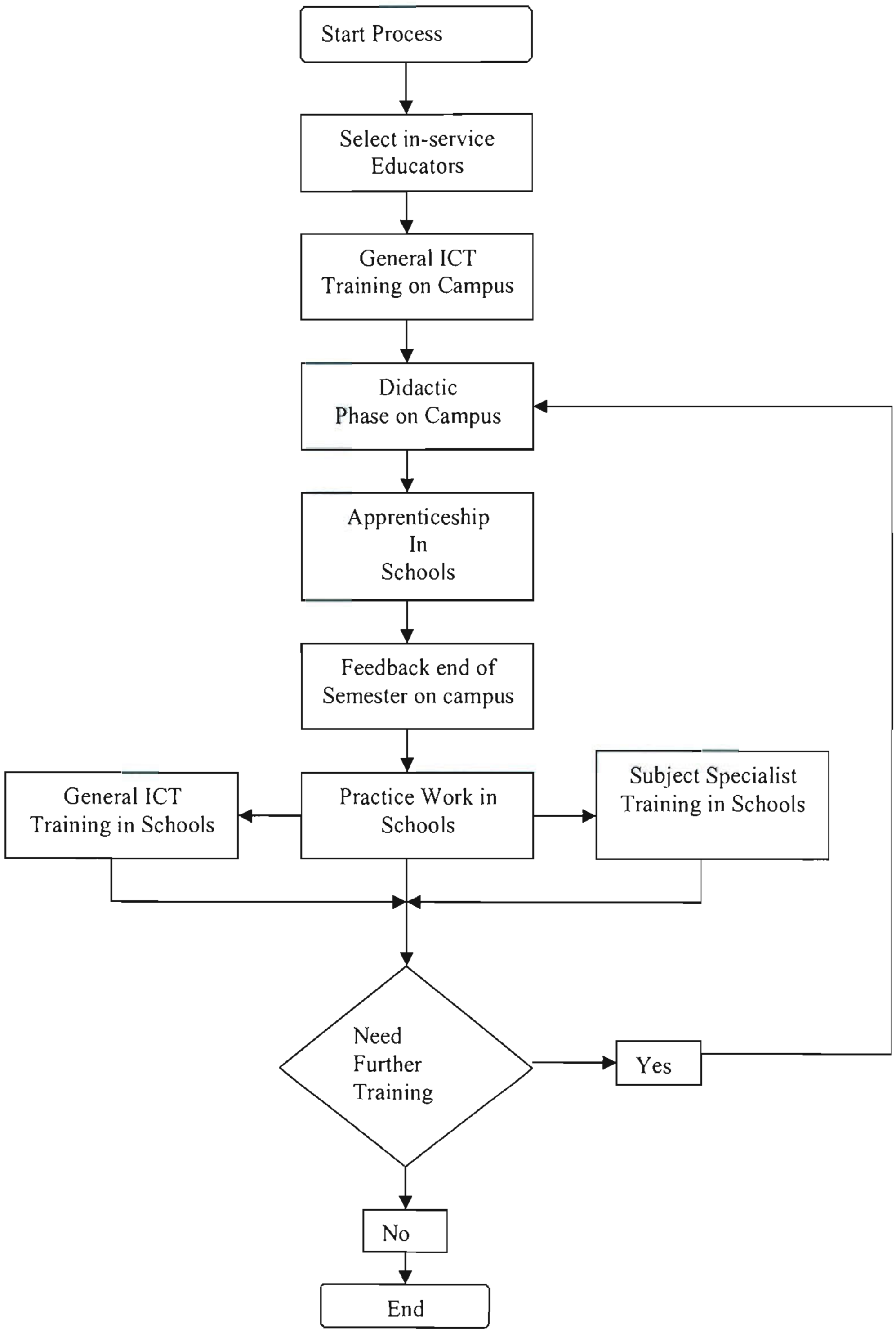

Figure 34: Proposed Process for Educator Professional Development

10.11. Concluding Remarks

The National Department of Education, in its White Paper on E-Education, has recognized that ICTs can expose learners to larger international contexts; a development that poses both opportunities and challenges for the educator in the classroom. Ideally, educator professional development in general, and development about ICTs in particular, should be an integral part of daily practice for all educators and schools. Such activities should be enhanced through the use of ICTs for professional development, allowing for interactivity between and among educator expert groups. Access, educator readiness, sustainable professional development, review of educator assessment models, developing and accessing quality resources, creating new structures that support professional development, and conducting research are all interrelated and crucial issues when considering educator professional development. Effective use of ICTs requires significant changes for educators that cannot be achieved through a top-down approach to educator professional development. The change process must be vested in the educators themselves, so that an educator's professional development cycle can be formulated, beginning with where an educator is today, and leading to a continuous process of integrating learning and practice, so that ICTs are integrated across the curriculum in an equitable manner. The Department of Education must begin discussions with tertiary institutions so that a model for educator professional development can be realised and implemented.

11. Conclusion & Recommendations

11.1. Educators' Attitudes

Given the importance of educators' attitudes, and the relationship of educators' attitudes to the variables discussed in the literature review (chapter 2), the purpose of this research was to determine the secondary school educators' attitudes toward ICT in South African education, and then to explore the relationship between educators' attitudes and factors that are thought to be influencing them, including perceived computer attributes, cultural perceptions, perceived computer competence and general computer use. Educator attitudes were also predicted by constructs extracted from the different Information Systems (IS) model/theories for technology adoption. The researcher also attempted to ascertain the extent to which ICT is being used by educators when access and competence is not an issue, as well as the reasons for non-usage. Finally, the study considered challenges facing the Provincial Department of Education with respect to ICT integration in their schools in KZN.

Educators' attitudes toward ICT have been universally recognized as an important factor for the success of technology integration in education (Rogers 1995; Watson 1998; Woodrow 1992). Findings from this study show that participants have positive attitudes toward ICT in education. The respondents' positive attitudes are evident within the affective, cognitive and behavioural domains. Such optimism cannot simply be attributed to the novelty of computers in South African education. The participants seem to have totally accepted the rationale for introducing ICT into schools and are able to base their judgments on understandable reasons. Therefore, the majority of respondents (90%) consider computers as a viable educational tool that has the potential to engender significant improvements in their schools and classrooms.

This positive attitude shows that educators have already been initiated into the innovation-decision process, as defined by Rogers (1995). Further, it is apparent that educators have already gone through the Knowledge and Persuasion stages (Rogers 1995) and are probably proceeding to the Decision phase.

11.2. Educators' Perceptions

The findings of the study indicate a very strong positive correlation between educators' attitudes toward ICT in education, and their perceptions of computer attributes. This is an important predictor of computer attitudes in this study. The findings are consistent with Roger's Innovation Attributes sub-theory (Rogers 1995). An examination of individual computer attributes shows that respondents are most positive about the relative advantage of computers as an educational tool. Following closely are educators' perceptions of the compatibility of ICT with their current teaching practices. Twenty five percent (25%) of participants are neutral / uncertain about whether or not computers fit well into their curricular goals. The disparity between technological demands and the existing curricula has often been a major hindrance for technology integration (Ojo & Awuah 1998). As the responses of the participants indicate, the KwaZulu-Natal educational landscape seems to be no exception. Besides, 45% of the participants consider that the class time is too limited for computer use. This problem has also been emphasized in the literature (Becker 1998). Educators' concerns about the incompatibility of computers with the existing curricula, as well as the lack of time for computer use, indicate that educational change cannot simply be attained by placing computers in schools (Hodas 1993). For a change to occur, many changes need to be made at the structural and ideological levels. Hence, the introduction of ICT innovations into education requires equal innovativeness in structural, pedagogical and curriculum approaches.

Interestingly, cultural perceptions are seen as a second important predictor of computer attitudes in this study. This conclusion points to the need for considering cultural factors in studies conducted in developing countries. The majority of respondents regard computers as pertinent to both South African schools and society, and as a viable means for improving education and standards of living in general. What should not go unnoticed, however, is that 40% of the respondents feel the need for computers that better suit the African culture and identity. It has often been noted that people who have not been quite influential in the design and development of ICT would prefer a localized version of these technologies (Damarin 1998). In addition, 49% of the respondents believe that there are more important social issues to be addressed before implementing computers in education. Therefore, it is not surprising to find that 45% of the respondents agree that computers are proliferating too fast. The above conclusion implies that balancing resource allocation among the competing areas of need is a critical issue in developing countries.

Educator attitudes were also predicted by constructs extracted from the different Information Systems (IS) model/theories for technology adoption. The strongest construct to predict educators' attitudes toward ICT integration was extrinsic motivation followed by perceived usefulness, complexity, perceived behavioural control and relative advantage. A combination of the different constructs from the IS models/theories was able to account for as much as 83% of the variance in educator attitudes toward technology and thus technology adoption. This is quite a significant finding since most previous research have only been able to account for between 17% and 69% (Venkatesh *et. al,* 2003) of the variance in user intentions to use technology. Arising from this result, a model for predicting educator technology adoption is proposed. This is where the researcher feels that the body of knowledge on predicting technology adoption (in this case in an educational scenario) has been expanded.

