TEACHERS' PERCEPTIONS OF THE PEDAGOGICAL USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS) AND PRINCIPALS' TECHNOLOGY LEADERSHIP

Zelna Janet Cloete

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Supervisor: Prof. Ian Moll

DECLARATION

I declare that this research report is my own unaided work. It is being submitted for the degree of Master of Education in Educational Technology by coursework and research report at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university, nor has it been prepared under the aegis or with the assistance of any other body or organisation outside of the University of the Witwatersrand, Johannesburg. All help received with the preparation and/or presentation of this thesis has been clearly acknowledged on the next page.

Zelna Janet Cloete

Signature: _____

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1. PROBLEM STATEMENT

1.1 Definition of terms

The phrases **"pedagogical purposes"** and **"educational purposes"** will be used interchangeably in this paper and it refers to the use of technology as a tool in teaching and learning.

My definition for **Information and Communication Technologies** comes from the White Paper on e-Education (2004). Information and Communication Technologies (ICTs) can be defined as "*a convergence of information technology and communication technology. ICTs are a combination of networks, hardware and software as well as the means of communication, collaboration and engagement that enable the processing, management and exchange of data, information and knowledge"* (White Paper on e-Education, 2004, p.15).

Information Technologies: equipment like personal computers, scanners and digital cameras, data projectors, thus hardware and computer programmes like database programmes and multimedia programmes which fit into the software category.

Communication Technologies: telecommunications equipment for example phones, faxes, modems and computers.

e-Learning: E-learning refers to learning facilitated and supported through the use of information and communication technology.

Information Age, also commonly known as the Computer Age or Information Era, refers to a period beginning in the last quarter of the 20th century when information became easily accessible through publications and through the manipulation of information by computers and computer networks.

The terms **"teacher thinking processes"**, **"teacher cognitions"**, and **"teacher beliefs"** are used interchangeably. It refers to the processes intrinsic to teachers that influence their teaching behaviour and attitudes towards learning (Sang, 2010).

Context beliefs are those beliefs about the ability of external/extrinsic factors or people, in this instance, principals, to enable a person to reach a goal plus the belief that a factor is likely to occur (Lumpe & Chambers, 2001:95).

Efficacy beliefs refer to "beliefs in one's capabilities to organize and execute the course of action required to manage prospective situations" (Bandura, 1995).

1.2 Introduction

The use of technology for educational purposes can be traced back to the 1920s when the first “teaching machine” (Skinner,1968) was built by Pressey, who recognised the need for a technological device that can improve teaching and learning. The teaching machine was used for rote-and-drill learning. The teaching machine worked as follows: the question remains before the user until the correct response was selected and the question is eliminated as the correct answer was mastered. It omits a question from further presentation as soon as the learner has obtained the correct answer twice in succession. Pressey was convinced that the machine would lead to an industrial revolution in education. But this new technological invention was not so enthusiastically embraced by teachers as one would have expected, as Skinner (1968) puts it: “Pressey’s machines succumbed in part to cultural inertia; the world of education was not ready for them”.

In the early 1980s American schools and universities were provided with computers (a modern version of the teaching machine) and software for pedagogical use under the same assumption that it can enhance the quality of teaching and learning. Again only a minority of teachers and academics were interested in using these new technologies in their classrooms (Cuban, 2001). The pedagogical integration of information and communication technologies (ICTs) poses different challenges for educators, school management and national authorities in the education sector, because there are certain factors that impede the adoption and integration of ICTs in education.

Several research studies have explored the obstacles that hinder technology integration into teaching and learning and identified different barriers that include: lack of access to ICTs, ICT training, planning time and local support, and teacher beliefs. Ertmer (1999) categorises these barriers into first-order and second-order barriers. The first-order barriers are related to barriers extrinsic to teachers, while second-order barriers are intrinsic to teachers. External barriers refer to lack of access to technology equipment, which include hardware, software and internet connection; insufficient planning time; and inadequate technical and local support. According to Sang (2010), the internal barriers are related to the processes intrinsic to teachers that influence their teaching behaviour and attitudes towards learning. Sang (2010:12) refers to these internal processes as "teacher thinking processes" or "teacher cognitions". These thinking processes include teachers' beliefs, self-efficacy, attitudes and perception.

Researchers argue that teacher thinking processes have an effect on their perceptions and judgments, which, in turn, affect their decisions about classroom practice (Pajares, 1992). An underlying assumption of this study is that the beliefs that teachers hold about the integration of ICTs in their classroom practice play a crucial role in the successful implementation of technology for pedagogical purposes. The aim of the current study is to explore teachers' beliefs about the pedagogical integration of ICTs and to determine to what extent their belief systems, that is, their self-efficacy beliefs, computer self-efficacy beliefs, pedagogical beliefs and computer anxiety, influence their utilisation of ICTs. The present study will also examine whether these teacher thinking processes can be regarded as barriers to ICT integration into teaching and learning.