The majority of respondents in this study report having little or no competence in handling most of the computer functions needed by educators. This finding does not support the assumption that educators with a low level of computer competence usually have negative attitudes toward computers (Summers 1990). The fact that computer competence is related, to a limited extent, to educators' attitudes, supports the theoretical and empirical arguments made for the importance of computer competence in determining educators' attitudes toward ICT (Al-Oteawi 2002, Berner 2003, Na 1993). In addition, the relationship between computer attitudes and competence suggests that higher computer competence may foster the already positive attitudes of educators, and eventually result in their use of computers within the classroom.

The findings of this study may be specific to KZN educators, but its implications are far-reaching. Educators' positive attitudes in the current study have a special significance given the limitations characterizing the current status of ICT in South African schools; that is, insufficient computer resources and educators' lack of computer competence. It is, therefore, essential for policy-makers to sustain and promote educators' attitudes as a prerequisite for deriving the benefits of costly technology initiatives. Since positive attitudes toward ICT usually foretell future computer use, policy-makers can make use of educators' positive attitudes toward ICT to prepare them better for incorporating ICT in their teaching practices.

11.3. Technology Use

Quite often, technology availability is mistaken for technology adoption and use, one does not want the KZN Department of Education to make this mistake. The researcher has shown in this study that there are educators who are in schools with computer rooms and who have the computer competence but are not using computers for teaching and learning. Perceptual Control Theory was used to analyse this. According to the Perceptual Control Theory (PCT), all purposeful behaviour is goal-oriented in the sense that behaviour results from an individual's attempt to make his perceptions conform to internal standards for these perceptions. Only when a discrepancy between the perception and the internal standards occurs, either as a result of external disturbances or a changed internal reference condition, does an individual start to vary his behaviour in an attempt to reduce this discrepancy. In order for educators to use technology, they must first have the need to do so, and this need, according to PCT, results from a sensed discrepancy between the perception and goal. There are a number of ways to create such discrepancies. First, as previously mentioned, educators can be expected to have the goal of delivering quality instruction. Technology has been reported to improve learning in a variety of forms. Whether an educator perceives quality teaching as good performance on tests scores, or as the development of critical thinking skills, research has provided evidence that technology can help better to achieve that goal (Pedretti *et al.* 1999). These research findings should make educators perceive a discrepancy as they realise that technology can help them better achieve their goals of delivering quality teaching. However, since most educators are not aware of these research findings or because they are reported in such an abstract manner that educators cannot make sense of them, they are not perceived as disturbances. Therefore, efforts should be made to make these research findings easily available to educators.

The second way in which technology could create a disturbance to educators, is to make the use of technology a requirement. While it is impossible to manipulate an individual's goal directly, it is possible to influence a person's lower-level goals by disturbing his higher-level goals. When one makes the use of technology a requirement (for example, a circular that details requirements for confirmation of educators or revised norms and standards for educators), although there is no way to ensure they will definitely use it, it is more likely that they will use it since it disturbs a higher-level goal, which is to have a job. There are currently hardly any technological requirements for pre-service or in-service educators. The only requirement for pre-service training for educators is that they include a stand alone computer literacy course as part of their curriculum.

As the technological age becomes more pronounced, other sources of disturbances will be from learners, colleagues and society. As more families own computers and the national information infrastructure enables more people to use technology, learners are coming to the classroom with more experience of learning with technology, therefore, making it very difficult for the educator to maintain the status quo. For example, when the Web becomes an important source of information for learners, educators will have to vary their current behaviour in order to maintain the goal of being a good educator.

As discussed in chapter 8, the perceived effectiveness of means is an important criterion when there are many possible means available to achieve a goal. Therefore, to promote the educational uses of technology, it is important that educators perceive that technology can help to achieve their goals more effectively. This is not as easy as it sounds, since effectiveness is not necessarily inherent in any technology, but rather what is important is the educator's perception, which is a function of his internal goal and knowledge of the technology. It is, therefore, crucial to understand what each individual educator's goals are before telling them how powerful technology can be. Case studies and stories from peers who have been using technology can be very effective in raising educators' interest in technology. It is expected that by reading these stories, other educators will come to perceive technology as an effective means in achieving their goals. A less effective and, unfortunately, a very popular approach, is having technical experts (sales agents) sell to educators the mighty power of technology. Very often, these experts are not educators themselves; even though they may understand the teaching process well, they may not be perceived by educators as individuals who have similar goals. Technical experts are often suspected of having a different agenda to educators, such as focusing on technology, rather than on quality teaching. Since they are not perceived as having similar goals, it is possible that educators would tend not to be convinced of the power of the means (technology) being advocated.

According to the PCT framework, in spite of the perceived effectiveness of technology, educators may not use technology because it disturbs other important high-level goals. It is, therefore, necessary to reduce these perceived disturbances. There are a number of ways that can help to reduce potential disturbances. First, pedagogical changes should not be required when promoting the use of technology. As previously discussed, pedagogical beliefs and practices are more difficult to change and educators do not want to change them. Technology should fit existing beliefs of educators (Olson 1995). If using technology also requires educators to adopt new teaching approaches, educators may well resist adopting technology. Once technology is integrated into the curriculum, it will introduce disturbances that will, on their own, necessitate pedagogical changes.

A second way to reduce potential disturbances, is to develop easy-to-use tools so that educators do not spend extra time and energy learning to use technology. Easy-to-use tools can also help reduce the potential disturbance to the goal of maintaining a good image before learners, since it is less likely that technical problems will arise. A third way to reduce disturbances is to provide on-site support, so that educators have someone to turn to when technical problems arise.

Data gathered in this study indicates that while educators are increasingly citing the benefits that learners derive from computer use, educators must weigh the costs in terms of their time and their lack of competence. It is, therefore, important to reduce the perceived disturbance to other goals resulting from using technology. The PCT framework discussed in chapter 8 views technology as a possible way for educators to achieve their higher-level goals. However, as stated before, the goal of using technology needs to be maintained by varying lower level systems.

11.4. Equal Access and Equal Competence

The researcher asserts that placing computers into previously disadvantaged schools will not succeed without other non-technological interventions, is supported by the results described in chapter 9. While it is clear that the vast majority of educators in this study all possess the basic ingredient of a positive attitude towards ICT, it is equally clear from the data that the very same educators are under-equipped to take full advantage of computers if they are installed in their schools. The researcher contends that the KZN Department of Education at times makes political, rather than rational, decisions. While under the present circumstances one cannot criticize these decisions, the researcher believes that it will not lead to the ultimate goals of the White Paper on E-Education. Technology tends to amplify advantage. It is for this reason that the principle of equity should inform the department of education's approach for supplying access to information and the allocation of resources. Equal access and equal competence must be the objective of the KZN education system.

11.5. Recommendations

As stated in the literature review, educators experience stages of development on their way to integrating technology fully into their instructional programs. These stages as summarized by Dywer *et al.*(1991) are: Entry, Adoption, Adaptation, Appropriation and Invention. This study finds that educators who have the computer competence and do have access to computers for teaching and learning are not using them, apart from in subjects like Computer Studies and Compu-Typing. The researcher can confidently claim that most of these educators are still in the Entry stage of development as outlined during the ACOT studies (see Table 2: Stages of Development).

As a recommendation one feels that the Department of Education needs to develop a national framework for competencies for educators, and the use of ICTs must be integrated into pre-service and in-service training. The different stages, as outlined by Dywer *et al.* (*ibid*), can be adapted and used to ensure that educators have mastered different competencies at different levels as follows:

1. Entry – must be computer literate, able to use computers and teach learners to use computers for simple tasks.
2. Adoption – must be able to use various technologies, including the computer, to support administration, management, teaching and learning.
3. Adaptation – must be able to use technology to enrich the curriculum, and use integrated systems for management and administration.

4. Appropriation – must be able to integrate technology into teaching and learning activities, and use integrated systems for management and administration in a community context.
5. Invention – must be prepared to develop entirely new learning environments that make use of technology, so that learning becomes collaborative and interactive.

A further recommendation is that the Department of Education will need to build an education and training system that will support ICT integration in teaching and learning. This will require the appointment of dedicated expertise at different levels of the system for the planning, management, support, monitoring and evaluation of ICTs. The system must build educators' and managers' confidence in the use of ICTs. This can be achieved by ensuring that:

1. Every educator and manager has the means to obtain a personal computer, through a government loan scheme, for personal use and administration.
2. Every educator and manager has access to basic training in the use of ICTs.
3. Technology incentives for schools and educators to use ICTs are put in place.
4. A set of case studies, documented research and examples on how to integrate ICTs in management, teaching and learning are available to educators and managers.
5. All pre-service educator-training institutions include basic computer literacy and basic ICT integration into their teaching and learning.
6. Educators have access to in-service training on how to integrate ICTs into teaching and learning.
7. Educators have access to technical support.

8. Subject Advisors are trained in ICT integration so that they can offer support to their schools.

11.6. Professional Development

A number of ICT initiatives are being implemented throughout the country, for example the Khanya project in the Western Cape, the Gauteng OnLine project in Gauteng and the Connectivity project in the Northern Cape. No significant project has been undertaken in the Province of KwaZulu-Natal as yet. Whether or not these initiatives are reaching all schools and districts is not evident. The Department of Education in KZN has a responsibility to ensure that the benefits of E-Education are enjoyed by all. The merits and weaknesses of other provincial projects can be used as a learning experience by the DOE KZN when planning for ICT integration into their schools.

Ideally, educator professional development in general, and development about ICTs in particular, should be an integral part of daily practice for all educators and schools. Such activities should be enhanced through the use of ICTs for professional development, allowing for interactivity between and among educator expert groups. Access, educator readiness, sustainable professional development, review of educator assessment models, developing and accessing quality resources, creating new structures that support professional development, and conducting research are all interrelated and crucial issues when considering educator professional development. Effective use of ICTs requires significant changes for educators that cannot be achieved through a top-down approach to educator professional development. The change process must be vested in the educators themselves, so that an educator's professional development cycle can be formulated that begins with where an educator is at today and leads to a continuous process of integrating learning and practice, so that ICTs are integrated across the curriculum in an equitable manner. The Department of Education must begin discussions with tertiary institutions so that a model for educator professional development can be realised and implemented.

11.7. Conclusion

Finally, the researcher contends that the White Paper on E-Education (DOE 2003) is a first world policy in a third world country. The government, as stated in the White Paper, aims to ensure that every school has access to a wide choice of diverse, high quality communication services which will benefit all learners and local communities. There are many obstacles (for example lack of computer competence, presence of other higher level goals for educators) that may hinder the implementation of this policy if due consideration is not given to these factors. As stated previously, often technology availability is mistaken for technology adoption and use. The framework that is presented in chapter 8 outlines three conditions required to ensure the use of technology by an educator:

1. The educator must believe that technology can more effectively maintain a higher-level goal than what has been used to achieve this goal previously.
2. The educator must believe that using technology will not cause disturbances to other higher-level goals which he deems more important than the one being maintained.
3. The educator must believe that he has, or will have, the ability and resources to use technology.

Once again, this is where the researcher feels that the body of knowledge on technology adoption has been advanced. The constructs as outlined in the existing IS models/theories may not be sufficient for predicting technology adoption, and it is the opinion of this researcher that for an educator to use technology, the above three conditions must first be met.

Further, the White Paper states that every learner in the GET and FET bands will be ICT capable by the year 2013. For this to become a reality, the Department of Education must take note of the needs of its educators and educators in training. Therefore, the educators need to be appropriately trained and equipped with the necessary skills to integrate ICT into their teaching and learning, which will, in turn, contribute to the realization of the E-Education policy goal.

The road ahead for South African schools, with respect to ICT integration, is going to be long, hard and challenging. It is envisaged that by adopting a Perceptual Control Theory framework and the proposed educator research model, as presented in this study, the DOE will be able to construct effective pedagogical models and approaches for ICT integration. The positive attitudes of educators must be sustained. However, extensive training and support is necessary before educators can perceive themselves to be competent for integrating ICT into their teaching methodologies. Introducing ICT into schools must be seen as a negotiated process in which educators' lower level goals may be altered to preserve what they perceive to be their goals of higher order. We are a long way off from achieving a position at which we can claim to have provisioned our learners sufficiently so that they may take their rightful place in the emerging e-society. The researcher expects that this research will assist in this regard.

References

Abdulkafi, A 2004, 'Teachers' attitudes toward information and communications technologies in the case of Syrian EFL teachers', *Computers & Education* – In-press article.

Adams, DA, Nelson, RR & Todd, PA 1992, 'Perceived usefulness, ease of use, and usage of information technology: A replication'. *MIS Quarterly*, vol. 16, pp. 227-247.

Ajzen, I 1991, 'The Theory of Planned Behavior', *Organizational Behavior and Human Decision Processes,* vol. 50, no. 2, pp. 179-211.

Agarwal, R & Prasad, J, 1998, 'A conceptual and operational definition of personal innovativeness in the domain of information technology', *Information Systems Research,* vol. 9, no. 2, pp. 204-215.

Ajzen, I & Fishbein, M 1980, *Understanding attitudes and predicting social behavior*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Al-Oteawi, SM 2002, 'The perceptions of Administrators and teachers in utilizing information technology in instruction, administrative work, technology planning and staff development in Saudi Arabia', Doctoral thesis, Ohio University, ProQuest Digital Dissertations.

Angeli, C 2005, 'Transforming a teacher education method course through technology : effects on preservice technology competency', *Computers & Education,* vol. 45, pp. 383 – 398.

Bagozzi, RP, Davis, FD & Warshaw, PR, 1992, 'Development and test of a theory of technological learning and usage', *Human Relations*, vol. 45, no. 7, pp. 660-686.

Baylor, A & Ritchie, D 2002, 'What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms?', *Computers & Education* vol. 39, no.1, pp. 395-414.

Becker, HJ 1994, 'How Exemplary Computer-using Teachers Differ from Other Teachers: implications for realising the potential of computers in schools', *Journal of Research on Computing in Education*, vol. 26, no. 3, pp. 291-321.

Becker, HJ 1998, 'Running to catch a moving train', *Theory into Practice,* vol.37, no.1, pp. 20-30.

Becker, HJ & Riel, MM 2000, 'Teacher Professional Engagement and Constructivist-compatible Computer Use', Centre for Research on Information Technology and Organisations, University of California, Irvine, Available: http://www.crito.uci.edu/tic/findings.html, Accessed: 20 July 2004.

Berner, JE 2003, 'A study of factors that may influence faculty in selected schools of education in the Commonwealth of Virginia to adopt computers in the classroom', Doctoral thesis, George Mason University, ProQuest Digital Dissertations.

Benzie, D 1995, IFIP working group3.5: 'using computers to support young learners', In: *World Conference on Computers in Education '95: Liberating the Learning*, eds. JD Tinsley and TJ van Weert, Chapman & Hall, London.

Blankenship, S.E., 1998. 'Factors related to computer use by teachers in classroom instruction', Doctoral thesis, Virginia Polytechnic Institute and State University, ProQuest Digital Dissertations.

Bork, A 1985, *Personal computers for Education*, Harper & Row, New York.

Bradford, M & Florin, J, 2003, 'Examining the role of innovation diffusion factors on the implementation success of enterprise resource planning systems', *International Journal of Accounting Information Systems,* vol. 4, no. 3, pp. 205-225.

Brown, HS, Collins, A & Duguid, P 1989, 'Situated Cognition and the Culture of Learning', *Educational Researcher*, vol. 18, no. 1, pp. 32-41.

Bruce, BC, Peyton, JK & Batson, TJ 1993, *Networked –based classrooms,* Cambridge University Press, New York.

Bullock, D 2004, 'Moving from theory to practice: an examination of the factors that pre-service teachers encounter as they attempt to gain experience teaching with technology during field placement experiences', *Journal of Technology and Teacher Education* vol. 12, no. 2, pp. 211-237.

Buys, R 2004, *Cyberlaw @ SAII*, Van Schaik Publishers, Pretoria.

Byron, I & Gagliardi, 1998, 'Communities and the Information Society: The role of Information and Communication Technologies in Education in Canada', Montreal International Development Research Centre, Available: http://www.irdc.ca/acacia/studies/ir-unes1.html, Accessed: 7 July 2004.

Carney, JM 1998, 'Integrating Technology into Constructivist Classrooms: an examination of one model for teacher development', *Journal Of Computing In Teacher Education*, vol. 15, no. 1, pp. 7-15.

CEC 2000a, 'Communication from the Commission: e-Learning - Designing Tomorrow's Education', COM 2000, 318 Final, Brussels, CEC.

CEC 2000b, 'Communication from the Commission: e-Learning - Designing Tomorrow's Education: Promoting Innovation with New Technologies', COM 2000, 23 Final, Brussels, CEC.

CEO Forum on Education and Technology 1997, *School technology and readiness report: From pillars to progress,* Washington, DC, Available: http://ceoforum.org Accessed: 29 June 2004.

Chale, EM & Michaud, P 1997. 'Distance Learning for change in Africa: A case study of Senegal and Kenya policy and research prospects for the International Development Research Centre', Montreal International Development Research Centre, Available: http://www.idrc.ca/acacia/03230/04-dlear/lear3.html, Accessed: 30 June 2004.

Chisholm, I & Wetzel, K 1998, 'Lessons Learned from a Technology Integrated Curriculum for Multicultural Classrooms', *Journal of Technology and Teacher Education,* vol. 5, no. 4, pp. 293-317.

Chlopak, O 2003, 'Computers in Russian schools: current conditions, main problems, and prospects for the future', *Computers & Education* vol. 40, pp. 41-55.

Christensen, R 1998, 'Effect of technology integration education on the attitudes of teachers and their students', Doctoral thesis, University of North Texas. ProQuest Digital Dissertations, Available:http://www.tcet.unt.edulresearch/dissert/rhondac, Accessed: 03 July 2004.

Clark, R 1983, 'Reconsidering research on learning from media', *Review of Educational Research,* vol. 53, no. 4, pp. 445-459.

Cooper, RB & Zmud, RW, 1990, 'Information technology implementation research: A technological diffusion approach', *Management Science,* vol. 36, no. 2, pp. 123-139.

Council of Chief State School Officers, (CCSSO), 1991, *Improving student performance through learning technologies,* Policy statement.

Council of Europe 1999, 'Lifelong Learning for Equity and Social Cohesion: a New Challenge to Higher Education', DCES-HE 98/5 rev 2 (unpublished document).

Creswell, JW 2003, *Research Design: qualitative, quantitative and mixed methods approaches,* 2nd ed., Sage Publications, Beverley Hills, California.