The incorporation of ICTs into education has become critical. We are living in an "Information Age"and are experiencing a "new global economy" which is characterised by productivity and competitiveness based on knowledge and information (Castells, 2001:2). Information and communication technologies, especially the Internet, are perceived as the most powerful medium to process and distribute information and knowledge throughout the entire planet (Castells, 2001:2). The teacher plays a crucial role in preparing our students to fully participate in the competitive global economy and rapidly changing information society. Prensky (2001a) argues that there is a vast difference between the children of today ("digital natives") who are born into the digital world and are native speakers of the digital language of computers, the internet and video games, and their teachers ("digital immigrants") who are not born into the world of digital technology but have to adapt to their environment, like immigrants. Prensky (2001a:2) further posits that the "Digital Immigrant instructors, who speak an outdated language (that of the pre-digital age), are struggling to teach a population that speaks an entirely new language". The solution to this problem is that teachers will have to become members of the dominant digital society by embracing technology and becoming digitally literate.

Various authors have attempted to define digital literacy, hence the difficulty in reaching consensus on a single definition. Digital literacy, according to Martin (2008) is,

"the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyze and synthesize digital resources, construct new knowledge, create media expressions, and

communicate with others, in the context of specific life situations, in order to enable constructive social action; and reflect upon this process".

Fieldhouse and Nicholas (2008) contend that being digitally literate is not sufficient. One also need to be "information savvy" and capable of identifying when information is needed, how to locate it, and how to use it effectively. These authors further claim that the digital natives can be considered information savvy as well as digitally literate because they are able to combine work and social life. They instinctively search the internet and freely navigate through unstructured, non-sequential links to locate information of all kinds while simultaneously emailing, chatting with peers, playing games and working on assignments (Fieldhouse and Nicholas, 2008). In order to reach the digital natives, teachers will have to reconsider their methodology and content (Prensky, 2001a). The gap between teachers and their students is a generation gap but it is also a digital divide of a different kind, in terms of the gap between the digital competence of teachers and their students.

Another assumption about the potential of ICTs is that it can be employed to bridge the digital divide. The digital divide refers to "a significant difference in the access to and equity of technology experience based on categories such as income, race, gender, location, or education" (Swain & Pearson, 2001). The digital divide is also linked to teacher-related variables like the lack of interest in technology, lack of digital competence and lack of experience teaching with computers. These are key factors in developing a better understanding of teachers' classroom use of computers. No empirical evidence is necessary to realise that there is a disparity between teachers' levels of digital literacy.

The South African government recognised the pivotal role that ICTs play in enabling our learners to become full participants in the global community but its efforts to bridge the digital divide that relates to teachers' digital literacy are not sufficient. The Government of South Africa in partnership with non-governmental organisations and the private sector committed itself to bridge the digital divide by providing the necessary infrastructure for the integration of ICTs in education and ensuring that all South African schools have access to a wide variety of ICT services. Some of its initiatives as specified in the White Paper on e-Education (2004) were:

(a) SCOPE (Finnish Development Support), SchoolNet and the South African Institute for Distance Education who developed 11 Teacher Development Modules for the introduction of ICTs into schools;

(b) SchoolNet SA who provided online mentor-based in-service training for teachers on introducing ICTs into the curriculum and management;

(c) INTEL "Teach to the Future" Teacher Development Programme that provided teacher training in ICT integration into teaching and learning;

(d) the Gauteng Online project which provided computers and Internet connection to all schools in Gauteng; and

(e) the Khanya Project in the Western Cape.

The Khanya Project in the Western Cape was established in April 2001 with the primary objective to steer the integration of technology into the curriculum in order to enhance teaching and learning. Schools are provided with computer technology not only to make learners computer literate, but also for use as a teaching aid to improve curriculum delivery. The Khanya Project is an ongoing programme and it also strives to

narrow the digital divide. Statistics in the White Paper on e-Education (2004) show that the Western Cape is one of the provinces which has made significant progress in providing infrastructure and connectivity for the integration of ICT in education, but there is still a lack of intensive and continuous training for educators and principals on the pedagogical integration of ICTs. Statistics of 2005 show that 76,6 percent of the schools in the Western Cape have computer laboratories for teaching and learning. It is now seven years later and it might be that the percentage has increased or, the other possibility is, that some schools might have lost their computers due to a lack of funds for maintenance, theft or vandalism.

From the abovementioned initiatives it is thus evident that the South African government and businesses have gone to great lengths to provide accessibility and connectivity to information and communication technologies for our schools, but these new technologies are still not effectively used in South African classrooms. The White Paper on e-Education (2004:10) states that the "[d]eployment of ICTs does not guarantee their efficient utilisation". This statement implies that accessibility and connectivity is not enough and that there is a need for clear guidelines on how these technologies can be effectively integrated in subjects across the curriculum.