Crum, MR, Premkumar, G & Ramamurthy, K, 1996, 'An assessment of motor carrier adoption, use, and satisfaction with EDI', *Transportation Journal*, vol. 35, no. 4, pp. 44-57.

Cuban, L 1994, 'Public school teachers using machines in the next decade', Report, 8th October 1994, Washington DC: Office of Technology Assessment.

Cziko GA, 1995, *Without miracles: Universal Selection Theory and the second Darwinian revolution,* Massachusetts Institute of Technology Press, Bradford.

Damarin, SK 1998, 'Technology and Multicultural Education: the question of convergence', *Theory into Practice,* vol. 37, no. 1, pp. 11-19.

Davis FD, Bagozzi, RP & Warshaw, PR, 1992, 'Extrinsic and Intrinsic Motivation to Use Computers in the Workplace', *Journal of Applied Social Psychology* vol. 22, no. 14, pp. 1111- 1132.

Davis, FD, 1989, 'Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology', *MIS Quarterly* vol. 13, no. 3, pp. 319-339.

Davis, FD, Bagozzi, RP & Warshaw, PR, 1989, 'User Acceptance of Computer Technology: A Comparison of Two Theoretical Models', *Management Science* vol. 35, no. 8, pp. 982-1002.

Davis, NE 1997, 'Framing Teacher Professional Development' (Editorial), *Journal of Information Technology for Teacher Education,* vol. 6, no. 2, pp. 109-114.

Demteriadis, S 2003, 'Cultures in negiotiation: Teachers' acceptance/resistance attitudes considering the infusion of technology into schools', *Computers & Education,* vol. 41, no. 1, pp. 19-37.

Department of Education 2000, *Learning for Life: White Paper on Adult Education,* Dublin, Government Stationery Office.

Devine, J 1997, 'Multimedia and the Internet: making a real difference?', Available: http://www.nks.no/eurodl/shoen/Devine.html, Accessed: 09 July 2004.

Diamantopoulos, A & Schlegelmilch, BB 2000, *Taking the Fear Out of Data Analysis,* Thomson Learning, London.

DOE 2003, *White Paper on E-Education*, Department of Education, Available: http://www.education.gov.za, Accessed: February, March & May 2004.

Dwyer, DC, Ringstaff, C & Sandholtz, J, 1991, 'Changes in teachers' beliefs and practices in technology-rich classrooms', *Educational Leadership* vol. 48, no. 8, pp. 45-52.

Dwyer, D 1994, 'Apple classrooms of tomorrow: what we've learned', Available: http://www.ascd.org/readingroom/edlead/9404/dwyer.html, Accessed : 23 June 2004.

ECT 2002, *Education and Communications Act of 2002,* South African Government, Available: http://www.acts.co.za/ect-act/ Accessed continuously in 2004.

Ely, DP 1993, 'Computers in schools and universities in the United States of America', *Educational Technology,* vol. 33, no. 9, pp. 53-57.

Evans-Andris, M 1995, 'Barrier to Computer Integration: micro-interaction among computer co-ordinators and classroom teachers in elementary schools', *Journal of Research on Computing in Education*, vol. 28, no. 1, pp. 29-45.

Fishbein, M & Ajzen, I, 1975, *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research,* Addison-Wesley, Reading, MA.

Francis-Pelton, L & Pelton, T 1996, 'Building attitudes: how a technology course affects pre-service teachers' attitudes about technology', Available: http://web.uvic.ca/educ/lfrancis/web/attitudesite.html, Accessed: 5 July 2004.

Fullan, M 1991, *The New Meaning of Educational Change*, Cassell, London.

Galanouli, D, Murphy, C & Gardner, J 2004, 'Teachers' perceptions of the effectiveness of ICT- competence training', *Computers & Education,* vol. 43, pp. 63-79.

Garner, R & Gillingham, M 1996, *Internet communications in six classrooms: Conversations across time, space and culture,* Erlbaum, Mahwah, New Jersey.

Gladieux, L & Swail, WS 1999, 'The Virtual University and educational opportunity: panacea or false hope?', *Higher Education Management*, vol. 11, no. 2, pp 43-56.

Govender DW 2001, 'Learning in a constructivist on-line environment', Master's dissertation, University of Natal.

Hadley, M & Sheingold, K 1993, 'Commonalities and Distinctive Patterns in Teachers' Integration of Computers', *American Journal of Education*, vol. 101, no. 3, pp. 261-315.

Hamza, MH & Alhalabi, B 1999, 'Technology and education: between chaos & order',*First Monday Journal.* Available: http://www.firstmonday.dk/issues/issue43/hamza/index.html Accessed: 28 June 2004.

Harper, DO 1987, 'The creation and development of educational computer technology', In: *Educational technology – its creation, development and cross-cultural transfer,* eds. RM Thomas and VN Kobayashi, Pergamon Press, Oxford.

Harrison, DA, Mykytyn, PP & Riemenschneider, CK, 1997, 'Executive Decisions About Adoption of Information Technology in Small Business: Theory and Empirical Tests', *Information Systems Research* vol. 8, no. 2, pp. 171-195.

Hawkridge, D, Jaworski, J & Mcmahon, H 1990, *Computers in Third World Schools: examples,experiences and issues,* Macmillan, London.

Hendrickson, AR, Massey, PD & Cronan, TP, 1993, 'On the test-retest reliability of perceived usefulness and perceived ease of use scales', *MIS Quarterly*, vol. 17, pp. 227-230.

Hodas S 1993, 'Technology refusal and the organizational culture of schools', Available: http://epaa.asu.edu/epaa/v1n10.html, Accessed: 2 July 2004.

Honey, M & Meoller, B 1990, *Teachers' beliefs and technology integration: different values, different understandings,* Centre for Technology in Education, Bank Street College of Education, New York.

Hoyles, C, Healy, L & Pozzi, S 1994, 'Groupwork with Computers: an overview of findings', *Journal of Computer Assisted Learning*, vol. 10, no. 4, pp. 202-215.

Hruskocy, C, Cennamo, KS, Ertmer, PA & Johnson, T 2000, 'Creating a Community of Technology Users: students become technology experts for teachers and peers', *Journal of Technology and Teacher Education,* vol. 8, no. 1, pp. 69-84.

Hu, PJ, Chau, PYK, Sheng, ORL, & Tam, KY, 1999, 'Examining the Technology Acceptance Model Using Physician Acceptance of Telemedicine Technology', *Journal of Management Information Systems* vol. 16, no. 2, pp. 91-112.

Information Society Commission 1999, *Building a Capacity for Change: Lifelong Learning in the Information Society*, Dublin, Government Stationery Office.

Irish Times 1999, 'Information for All Ages', *The Irish Times*, 7 December 1999.

Isleem, M 2003, 'Relationships of selected factors and the level of computer use for instructional purposes by technology education teachers in Ohio public schools: a statewide survey', Doctral thesis, Ohio State University, ProQuest Digital Dissertations.

Jaber, W 1997, 'A survey of factors which influence teachers' use of computer-based technology'. Masters Dissertation, Virginia Polytechnic Institute and State University, ProQuest Digital Dissertations.

Jules Van Belle, GC & Soetaert, R 2001, 'Breakdown into the virtual user-involved design and learning', *Journal of Technology and Teacher Education,* vol. 9, no. 1, pp. 31-42.

Kersaint, G, Horton, B, Stohl, H, & Garofalo, J 2003, 'Technology beliefs and practices of mathematics education faculty', *Journal of Technology and Teacher Education* vol. 11, no. 4, pp. 549-577.

Kluever, RC, Lam, TC, Hoffman, ER, Green, KE & Swearinges, DL 1994, 'The computer attitude scale: assessing changes in teachers' attitudes toward computers', *Journal of Educational Computing Research,* vol. 11, no. 3, pp. 251-261.

Knezek, G & Christensen, R 2002, 'Impact of new information technologies on teachers and students', *Education and Information Technologies* vol. 7, no. 4, pp. 369-376.

Leedy PD & Ormrod JE 2005, *Practical Research-Planning and Design,* 8th edition, Pearson Education, New Jersey.

Li, N 2002, 'Culture and gender aspects of students' information searching behaviour using the Internet: a two-culture study of China and the United Kingdom', Doctoral thesis, Open University United Kingdom, ProQuest Digital Dissertations.

Lim, CP & Chai, CS 2004, 'An activity-theory approach to research of ICT integration in Singapore schools: Orienting activities and learner autonomy', *Computers & Education* vol. 43, pp. 215-236.

Livesay, JM & Murray, PE 1992, 'Integration of instructional technology into special education: An organizational process model', *Technology and Disability*, vol. 1, no. 1, pp. 7-18.

Marchese, T 1998, 'Not so distant competitors: how new providers are remaking the postsecondary market place', American Association for Higher Education Bulletin (May '98).

Mathieson, K, 1991, 'Predicting User Intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior', *Information Systems Research* vol. 2, no. 3, pp. 173-191.

Mawson, C 1999, 'School Education Information Technology Initiatives', Available: http://www.edu/.au/edna/publish/schools/draft/schoolsector.html, Accessed: 30 June 2004.

Mc Cannon, M & Crews, TB 2000, 'Assessing the technology training needs of elementary school teachers', *Journal of Technology and Teacher Education* vol. 8, no. 2, pp. 111-121.

Mc Clelland, K 1998, 'The collective control of perception: Constructing order from conflict', Presented at the 1998 annual meeting of the Control Systems Group, Vancouver, British Columbia, Available: http://www.grinnell.edu/sociology/ccp.html, Accessed: 29 June 2004.

Mc Clure, PA 1993, 'Growing our academic productivity', In: *Reengineering Teaching and Learning in Higher Education: sheltered groves, Camelot, windmills, and malls*, ed. RC Heterick, Available: http://www.colorado.edu/informationresources/ir-library/abstracts/pub3010.html, Accessed: 24 June 2004.

McDougall, A & Squires, D 1997, 'A Framework for Reviewing Teacher Professional Development Programmes in Information Technology', *Journal of Information Technology for Teacher Education*, vol. 6, no. 2, pp. 115-126.

Means, B, Blando, J, Olson, K, Middleton, T, Morocco, C, Remz, A & Zorfass, J 1993, 'Using technology to support education reform', Office of Educational Research and Improvement (OERI), Department of Education, Washington, DC Available: http://www.ed.gov/pubs/EdReformStudies/TechReforms, Accessed: 23 June 2004.

Means, B 1994, 'Introduction: Using technology to advance educational goals', In: *Technology in educational reform: the reality behind the promise,* Jossey Bass Publishers, San Francisco.

Means, B & Olson, K 1994, 'Tomorrow's schools: technology and reform in partnership', In: *Technology in educational reform: the reality behind the promise*, Jossey Bass Publishers, San Francisco.

Michalsons Attorneys 2002, 'Guide to the ECT Act', Available: http://www.michalson.com, Accessed: January 2006.

Ministry of Education 1998, *Green Paper for the Information Society in Portugal,* Available: http://www.missao-si.mct.pt/english/greenpaper/socinfo4.html, Accessed: 20 June 2004.

Ministry of Finance 1996, *Finland's way to the information society: the National Strategy and its implementation*, Helsinki, Ministry of Finance.

Mooij, T and Smeets, E 2001, 'Modeling and supporting ICT implementation in secondary schools', *Computers & Education* vol. 36, no. 3, pp. 265-281.

Moore, GC & Benbasat, I, 1991, 'Development of an instrument to measure the perceptions of adopting an information technology innovation', *Information Systems Research,* vol. 2, no. 3, pp. 192-222.

Moore, GC & Benbasat, I, 1996, 'Integrating Diffusion of Innovations and Theory of Reasoned Action Models to Predict Utilization of Information Technology by End-Users', in *Diffusion and Adoption of Information Technology*, eds. K. Kautz & J. Pries-Hege, Chapman & Hall, London, pp. 132-146.

Mumtaz S 2000, 'Factors affecting Teachers' Use of Information and Communications Technology', *Journal of Information Technology for Teacher Education,* vol. 9, no. 3, pp. 319 – 341.

Myhre, OR 1998, 'I think this will keep them busy: computers in a teacher's thought and practice', *Journal of Technology and Teacher Education* vol. 6 no. 2-3, pp. 93-103.

Na, SI 1993, 'Variables associated with attitudes of teachers toward computers in Korean vocational agriculture high schools', Doctoral thesis, The Ohio State University, ProQuest Digital Dissertations.

NCS 2003, *National Curriculum Statement for Information Technology,* Department of Education, Available: http://www.education.gov.za, Accessed: February, March & May 2004.

Negroponte, N, Renick, M & Cassell, J 1997, 'Creating a learning revolution', Available: http://education.unesco.org/unesco/educprog/lwf/doc/portfolio/opinion8.htm, Accessed: 23 July 2004.

Noble, D 1998, 'Digital Diploma Mills: The Automation of Higher Education', *First Monday Journal,* Available: http://www.firstmonday.dk/issues/issue31/noble/index.html, Accessed: 28 June 2004.

Noble, D 1999, 'Digital Diploma Mills, Part IV: Rehearsal for the Revolution', Available http://www.communication.ucsd.edu/DL/DDM4.html, Accessed: 28 June 2004.

North Central Regional Educational Laboratory (NCREL) 2003, 'Technology connections for school improvements', Available: http://www.ncrel.org/tplan/tplanB.html, Accessed: 16 July 2004.

Norum, K 1997, 'Lights, Camera, Action!, The trials and triumphs of using technology in the classroom', *Journal of Technology and Teacher Education*, vol. 5, no. 1, pp. 3-18.

NTIA 1998, *Falling through the Net II: New Data on the Digital Divide*, National Telecommunications and Information Administration (NTIA), Washington DC, US Department of Commerce.

Oja S & Awuah B 1998, 'Building resource capacity for IT education and training in schools', In: *Capacity building for IT in education in developing countries,* eds. G Marshal & M Ruohonen, Chapman & Hall, London.

OLS 2004, Open Learning System, University of KwaZulu-Natal, Available: http://ols.ukzn.ac.za, Access available continuously.

Olson, J 1995, 'Classroom ethos and the concerns of the teacher', In: *Integrating Informationl Technology into Education,* Eds. D Watson & D Tinsley, Chapman & Hall, London.

OTA, 1995, US Congress, Office of Technology Assessment, 'Teachers and Technology: Making connection', Report Summary, Washington, DC: US Government Printing Office, OTA-HER-616.

Papert, S 1980, *Mindstorms: children, computers, and powerful ideas*, Basic Books, New York .

Pedretti, E, Mayer-Smith, J & Woodrow, J 1999, 'Teaming technology enhanced instruction in the science classroom and teacher professional development', *Journal of Technology and Teacher Education* vol. 7, no. 2, pp. 131-143.

Pelgrum, WJ 2001, 'Obstacles to the integration of ICT in education: results from a worldwide educational assessment', *Computers & Education* vol. 37, no. 2, pp. 163-178.

Piele, PK 1989, 'The politics of technology utilization', In: *Education politics/or the new century: The twentieth anniversary yearbook of the Politics of Education Association,* eds. DE Mitchell & ME Goertz, Falmer Press, London.

Plouffe, CR, Hulland, JS & Vandenbosch, M, 2001, 'Research Report: Richness Versus Parsimony in Modeling Technology Adoption Decisions— Understanding Merchant Adoption of a Smart Card-Based Payment System', *Information Systems Research* vol. 12, no. 2, pp. 208-222.

Powers, WT 1973, *Behaviour: The control of Perception,* Aldine, Greenwood, New York.

Powers, WT 1989, *The living control system: Selected papers by Powers,* Gravel Switch: Control System Group, Kentucky.

Ragosta, M 1983, 'Computer-assisted instruction and compensatory education: a longitudinal analysis', *Machine-Mediated Learning,* vol. 1, no. 1, pp. 97-127.

Robertson, SI, Calder, J, Fung, P, Jones, A, O'Shea, T & Lambrechts, G 1996, 'Pupils, Teachers and Palmtop Computers', *Journal of Computer Assisted Learning*, vol. 12, no. 4, pp. 194-204.

Rogers, E.M., 1995, *Diffusion of innovations*, 4^{th} edition, The Free Press, New York.

Rogers, EM and Shoemaker, FF 1971, *Communication of innovations*, The Free Press, New York.

Rozalind, G 2004, 'Technology and its impact in the classroom', *Computers & Education* vol. 42, no. 2, pp. 111-131.

Runkel PJ 1990, *Casting nets and testing specimens: Two grand methods of psychology,* Praeger, New York.

SABC 2006, The South African Broadcasting Cooperation: Morning Live, television program, SABC 2, 25 January.

Sandholtz, J, Ringstaffand, C, Dwyer, D, 1997, *Teaching with technology: creating student-centered classrooms*, Teachers College Press, New York.

Segars, AH & Grover, V, 1993, 'Re-examining perceived ease of use and usefulness: A confirmatory factor analysis', *'MIS Quarterly'*, vol. 17, pp. 517-525.

Selinger, M 1996, 'Beginning Teachers Using IT: the Open University model', *Journal of Information Technology for Teacher Education,* vol. 5, no. 1, pp. 253-270.

Sheingold, K & Hadley, M 1990, *Accomplished Teachers: integrating computers into classroom practice*, Centre for Technology in Education, New York.

Sheppard, BH, Hartwick, J & Warshaw, PR, 1988, 'The Theory of Reasoned Action: A Meta- Analysis of Past Research with Recommendations for Modifications and Future Research', *Journal of Consumer Research* vol. 15, no. 3, pp. 325-343.

Smeets, E, Mooij, T, Bamps, H, Bartolome, A, Lowyck, J, Redmond, D, & Steffens, K 1999, 'The impact of information and communication technology on the teacher', Nijmegen, The Netherlands, Available: http://webdoc.ubn.kun.nl/anon/i/impaofina.pdf, Accessed: 23 July 2004.

Solomon, C 1986, *Computer Environments For Children*, Massachusetts Institute of Technology Press, Cambridge, Massachusetts.

Sooknanan, P 2002, 'Attitudes and perceptions of teachers toward computers: the implication of an educational innovation in Trinidad and Tobago', Doctoral thesis, Bowling Green University, ProQuest Digital Dissertations.

Stewart, T 1986, 'Task fit, ease-of-use and computer facilities', in *Managing computer impact: An international study of management and organizations*, eds. N. Bjorn-Anderson, K. Eason, & D. Robey, pp. 63-76, Norwood, NJ: Ablex.