The present study postulates that the beliefs that teachers hold about teaching and learning, their efficacy beliefs and context beliefs play a crucial role in the successful implementation of ICTs for pedagogical purposes. Within the context of this study teachers' "context beliefs" represent their perception of the principal as technology leader (Lumpe & Chambers, 2001). In this study the term "teacher beliefs" refers to

teachers' internal processes. Sang *et al*. (in press) refer to these internal processes as teacher "thinking processes" or "teacher cognition".

Ertmer *et al*. (1999) argue that teachers' beliefs about classroom practice shape their goals for technology utilisation and the value they assign to different barriers. Key areas of concern that underpin the current study are as follows:

(a) Educators have beliefs about the usefulness of ICTs in teaching and learning, and these beliefs and attitudes directly influence their behavioural intention, whether and how, to utilise ICTs in their teaching practice.

(b) There is a significant interrelationship between teachers' pedagogical beliefs, self-efficacy beliefs, computer self-efficacy beliefs, computer anxiety and their computer usage.

(c) Principals' technology leadership directly affects teachers' decisions on, whether and how, to integrate new technologies into their teaching practice.

1.3 Rationale

The field of Educational Technology is still a young field (Czerniewicz, 2008) and therefore there is a need for research in its different subfields, like e-learning. Most research that has been done within the South African context was about how ICTs are integrated in higher education. There is a need for research in schools on educators' perspectives of and their attitudes toward the pedagogical integration of ICTs and how it influences their ICT integration into teaching and learning.

This study is significant since little has been done by authorities in the education sector to steer the effective pedagogical integration of ICTs. The emphasis is on the pedagogical integration of ICTs because teachers are already utilising ICTs for lesson

planning and other administrative tasks. The challenge here is that teachers should be able to design lesson plans that incorporate ICTs in their daily teaching and learning process in such a manner that it assists learners in constructing their own knowledge. Teachers' beliefs play a critical role in the successful integration of ICTs in the classroom and it should therefore be carefully considered in the planning and implementation of professional development programmes for teachers.

Several research studies have identified factors that are external to South African teachers that impede the infusion of technology into teaching and learning. Some of these external factors that are of significance for the current study are the lack of ICT training for teachers and lack of support from the school principal. South African educators' beliefs are intrinsic barriers to the integration of ICTs in teaching and learning and their attitude towards computers in the classroom is perceived as an important influential factor in the successful pedagogical integration of ICTs and it has not been given the attention it deserves. Few, if any, research has been done in South African schools to examine to what extent educators' beliefs systems or "thinking processes" (Sang *et al*., in press), especially their pedagogical beliefs, efficacy beliefs and context beliefs, influence the effective integration of ICTs in schools. Researchers in other countries have also recognised the need for research in this field to develop a better understanding of the complex relationship between teachers' beliefs and their practices in order to understand how teachers make technology-integration decisions (Chen, 2008).

As a teacher at a secondary school in the Northern Cape which was one of the pilot schools for the SCOPE – project, I participated in the Intel Teach to the Future project and SchoolNet's programme. The main objective of these projects was the integration of ICTs into teaching and learning and ICT professional development of educators. The school was provided with internet-connected computers and teachers could participate in the online mentor-based training courses. Another computer laboratory was funded by Escom to improve learners' academic achievement in Mathematics and Science and to enhance teaching and learning in these subjects. Despite all these efforts, teachers still lack confidence in using these computers in their teaching practice. Teachers were not interested in using these computers or taking advantage of the opportunity to integrate it into their lesson plans. The lack of computer skills cannot be the only reason for teachers' reluctance to utilise technology in the classroom because most of the teachers work on their computers at home and use it for their administrative work. If teachers believe that ICTs can enhance teaching and learning, why are they still sceptical about utilising ICTs in the classroom and how do their different beliefs influence the pedagogical integration of ICTs in their schools? There must be a reasonable explanation and this is what this study would like to provide. Another question that also needs to be answered is, how are teachers trained to pedagogically integrate technology?

Ertmer *et al*. (1999) studied the relationship between "first-order" barriers (external barriers, for example, access to ICTs, training and local support) and "second-order" barriers (internal barriers, e.g. teachers' beliefs, self-efficacy and attitudes) to ICT integration at a single school. The findings of this study have shown that teachers

experienced similar barriers, such as limited resources and time, but these barriers affected their technology use differently. The current study can contribute to the improvement of effective ICT integration in schools by developing a better understanding of teacher beliefs as a factor that significantly influences the effective pedagogical integration of ICTs in schools. It may provide useful insight on how to develop effective professional development programmes on the pedagogical integration of ICTs.

1.4 Research questions

The general research question is formulated in light of the worldwide reluctance of educators' integration of ICTs in teaching and learning and the awareness of the significant role that teachers' beliefs play in their decision-making about what happens in the classroom. The present study aims to explore the following general research question:

To what extent do teachers' beliefs (that is, their pedagogical beliefs, self-efficacy beliefs and context beliefs) influence their behavioural intention, whether and how, to use computers in the classroom ?