Subramanian, GH, 1994, 'A replication of perceived usefulness and perceived ease of use measurement', *Decision Sciences*, vol. 25 no. 5/6, pp. 863-873.

Summers, M 1990, 'New student teachers and computers: an investigation of experiences and feelings', *Educational Review* vol. 42, no. 3, pp. 261-271.

Sutherland R 2004, 'Designs for learning: ICT and knowledge in the classroom', *Computers & Education* vol. 43, pp. 5-16.

Szajna, B, 1994, 'Software evaluation and choice: predictive evaluation of the Technology Acceptance Instrument', *MIS Quarterly*, vol. 18, no. 3, pp. 319-324.

Taylor, S & Todd, PA, 1995a, 'Assessing IT Usage: The Role of Prior Experience', *MIS Quarterly* vol. 19, no. 2, pp. 561-570.

Taylor, S & Todd, PA, 1995b, 'Understanding Information Technology Usage: A Test of Competing Models', *Information Systems Research* vol. 6, no. 4, pp. 144-176.

Thomas, RM 1987, 'Computer technology: an example of decision-making in technology transfer', In: *Educational Technology - its creation, development and cross-cultural transfer,* eds. RM Thomas & VN Kobayashi, Pergamon Press, Oxford.

Thompson, RL, Higgins, CA & Howell, JM, 1991, 'Personal Computing: Toward a Conceptual Model of Utilization', *MIS Quarterly* vol. 15, no. 1, pp. 124-143.

Thompson, AD, Simonson, MR, & Hargrave CP 1992, 'Educational technology: A review of the research', Association for Educational Communication and Technology, Washington, DC.

Tornatzky, LG & Klein, RJ, 1982, 'Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings', *IEEE Transactions on Engineering Management*, vol. 29, pp. 28-45.

UNESCO 1999, 'Technologies in Support of Education', Available: http://www.unesco.org/education/educprog/50y/brochure/promotin/194.html, Accessed: 27 June 2004.

UJ 2005, University of Johannesburg Projects, Available: http://www.ujprojectday.za.net, Accessed: December 2005.

University of Illinious 1999, 'Report of the Teaching at an Internet Distance Seminar', December 1999, Available: http://www.vpaa.uillinois.edu/TID/Report/Toc.html, Accessed: 20 July 2004.

Vallerand, RJ, 1997, 'Toward a Hierarchical Model of Intrinsic and Extrinsic Motivation', in *Advances in Experimental Social Psychology*, ed. M. Zanna, Academic Press, New York, pp. 271-360.

Van der Berg, S 2002, 'Education, poverty and inequality in South Africa', Paper presented at Conference of the Centre for the Study of African Economies on Economic Growth and Poverty, Oxford, United Kingdom, 2002.

Vannatta R & O'Bannon B, 2002, 'Beginning to put pieces together: Technology Infusion model for teacher education', *Journal of Computing in Teacher Education*, vol. 18, no. 4, pp. 112-123.

Veen, W 1993, 'How Teachers Use Computers in Instructional Practice: four case studies in a Dutch secondary school', *Computers and Education*, vol. 21, no. 1-2, pp. 1-8.

Veen, W 1995, 'Factors affecting the use of computers in the classroom: four case studies', In: *Integrating Informationl Technology into Education,* eds. D Watson & D Tinsley, Chapman & Hall, London.

Venkatesh, V & Davis, FD, 2000, 'A theoretical extension of the technology acceptance model: Four longitudinal field studies', *Management Science*, vol. 46, no. 2, pp. 186-204.

Venkatesh, V, Morris, MG, Davis, GB & Davis, FD, 2003, 'User acceptance of information technology: Toward a unified view', *MIS Quarterly* vol. 27, no. 3, pp. 425-478.

Venkatesh, V & Speier, C, 1999, 'Computer Technology Training in the Workplace: A Longitudinal Investigation of the Effect of the Mood', *Organizational Behavior and Human Decision Processes* vol. 79, no. 1, pp. 1-28.

Volman, M, Van Eck, E, Heemskerk, I & Kuiper, E 2005, 'New Technologies, new differences. Gender and Ethnic differences in pupil's use of ICT in primary and secondary education', *Computers and Education*, vol. 45, pp. 33-55.

Walker, D 1989, 'Introducing informatics into education at the national level', *Higher Education Policy*, document no. 2, pp. 41-45, University of Pennsylvania, Library copy.

Watson, D 1987, *Developing CAL: computers in the curriculum,* Harper, London.

Watson, DM, 1998, 'Blame the technocentric artifact! What research tells us about problems inhibiting teacher use of IT', In: *Capacity building for IT in education in developing countries,* eds. G Marshall & M Ruohonen, Chapman & Hall, London.

Willis, J, Thompson, A & Sadera, W 1999, 'Research on Technology and Teacher Education: current status and future directions', *Curriculum and Instruction*, vol. 47, no. 4, pp. 29-45.

Wilson, M, Qayyum, A & Boshier, R 1998, 'World Wide America? Think globally, click locally', *Distance Education*, vol. 19, no. 1, pp. 109-123.

Woodrow, JE 1992, 'The influence of programming training on the computer literacy and attitudes of pre-service teachers', *Journal of Research on Computing in Education,* vol. 25, no. 2, pp. 200-219.

World Bank Institute 1999, Annual Report, World Bank Institute, Washington.

Young, EB 1991, 'Empowering teachers to use computers in their classrooms', *Computers in the Schools* vol. 8, no. 1-3, pp. 143-147.

Youngman, M & Harrison, C 1998, 'Multimedia Portables for Teachers Pilot Project Report', British Educational Communications and Technology Agency, Coventry, United Kingdom.

Zhao, Y and Cziko, GA 2001, 'Teacher adoption of technology: a perceptual control theory perspective', *Journal of Technology and Teacher Education* vol. 9, no. 1, pp. 5-30.

Zimbardo, P, Ebbesen, E & Maslach, C 1997, *Influencing attitudes and changing behavior,* Addison-Wesley Publishing Company, Reading, Massachusetts.

Appendix A: Questionnaire

TEACHER TECHNOLOGY SURVEY 2005

adapted from Vannatta & O'Bannon (2002) and Abdulkafi Albirini (2004)

Thank you for accepting this questionnaire. This questionnaire is confidential and will not be used to identify you as an individual. We appreciate you assisting us by completing this questionnaire. The results of this research will enable us to formulate a cohesive and comprehensive policy for the implementation of ICT into our schools. Please be honest when completing the following details:

1. **NAME OF SCHOOL:** ______________________________

2.**GENDER**:

Female	Male

3.**RACE**

African	Coloured	Indian	White

4.**AGE**:

YEARS	TICK
21 or younger	
22 to 30	
31 to 40	
41 to 50	
51 to 60	
61 or older	

5. **PLEASE INDICATE THE SUBJECTS THAT YOU TEACH AND THE NUMBER OF LEARNERS IN YOUR SUBJECT CLASS.**

	SUBJECTS	TICK	NO. OF LEARNERS		SUBJECTS	TICK	NO. OF LEARNERS
1	Afrikaans			14	Agricultural Studies		
2	English			15	Art		
3	Zulu			16	Biblical Studies		
4	Biology			17	Computer Literacy		
5	Computer Studies			18	Compu-Typing		
6	General Science			19	Home Economics		
7	Mathematics			20	Physical Education		
8	Physical Science			21	Speech & Drama		
9	Accounting			22	Technical Drawing		
10	Business Economics			23	Technology		
11	Economics			24	Travel & Tourism		
12	History			25	OTHER – Please specify:		
13	Geography						

6. **PLEASE INDICATE YOUR LEVEL OF TERTIARY QUALIFICATION:**

Diploma	Bachelors Degree	Honours degree	Masters degree	Doctorate	Other – Please specify:

7. **HOW OFTEN DO YOU USE THE INTERNET AT HOME?**

No computer at home	Have computer but no Internet Access	Daily	Once or twice a week	Once or twice a month	Less than once a month	Never

8. **FOR WHAT PURPOSE DO YOU USE THE INTERNET AND HOW OFTEN?**

PURPOSE	Daily	Once or twice a Week	Once or twice a month	Less than once a month	Never
Teaching					
On-line Banking					
On-line Shopping					
Research					
News					
Educational material					
Games					
Vacation Planning					
Communication e.g. E-mail & Chat					
Download music, movies etc.					
Other- specify :					

9. **INDICATE THE MOST SIGNIFICANT FACTOR THAT IS PREVENTING YOU FROM USING A COMPUTER .**

FACTORS	TICK
I use a Computer	
No Computer	
No Computer Skills	
No time	
Not interested	
No need	
Other – specify:	

The purpose of the next three tables is to examine your attitudes toward the introduction of ICT into South African schools.

10. Please indicate your reaction to each of the following statements by circling the number that represents your level of agreement or disagreement with it. Make sure to respond to every statement.

NO.	STATEMENT	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Computers do not scare me at all.	1	2	3	4	5
2	Computers make me feel uncomfortable.	1	2	3	4	5
3	I am glad there are more computers these days.	1	2	3	4	5
4	I do not like talking with others about computers.	1	2	3	4	5
5	Using computers is enjoyable.	1	2	3	4	5
6	I dislike using computers in teaching.	1	2	3	4	5
7	Computers save time and effort.	1	2	3	4	5
8	Schools would be a better place without computers.	1	2	3	4	5
9	Students must use computers in all subject matters.	1	2	3	4	5
10	Learning about computers is a waste of time.	1	2	3	4	5
11	Computers would motivate learners to do more study.	1	2	3	4	5
12	Computers are a fast and efficient way of getting information.	1	2	3	4	5
13	I do not think I would ever need a computer in my classroom.	1	2	3	4	5
14	Computers can enhance a learners' learning.	1	2	3	4	5
15	Computers do more harm than good.	1	2	3	4	5
16	I would rather do things by hand than with a computer.	1	2	3	4	5
17	If I had spare money I would buy a computer.	1	2	3	4	5

NO.	STATEMENT	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
18	I would avoid computers as much as possible.	1	2	3	4	5
19	I would like to learn more about computers.	1	2	3	4	5
20	I have no intention to use computers in the near future.	1	2	3	4	5

11. Please indicate your reaction to each of the following statements by circling the number that represents your level of agreement or disagreement with it. Make sure to respond to every statement.

NO.	STATEMENT	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Computers will improve education.	1	2	3	4	5
2	Teaching with computers offers real advantages over traditional methods of instruction.	1	2	3	4	5
3	Computer technology cannot improve the quality of a learners' learning.	1	2	3	4	5
4	Using computer technology in the classroom will make the subject matter more interesting.	1	2	3	4	5
5	Computers have no place in schools.	1	2	3	4	5
6	Computer use fits well into my curriculum goals	1	2	3	4	5
7	Class time is too limited for computer use.	1	2	3	4	5
8	Computer use suits my learners' learning preferences and their level of computer knowledge.	1	2	3	4	5
9	It would be difficult for me to learn to use the computer in teaching.	1	2	3	4	5

NO.	STATEMENT	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
10	I have no difficulty in understanding the basic functions of computers.	1	2	3	4	5
11	Computers complicate my tasks in the classroom.	1	2	3	4	5
12	Everyone can easily learn to operate a computer.	1	2	3	4	5
13	I have never seen computers at work.	1	2	3	4	5
14	Computers have proved to be effective learning tools worldwide.	1	2	3	4	5
15	I have never seen computers used as an educational tool.	1	2	3	4	5
16	I have seen some KZN teachers use computers for educational purposes.	1	2	3	4	5

12. Please indicate your reaction to each of the following statements by circling the number that represents your level of agreement or disagreement with it. Make sure to respond to every statement.

NO.	STATEMENT	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Computers will not make any difference in our classrooms, schools or lives.	1	2	3	4	5
2	Learners need to know how to use computers for their future jobs.	1	2	3	4	5
3	Learners prefer to learn from teachers rather than computers.	1	2	3	4	5
4	Knowing about computers earns one the respect of others.	1	2	3	4	5
5	We need computers that better suit the African culture and identity.	1	2	3	4	5

NO.	STATEMENT	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
6	Computers will improve our standard of living.	1	2	3	4	5
7	Using computers will not hinder African generations from learning their traditions.	1	2	3	4	5
8	Computers are proliferating too fast.	1	2	3	4	5
9	People who are skilled in computers have privileges not available to others.	1	2	3	4	5
10	Computers will increase our dependence on foreign countries.	1	2	3	4	5
11	There are other social issues that need to be addressed first before implementing computers in education.	1	2	3	4	5
12	Computers will make our lives easier.	1	2	3	4	5
13	Computers dehumanize society.	1	2	3	4	5
14	Working with computers does not diminish peoples' relationships with one another.	1	2	3	4	5
15	Computers encourage unethical practices.	1	2	3	4	5
16	Computers should be a priority in education.	1	2	3	4	5

13. IF A COMPUTER WAS MADE FREELY AVAILABLE TO YOU AND YOU KNEW HOW TO USE IT, WHAT WOULD YOU LIKE TO USE THE COMPUTER FOR AND HOW OFTEN DO YOU EXPECT TO USE IT FOR THESE PURPOSES?

PURPOSE	Daily	Once or twice a Week	Once or twice a month	Less than once a month	Never
Teaching					
On-line Banking					
On-line Shopping					
Research					
News					
Educational material					
Games					
Vacation Planning					
Communication e.g. E-mail & Chat					
Download music, movies etc.					
Other- specify :					

14. In **TABLE 1** please indicate your **level of proficiency** for each of the following computer tools and/or applications by marking the appropriate column.
If you are not sure of a tool or application please indicate in column "NONE".

TABLE 1

NO.	TOOL / APPLICATION	PROFICIENCY			
	TECHNOLOGY:	**HIGH**	**MODERATE**	**LITTLE**	**NONE**
1	Computer				
2	Digital Camera				
3	Scanner				
4	LCD Panel and or Data Projector				
5	Video Conferencing System				
	APPLICATIONS:				
6	Word Processing				
7	Database				
8	Spreadsheet				
9	Graphics Program				
10	Presentation Software (Power Point)				

11	Software (specific to your subject e.g. GIS, CAD, PASTEL)				
	WEB APLLICATIONS:				
12	Website Development				
13	Electronic References (e.g. EnCarta., World Book)				
14	Discussion Groups, Listservers				
15	Email				
16	Internet (WWW)				
17	Assistive Technologies (for the disabled e.g. deaf, no arms)				

15. **In TABLE 2** please indicate how **frequently** you have engaged in the following tasks during the last 6 months.

TABLE 2

NO.	**I used technology to ....**					
		Daily	**Once or twice a week**	**Once or twice a month**	**Less than once a month**	**Never**
1	Keep track of learner grades					
2	Keep track of learner attendance					
3	Create schemes of work / syllabi					
4	Create worksheets and/or assignments					
5	Create a web site for my subject to guide learner assignments					

You will only fill in TABLE 3 and TABLE 4 if your school has computers for teaching purposes. If not please leave these tables blank.

16. Excluding Computer Studies and/or Compu-Typing and/or Computer Literacy, indicate in TABLE 3 **how often you as a teacher of** any other subject **may have used the following tools/applications during the last 6 months in your classroom. Examples of teacher use are: teacher demonstration, use of tool/application in presentation, etc.**

TABLE 3

No.	**TOOL / APPLICATION**	**FREQUENCY**				
	TECHNOLOGY:	**Daily**	**Once or twice a week**	**Once or twice a month**	**Less than once a month**	**Never**
1	Computer					
2	LCD Panel and or Data Projector					
3	Video Conferencing System					
4	Presentation Software (Power Point)					
5	Software (specific to your subject e.g. GIS, CAD, PASTEL)					
6	Electronic References (e.g. EnCarta., World Book)					
7	Discussion Groups, Listservers					
8	Email					
9	Internet (WWW)/ Internet searches					
10	Assistive Technologies (for the disabled e.g. deaf, no arms)					
11	Other: Specify					

17. For Computer Studies and/or Compu-Typing and/or Computer Literacy, indicate in TABLE 4 **how often you as a teacher of Computer Studies and/or Compu-Typing and/or Computer Literacy may have used the following tools/applications during the last 6 months in your classroom. Examples of teacher use are: teacher demonstration, use of tool/application in presentation, etc.**

TABLE 4

No.	TOOL / APPLICATION	FREQUENCY				
	TECHNOLOGY:	**Daily**	**Once or twice a week**	**Once or twice a month**	**Less than once a month**	**Never**
1	Computer					
2	Digital Camera					
3	Scanner					
4	LCD Panel and or Data Projector					
5	Video Conferencing System					
	APPLICATIONS:					
6	Word Processing					
7	Database					
8	Spreadsheet					
9	Graphics Program					
10	Presentation Software (Power Point)					
11	Software (specific to your subject e.g. GIS, CAD, PASTEL)					
	WEB APPLICATIONS:					
12	Website Development					
13	Electronic References (e.g. EnCarta., World Book)					
14	Discussion Groups, Listservers					
15	Email					
16	Internet (WWW)/ Internet searches					
17	Assistive Technologies (for the disabled e.g. deaf, no arms)					

This questionnaire is confidential and will not be used to identify you as an individual.

I hereby give permission that my responses may be used for academic research purposes.

....

Signature

Appendix B: Letter of Recruitment

UNIVERSITY OF
KWAZULU-NATAL

D.W.Govender
University of KwaZulu-Natal
Faculty of Education
School of Maths,Science, &
Technology
Private Bag X03
Ashwood
3605
28/02/2005

TO: Principals of Secondary Schools in the
Ethekwini Region

RE: Research Project – University of KwaZulu-Natal

Thank you for your participation in this research project. Attached is a copy of a letter from the Director: Research Strategy Development & ECMIS – KZN, granting permission for this research to be done in schools in KZN. The results of this research project will enable us to formulate a cohesive and comprehensive policy for the implementation of Information and Communications Technology (ICT) in our schools.

In your envelope you will find 20 questionnaires which need to be correctly and honestly filled in by members of your staff. You may select at random any 20 staff members to fill in a questionnaire. If you have less than 20 staff, one questionnaire per staff member will suffice.
NB: In appreciation for the time and effort that you and your staff put into this project we will make available to your school networking equipment (hubs/switch boxes) which can be used immediately or later.
Once all questionnaires have been filled in we will appreciate it if they can be returned to your Circuit Office within two weeks of receipt.