The research will focus on the following specific research questions in order to explore the general research question:

(a) Is there a significant relationship between teachers' pedagogical beliefs and their uptake of computers in the classroom?

(b) Is there a significant relationship between teachers' self-efficacy beliefs and their integration of technology into teaching and learning?

(c) Is there a significant relationship between teachers' computer self-efficacy beliefs and their uptake of technology in the classroom?

(d) Is there a significant relationship between teachers' computer anxiety and their uptake of technology in the classroom?

(e) Is there a significant relationship between teachers' perception of the principal's technology leadership and their integration of technology into teaching and learning?

1.5 Hypotheses

The major hypothesis of the current study is that teachers' behavioural intention, whether and how to use ICTs in the classroom, is determined by a set of teacher related variables, which include their pedagogical beliefs, self-efficacy beliefs and context beliefs.

The following null hypotheses were derived from the research questions:

(a) Teachers' behavioural intention, whether and how to use ICTs in the classroom, is not determined by a set of teacher related variables, which include their pedagogical beliefs, self-efficacy beliefs and context beliefs.

(b) Teachers' pedagogical beliefs (constructivist or cognitivist) have no direct effect on their uptake of computers in the classroom.

(c) There is no significant relationship between teachers' self-efficacy beliefs and their integration of technology into teaching and learning.

(d) There is no significant relationship between teachers' computer self-efficacy beliefs and their uptake of technology in the classroom.

(e) There is no significant relationship between teachers' computer anxiety and their uptake of technology in the classroom.

(f) There is no significant relationship between teachers' perception of the principal's technology leadership and their integration of technology into teaching and learning.

1.6 Research objectives

This study aims to investigate educators' different beliefs of the pedagogical integration of ICTs and to determine whether these beliefs have a significant influence on their intention to utilise ICTs in the classroom.

The general objective of this study is to develop a better understanding as to why South African teachers embrace or resist technology in teaching and learning by exploring the relationship between a series of teacher related beliefs and their integration of information and communication technologies into teaching and learning in schools in the Western Cape.

Firstly, an investigation of the direct and indirect effects of a set of major teacher "thinking processes" (Sang *et al*., in press) on their computer usage will be conducted. These teacher thinking processes refer to teachers' pedagogical beliefs, self-efficacy beliefs, computer self-efficacy beliefs and computer anxiety. One of the key assumptions of this study is that principals' technology leadership directly impacts educators' pedagogical integration of ICTs. Educators' perception of their principals' technology leadership will therefore be examined, with reference to: (a) vision, planning and management; (b) staff development and training; (c) technology and infrastructure support; and (d) interpersonal and communication skills.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This section reviews the literature related to the research questions and objectives of the present study and forms the theoretical framework of this study. It includes a review of literature and research studies on belief systems, the nature of beliefs and dominant theories of teaching and learning in the 20th century (that is, behaviourism, cognitivism and constructivism). The review focuses specifically on teachers' beliefs, that is, teachers' pedagogical beliefs; teachers' self-efficacy beliefs; teachers' computer self-efficacy beliefs; teachers' computer anxiety and teachers' computer use; as well as principals' technology leadership as factors that influence or hinder the effective pedagogical integration of ICTs.

2.2 Barriers to successful ICT integration

In the reviewed literature it is apparent that educators' reluctance to adopt ICTs as an educational or instructional tool in their classroom practice is a phenomenon which does not occur only in South Africa. As mentioned previously, educators' reluctance to integrate technology in the classroom can be traced back to the 1920's when Pressey's teaching machines were introduced to enhance teaching and learning. Cuban (2001:179) also refers in his book "*Oversold and Underused"* to the fact that teachers basically use technology, especially computers, to "communicate with parents and administrators, prepare syllabi and lectures, record grades [and] assign research papers" and that teachers are "infrequent and limited users" (p.178) of technologies for pedagogical purposes.

A cardinal question in the current study is thus: What factors prevent teachers from integrating ICTs in their classroom practice. The literature suggests that a combination of several factors influence teachers' adoption of ICTs in their teaching practice, for instance, teachers' beliefs (including pedagogical beliefs and self-efficacy beliefs) (Ertmer, 2005); computer self-efficacy (Sang, *et al*., in press); computer anxiety (Sam, *et al*., 2005); lack of in-service and pre-service training; lack of appropriate software and infrastructure; lack of technical support; and lack of proper technology leadership, to mention but a few.

The barriers to effective ICT integration into education are categorised as (a) external ("first-order") barriers and (b) internal ("second-order") barriers (Ertmer, 1999). External barriers refer to issues related to access to the technologies, training, and local support, while internal barriers are related to teachers' philosophy about teaching and learning, for example, teachers' beliefs, teacher self-efficacy and teacher attitudes (Sang *et al*., in press). Lumpe and Chambers (2001:95) use the term teachers' "context beliefs", which refer to people's beliefs about the ability of external factors or people to impact their achievement of a particular goal. In terms of technology integration into education, the environmental context includes students, administrators, parents, teachers, buildings, equipment and professional development. In the current study teachers' beliefs about the impact of the principal's technology leadership on their ICT use in the classroom represent their context beliefs. The primary focus of the present study is to investigate how teachers' beliefs influence their utilisation of ICTs in teaching and learning. Three types of teacher beliefs will be focused on, that is, teachers' pedagogical beliefs, their self-efficacy beliefs and their context beliefs.

Law (2004) observes that a possible reason for educators reluctance or inability to integrate ICTs in their classroom practice is that educators encounter difficulties in identifying pedagogically sound uses of ICT that add value to the learning process. Loveless and Ellis (2001:67) support this argument and opine that teachers using technology in the learning situation should be able to recognise "the distinctive contribution which ICT might bring to a learning situation and know when and how to use digital technologies appropriately". It is one of the biggest challenges that educators face in this digital era. Chen (2008) posits that it is possible that teachers have limited or inappropriate theoretical understanding of constructivist ICT integration. The author further notes that due to a lack of specific guidelines and guidance, teachers are more inclined to implement policies on the basis of their own interpretation and understanding.

Within the South African context this is exactly the case, because the White Paper on e-Education does not give specific guidelines for ICT integration in schools. It only includes assumptions about what ICT can do for education. There is a shift in responsibility from the National Department of Education to the schools to develop an ICT integration policy. The wide range of projects that have been launched to facilitate the integration of ICTs in teaching and learning varies in success. It is therefore imperative to investigate how South African teachers are trained to incorporate ICTs into their classroom practice.

There is thus a need for research to determine what teachers' perception is of the pedagogical integration of ICTs in order to develop effective professional development programmes that will equip teachers with the skills and knowledge

necessary to identify pedagogically sound uses of ICT, but this is not the primary objective of the current study. This study primarily focuses on teachers' thinking processes and assumes that teachers' beliefs influence their decision to incorporate or not to incorporate ICTs in their classroom practice. Researchers argue that the teacher plays a vital role in the successful integration of ICTs into classroom practice because they decide what takes place in the classroom (Loveless and Ellis, 2001).

Professional development programmes for teachers should therefore go beyond the development of basic computer skills and should identify teachers' beliefs about effective teaching, strategies for improved teaching and learning, and curriculum design appropriate for pedagogical purposes (Chen, 2008). Goktas *et al.* (2009) argue that once the barriers to pedagogically sound ICT integration have been identified, it will be possible to put enablers in place to successfully facilitate training programmes for pre-service and in-service educators.

Becker (2000) identified four factors that contribute to the successful use of the computer as a valuable and well-functioning "instructional tool". These factors include: (1) convenient access to computers; (2) adequately trained teachers; (3) some freedom in the curriculum and (4) personal beliefs aligned with a constructivist pedagogy. According to Ertmer (2005) the first three conditions have nearly been met (in American schools), but teachers' beliefs still need to be resolved due to the fact that they are less understood. This study therefore aims to develop a better understanding of the complex interrelationship between teacher beliefs and technology integration which may enable us to understand their reluctance to make full use of the available technological tools, for example, computers, in the classroom.

2.3 Teacher beliefs

2.3.1 The nature of teacher beliefs

A review of the nature of beliefs is necessary in order to gain a better understanding of teachers' beliefs. The nature of beliefs is expounded by Pajares (1992) in his paper *Teachers' beliefs and educational research: cleaning up a messy construct* and he also distinguishes between beliefs and knowledge (drawing on Abelson, 1979 and Nespor, 1987), but a discussion on this is not the purpose of this review. What is important is the characterising features of beliefs, namely, existential presumption, alternativity, affective and evaluative loading and episodic structure (Nespor, 1987). One characteristic of beliefs that is of significance for this study is its reliance on episodic memory. Episodic memory refers to our memory of specific events or episodes occurring in a particular place or at a particular time – a mental movie of things we saw and heard (Abadzi, 2006). How does the episodic memory relate to beliefs? People draw material from personal experiences or cultural sources of knowledge and according to Nespor (1987) these critical episodes play a crucial role in teachers' practices. Ertmer (2005) relates this to teachers' use of computers and contends that if teachers' initial experiences with computers were traumatic or negative, it is most likely that they will avoid computers in their teaching practice.

Lumpe and Chambers (2001) note that it is likely that teachers' beliefs about the pedagogical use of technology are formed during time spent in the classroom, either as a teacher or a student. The teachers in Nespor's (1987) study suggested that critical episodes or earlier experiences in their teaching careers were of great importance in their current practices. Teachers' teaching practices were thus shaped by their

experiences as students. Nespor (1987) states that a richly detailed episodic memory of a particularly influential teacher may serve as both an inspiration and template for their own teaching practices. Teachers therefore model their teaching on teachers who had a great impact on them. Evidence from Goktas *et al*'s (2009) study of the main barriers and possible enablers for integrating ICTs in Turkey's pre-service teacher education programmes, supports this argument. Their study reported that prospective teachers need to observe appropriate role models throughout their training programme. They suggest that teacher educators should act as role models for student teachers. The assumption is that if teacher educators use technology in their training programmes it will encourage pre-service teachers to use computers more frequently and effectively in their classroom practice.