If you have any queries, please do not hesitate to contact me (Desmond Govender).
Once again, thank you and we look forward to your cooperation.

D.W.Govender
Discipline Head – Computer Science Education
School of Maths, Science & Technology
Faculty of Education
University of KwaZulu-Natal
Tel: (031) 2603428
Fax: (031) 2603423

Appendix C: Letter of Permission

PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATAL
PROVINSIE KWAZULU-NATAL

DEPARTMENT OF EDUCATION
UMNYANGO WEMFUNDO
DEPARTEMENT VAN ONDERWYS

EAD OFFICE **INHLOKO HHOVISI** **HOOFKANTOOR**

	EX-DURBAN COLLEGE OF EDUCATION CNR NICHOLSON ROAD AND QUEEN MARY AVENUE UMBILO	PRIVATE BAG ISIKHWAMA SEPOSI PRIVAATSAK	X05 ROSSBURGH 4072	TELEPHONE UCINGO TELEFOON	031 2744919
				FAX	031 2744922
				Cell	083 337 1324
	S. R. Alwar	REFERENCE INKOMBA VERWYSING	Permission Research	DATE USUKU DATUM	01 November 2004

E: PERMISSION TO CONDUCT RESEARCH

TO WHOM IT MAY CONCERN

his is to serve as a notice that **Mr. D. W. Govender** has been granted permission to conduct research with the llowing terms and conditions:

- That as a researcher, she/he **must** present a copy of the written approval from the Department to the Head of the Institution concerned before any research may be undertaken at a departmental institution.
- Attached is the list of schools she/he has been granted permission to conduct research in. however, it must be noted that the schools are not obligated to participate in the research if it is not a KZNDEC project.
- **Mr. D. W. Govender** has been granted special permission to conduct her/his research during official contact times, as it is believed that her/his presence would not interrupt **education programmes**. Should education programmes be interrupted. she/he must. therefore. conduct his/her research during nonofficial contact times
- No school is expected to participate in the research during the fourth school term. as this is the critical period for schools to focus on their exams.

Comments: ______________________________

handiwe Zungu
Deputy Director: Research. Strategy and Policy Development

Comments: ______________________________

Dr B. H. Mthabela
Director: Research, Strategy Development and ECMIS

Appendix D: Letter to Directors

D.W.Govender
University of KwaZulu-Natal
Faculty of Education
Schools of Maths. Science&
Technology
Private Bag X03
Ashwood
3605
07/02/2005

The Director : Mr. E.M. Kganye
Pinetown District
Dept. of Education - KZN

RE: Research in Secondary Schools

Sir

I have been granted permission by the Director: Research. Strategy Development & ECMIS (see attached letter) to conduct research in schools in your district. The research is in the form of a survey where staff will fill in a questionnaire with respect to implementation of Information Communications Technology (ICT) in schools.

I would like to meet with you to discuss the possibility of using your distribution structures (via SEMs) to distribute these surveys to schools. If you are willing to allow us to use your distribution structures we are prepared to give to each participating school new networking equipment to the value of R± 5000.00. This equipment can be used immediately if there are computers in the school or can be kept for later use. If your office is also in need of such equipment, it will be made available as well.

This research will be conducted in all three districts in the Ethekwini region. The research will enable us to formulate a cohesive and comprehensive policy for the implementation of ICT into our schools.

Attached is a letter from the Dept. of Education – KZN granting permission to conduct research. It will be highly appreciated if we can receive your cooperation in this matter.

Thank you.

D.W.Govender

Discipline Head – Computer Science Education
School of Maths. Science & Technology
Faculty of Education
University of KwaZulu-Natal

Tel: (031) 2603428
Fax : (031) 2603423

Appendix E: Letter to Circuit Managers

D.W.Govender
University of KwaZulu-Natal
Faculty of Education
Schools of Maths, Science& Technology
Private Bag X03
Ashwood
3605
01/03/2005

The Circuit Manager: Mrs. P.P. Kganye
Hammarsdale
Pinetown District
Dept. of Education - KZN

RE: Research in Secondary Schools

Sir

I have been granted permission by the Director: Research, Strategy Development & ECMIS (see attached letter) to conduct research in schools in your circuit. The research is in the form of a survey where staff will fill in a questionnaire with respect to implementation of Information Communications Technology (ICT) in schools.

I would like to meet with you (or telephonically) to discuss the possibility of using your distribution structures (via SEMs) to distribute these surveys to schools. A single envelope will contain questionnaires which can be given to principals at a principals meeting or handed to a school while doing a scheduled visit or as a last resort I can request schools to fetch from the Circuit office. **If you are willing to allow us to use your distribution structures we are prepared to make available new networking equipment to each participating school.** This equipment can be used immediately if there are computers in the school or can be kept for later use. If your office is also in need of such equipment, it will be made available as well.

This research will be conducted in all three districts in the Ethekwini region. The research will enable us to formulate a cohesive and comprehensive policy for the implementation of ICT into our schools.

Attached please find :

1) a letter from the Dept. of Education – KZN granting permission to conduct research.
2) A copy of letter sent to your District Director and
3) A list of schools we would like to use in your circuit.

It will be highly appreciated if we can receive your cooperation in this matter.

Thank you.

D.W.Govender
Discipline Head – Computer Science Education
School of Maths, Science & Technology
Faculty of Education
University of KwaZulu-Natal Tel: (031) 2603428 Fax : (031) 2603423

Appendix F: Clearance from DOE (KZN)

PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATAL
PROVINSIE KWAZULU-NATAL

DEPARTMENT OF EDUCATION
UMNYANGO WEMFUNDO
DEPARTEMENT VAN ONDERWYS

HEAD OFFICE		INHLOKO HHOVISI			HOOFKANTOOR
ADDRESS IKHELI ADRES	EX-DURBAN COLLEGE OF EDUCATION CNR. NICHOLSON ROAD AND QUEEN MARY AVENUE UMBILO	PRIVATE BAG ISIKHWAMA SEPOSI PRIVAATSAK	X05 ROSSBURGH 4072	TELEPHONE UCINGO TELEFOON	031 2744919
				FAX	031 2744922
				Cell	083 337 1324
ENQUIRIES IMIBUZO NAVRAE	S. R. Alwar	REFERENCE INKOMBA VERWYSING	Permission. Research	DATE USUKU DATUM	01 November 2004

TO: Mr. D. W. Govender
University of KwaZulu-Natal
Edgewood Campus
Private Bag X03
Ashwood
3605

RE: PERMISSION TO CONDUCT RESEARCH

Please be informed that you have been granted permission to conduct research with the following terms and conditions:

- That as a researcher, you **must** present a copy of the written approval from the Department to the Head of the Institution concerned before any research may be undertaken at a departmental institution bearing in mind that the institution **is not obliged to participate** if the research is not a departmental project.

- Research should not be conducted during official contact time, as **education programmes should not be interrupted,** except in exceptional cases with special approval of the KZNDEC.

- The research is not to be conducted during the fourth school term, except in cases where the KZNDEC deem it necessary to undertake research at schools during that period.

- Should you wish to extend the period of research after approval has been granted, an application for extension must be directed to the Director: Research, Strategy Development and ECMIS.

- The research will be limited to the schools or institutions for which approval has been granted.

- A copy of the completed report, dissertation or thesis must be provided to the: RSDE Directorate

- Lastly, you must sign the attached declaration that, you are aware of the procedures and will abide by the same.

B. H. MTHABELA
DDIRECTOR: RESEARCH, STRATEGY, POLICY DEVELOPMENT AND ECMIS

Appendix G: Ethical Clearance - UKZN

UNIVERSITY OF
KWAZULU-NATAL

RESEARCH OFFICE (FRANCIS STOCK BUILDING)
HOWARD COLLEGE
TELEPHONE NO.: 031 – 2603587

17 DECEMBER 2004

MR. DW GOVENDER
INFORMATION SYSTEM

Dear Mr. Govender

ETHICAL CLEARANCE "INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) IN SCHOOLS IN KWAZULU -NATAL (KZN) - A CRITICAL OVERVIEW"

I wish to confirm that ethical clearance has been granted for the above project:

- Used for learners names on questionnaire to be reconsidered
- Letter requesting permission from school principals

Yours faithfully

MS PHUMELELE XIMBA
(FOR) MANAGER RESEARCH OFFICE

PS: The following general condition is applicable to all projects that have been granted ethical clearance:

THE RELEVANT AUTHORITIES SHOULD BE CONTACTED IN ORDER TO OBTAIN THE NECESSARY APPROVAL SHOULD THE RESEARCH INVOLVE UTILIZATION OF SPACE AND/OR FACILITIES AT OTHER INSTITUTIONS/ORGANISATIONS. WHERE QUESTIONNAIRES ARE USED IN THE PROJECT, THE RESEARCHER SHOULD ENSURE THAT THE QUESTIONNAIRE INCLUDES A SECTION AT THE END WHICH SHOULD BE COMPLETED BY THE PARTICIPANT (PRIOR TO THE COMPLETION OF THE QUESTIONNAIRE) INDICATING THAT HE/SHE WAS INFORMED OF THE NATURE AND PURPOSE OF THE PROJECT AND THAT THE INFORMATION GIVEN WILL BE KEPT CONFIDENTIAL.

cc Director of School
cc Supervisor