One of the barriers to ICT integration is teachers' resistance to change. Many teachers are unwilling to leave their comfort zone. This is consistent with Pajares' (1992) theory that because beliefs are formed early in life, they are more difficult to change. Which means, once beliefs are formed they are difficult, almost impossible, to change. *"Early experiences strongly influence final judgements, which become theories (beliefs) highly resistant to change... the earlier a belief is incorporated into the belief structure, the more difficult it is to alter, for these beliefs subsequently affect perception and strongly influence the processing of new information" (*Pajares, 1992:317). It will thus be a challenging task to try to convince teachers, who have negative attitudes towards computers and negative beliefs about the use of computers in education, to integrate it in their teaching practice.

An exploration of the nature of beliefs can further shed light on teachers' resistance to ICT integration in the classroom. Kagan (1992) identifies two generalizations about teacher beliefs: (1) they are relatively stable and resistant to change and; (2) they tend to be associated with a congruent teaching style. People's beliefs are organised in a belief system, which represents within it, "in some organized psychological but not necessarily logical form, each and every one of a person's countless beliefs about physical and social reality" (Rokeach, 1968, cited in Pajares, 1992). A belief structure is similar to that of an atom in the sense that some beliefs form the nucleus of the belief system and because of the centrality of these beliefs they are more important and resistant to change (Rokeach, 1968, cited in Pajares, 1992). Lim *et al*. (2009) emphasise the effect that teacher beliefs have on their teaching practice by arguing that even "well-designed teacher education programs" have little impact on pre-service "teachers' pre-existing pedagogical beliefs due to the resilient nature of the beliefs system".

2.3.2 Defining teacher beliefs

Teachers are the most complex subject to study and studying teachers' beliefs is a challenging and complex task. Studies on beliefs in diverse fields, like medicine, law, anthropology, sociology, political science, business, psychology and education, have led to a variety of meanings, therefore the inability to adopt a specific working definition (Pajares, 1992). When studying teachers' beliefs one should be clear about what represents teachers' beliefs or more specifically, what is meant by the term "beliefs". Some authors claim that the inconsistent use of the term "teacher beliefs" by researchers leads to confusion (Pajares, 1992; Kagan, 1992).

Pajares (1992) puts it as follows: *"The difficulty in studying teachers' beliefs has been caused by definitional problems, poor conceptualizations, and differing understandings of beliefs and belief structures."* A variety of terms are used in the literature as synonyms for the term, beliefs, for example, "*attitudes, values, judgements, axioms, opinions, ideology, perceptions, conceptions, conceptual systems, preconceptions, dispositions, implicit theories, explicit theories, personal theories, internal mental processes, action strategies, rules of practice, practical principles, perspectives, repertoires of understanding, and social strategy,"* (Pajares, 1992) *"personal epistomologies, orientations, and practical knowledge"* (Kagan, 1992). Furthermore, Kagan (1992) defines teacher beliefs as "pre- and in-service teachers' implicit assumptions about students, learning, classrooms, and the subject matter to be taught" which is in line with Pajares' definition that teachers' beliefs refer to teachers' attitudes about education, that is, about schooling, teaching, learning, and students (Pajares, 1992). In other words, teachers' beliefs about teaching and learning represent their pedagogical beliefs (Chen, 2008).

According to Pajares (1992:314) people have beliefs about everything and all "teachers hold beliefs, however defined and labelled, about their work, their students, their subject matter, and their roles and responsibilities,…" In an investigation of the relationship between teachers' educational beliefs and their computer use Hermans *et al*. (2008) found empirical evidence that teachers' beliefs about the practice of teaching, that is, their pedagogical beliefs, are a significant determinant in explaining the reasons for teachers' adoption of computers in the classroom.

2.3.3 Teachers' pedagogical beliefs

Ertmer (2005) suggests that there are additional barriers to ICT integration that need to be studied, for instance, teachers' pedagogical beliefs, that is, teachers' beliefs about teaching and learning. Three educational schools of thought about teaching and learning that dominate beliefs about teaching and learning are the behaviourist, cognitivist and constructivist theories of learning, of which constructivism is the most dominant one. These three learning theories are most associated with educational technology and, therefore, a brief reflection on these different theories of teaching and learning follows in this section. Since technology affords teachers the instructional tools to create constructivist learning activities and environments, a few recommendations will be made on how to design these activities and environments.

The behaviourist learning and teaching approach, also referred to as traditional teaching or the transmissionist or instructionist model of learning, is still the dominant mode of instruction in most South African educational institutions, in spite of the Outcomes-based Education system, which is based on the principles of constructivist teaching. For the behaviourist the emphasis is on learning through associations and reinforcement and trial and error learning, which encourage rote learning. The behaviourist model is derived from Skinner's stimulus and response theory which is based on the assumption that learning is related to creating associations between stimuli provided by the environment (the teacher) and response developed by individuals (learners) (Kelz, 2009).

Four key features about learning from the behaviourist perspective are summarised by Semple (2000) as follows: each step in the learning process should be

short and should arise from previously learned behaviour; learning should be rewarded and reinforced regularly, since behaviour is shaped by the pattern of reinforcements in the environment; feedback should be as immediate as possible; and the learner should be given stimulus discriminations for the most likely path to success.

Teachers who use the traditional teaching method also tend to align their design of computer-based learning experiences with these principles, for example, drill and practice activities and tutorials, which require the breaking down of the overall task into a sequence of short, simpler steps. The simpler tasks then need to be practised and mastered before the more complex one is introduced (Semple, 2000). Assessment takes place through testing and correct answers and knowledge is seen as inert. Teachers strictly adhere to a fixed curriculum and learners are not engaged in dialogue about what they value as important in the teaching and learning process.

Criticism against the behaviourist theory of learning is that the behaviourist is not concerned with what is happening inside the "black box" (the inner processes) but only observable, measurable, outward behaviour is worthy of inquiry (Skinner, 1974; Bush, 2006). Changed behaviour, therefore, is the only evidence that learning occurred. This gave rise to the cognitivist theories of learning which view learning as the making of symbolic, mental constructions involving active mental processing by the learner – which, in turn, led to the evolution of constructivism.

A cognitive approach to teaching and learning is advocated by most educational researchers and educators across the globe. From the cognitivist perspective learning is viewed as the acquisition or reorganisation of cognitive structures through which students process and store information (Lameras *et al*., 2007). The cognitive theory is

considered the dominant theory in instructional design. Cognitive models include information-processing and constructivism. Two theorists who played a leading role in the evolution of constructivism are Piaget and Vygotsky, but they have different philosophies about teaching and learning. Two types of constructivism can be identified: Piaget's cognitive constructivism and Vygotsky's social constructivism. Vygotsky emphasises the fundamental role that social interaction plays in the process of cognitive development, which implies that social learning precedes development, while Piaget emphasises the interaction of the individual with objects. For Piaget the construction of knowledge involves the processes of assimilation and accommodation. Iran-Nejad (2001) interprets these processes as follows: "Assimilation is an active response to a minor perturbation, and accommodation is an active response to a major perturbation of the child's existing representations of the world,…"

Based on the writings of various authors, Iran-Nejad (2001) notes that constructivism has many forms. He observes that constructivism is "a specific theory of development (Piaget, 1970), an information processing of knowledge (Neisser, 1967) and a way of thinking about human cognitive functioning in real world contexts (Bartlett, 1932)…" There is common ground on what constructivism involves despite these different perceptions of various theorists.

In a constructivist view students or learners are perceived as active participants in the process of knowledge construction. Learning is an active process of constructing knowledge rather than acquiring it. Iran-Nejad (2001) refers to it as "the process of building, creating, or making mental structures instead of merely absorbing or reproducing products". The construction of knowledge is thus a continuous and active

process in which the learner anchors “new information to pre-existing knowledge, and interact with knowledge, the learning environment and with other learners (Sesemane, 2008). The teacher adopts the role as facilitator, coach, motivator or “reflective practitioner” (Iran-Nejad, 2001) .

Burns *et al*. (1998) argue that there is no “blueprint” for constructivist classrooms due to the fact that constructivist teaching practices are varied and flexible. There are though certain commonalities which include: active and engaged students who are responsible for their own learning; students who work collaboratively to solve authentic problems that have real meaning to them; students who reflect on their ideas through peer and teacher questioning, discussion, or journals; the use of technological and other educational tools for inquiry, exploration, research, expression and assessment.

Savery and Duffy (2001) suggest several instructional principles derived from constructivism which will assist teachers in creating constructivist learning activities and environments. They propose that all learning activities should be anchored to a larger task or problem allowing the learner to clearly perceive and accept the relevance of the specific activities in relation to the larger task. Support to the learner in developing ownership for the overall problem or task is essential. Instructional goals should be consistent with the goals that the learner brings to the learning environment. The argument is that if learners are involved in the development of problems or tasks through meaningful discussions, they will adopt the problem as their own. Designing authentic tasks for learners to engage in is in line with the principles of constructivism.

The task and the learning environment should be designed in such a manner that it reflects the complexity of the environment they should be able to function in at the end

of learning. The learning environment should also support and challenge the learner's thinking. By giving the learner ownership of the process used to develop a solution, they engage in authentic thinking and problem solving. The teacher, thus, challenges the learner's thinking instead of dictating or proceduralising their thinking. In a constructivist learning environment the testing of ideas against alternative views and alternative contexts should be encouraged. This goal can be achieved through the use of collaborative learning groups. Electronic communication networks and social networks link learners and make collaboration possible. Teachers should provide opportunity for and support reflection on both the content learned and the learning process.

To summarise, teachers holding constructivist beliefs about teaching and learning allow learners to develop solutions to problems on their own and use prompting questions to encourage further thought and exploration. The emphasis is more on the development of thinking and reasoning processes rather than the acquisition of specific knowledge. Opposed to this viewpoint is the behaviourist perspective that perceives learners as empty vessels (a *tabula rasa*) and passive recipients of knowledge, while the teacher acts as the sole provider of knowledge (an expert).

The current study aims to investigate whether there exists a significant relationship between South African teachers' pedagogical beliefs and their uptake of technology into the classroom. In addition, the impact of other beliefs on the effective integration of ICTs also need to be examined, for example, teachers' self-efficacy beliefs and their computer self-efficacy beliefs to get a full picture of the complex interrelationships between teachers' beliefs and computer utilisation.

2.3.4 Self-efficacy beliefs

Self-efficacy, a cornerstone of Bandura's social cognitive theory (Pajares, 1992), refers to "beliefs in one's capabilities to organize and execute the course of action required to manage prospective situations" (Bandura, 1995). Efficacy beliefs influence people's thoughts, feelings, motivation and actions, and therefore it is an important concept in the understanding of teachers' thoughts, decisions, feelings, behaviours, performance, and attitudes towards their students Bandura (1995). An underlying assumption of the present study is that teachers' self-efficacy beliefs influence their attitudes towards technology integration into education and their decisions regarding whether to integrate or not to integrate ICTs in their classroom practice. People with strong self-efficacy beliefs implement a decision and stick to it, even in the face of difficulties, while people with low efficacy beliefs feel demotivated and attribute their failures to low ability. Bandura (1999) further postulates that efficacy beliefs affect thought patterns that can enhance or undermine performance and describes it as follows:

> *People construct anticipatory cognitive scenarios and visualized futures and use them to guide their actions. Those of high efficacy visualize success scenarios that provide positive guides for performance, whereas those beset by doubts about their efficacy visualize failure scenarios that undermine performance by dwelling on how things might go wrong.*

This theory also explains why some teachers take advantage of the myriad capabilities of technology to enhance teaching and learning and why others are afraid to utilise technology in the classroom and experience some kind of anxiety towards

technology. Bandura (1994) contends that "both perceived coping self-efficacy and thought control efficacy operate jointly to reduce anxiety and avoidant behaviour". An examination of teachers' self-efficacy beliefs, including their computer efficacy beliefs, will explain their avoidant behaviour towards the pedagogical integration of ICTs.

Teachers' reluctance to experiment with unfamiliar and new teaching methods and teaching aids, for example, the use of computers in their classroom practice, can also be explained in terms of inherent characteristics of classroom teaching as identified by Kagan (1992). These characteristics include: (1) uncertainties, (2) isolation and, (3) the need to maintain control. Teachers experience uncertainty about: how their planned lessons will go; the link between what is taught and what is learned; and how to judge student understanding. Since so many things in teachers' professional lives are beyond their control, they tend to isolate themselves in their classrooms because it is the only environment where they feel they have some control over what happens there. This isolation seems to have a negative effect on their attitudes, which include defensiveness and distrust of external advice (or new teaching tools, for example, computers). Teachers need to develop "an elaborate and coherent set of pedagogical beliefs" (Kagan,1992) which will allow them to take control of uncertainty in an unpredictable environment and technology in the classroom creates an unpredictable environment for teachers, hence their anxiety and reluctance to use it. "In a landscape without bearings, teachers create and internalize their own maps" (Kagan, 1992).

This study is based on the assumption that teachers with a strong sense of self-efficacy are more likely to use computers for teaching and learning, even in the face of failure or difficulty to master the task. In other words, there is a strong causal

relationship between teachers' self-efficacy beliefs and their adoption of computers as instructional tools. Because of their high self-efficacy level, they will persevere in their efforts to successfully integrate computers in their classroom practice. According to Bandura (1995) teachers' personal efficacy beliefs are affected by "their general orientation toward the educational process as well as their specific instructional activities". It is thus safe to argue that personal efficacy beliefs affect teachers' decisions about the use of modern technologies as seamless educational tools to enhance teaching and learning. Bandura (1994) describes the influence of self-efficacy on human behaviour as follows:

> *People with high assurance in their capabilities approach difficult tasks as challenges to be mastered rather than as threats to be avoided. Such an efficacious outlook fosters intrinsic interest and deep engrossment in activities. They set themselves challenging goals and maintain strong commitment to them. They heighten and sustain their efforts in the face of failure. They quickly recover their sense of efficacy after failures or setbacks. They attribute failure to insufficient effort or deficient knowledge and skills which are acquirable. They approach threatening situations with assurance that they can exercise control over them. Such an efficacious outlook produces personal accomplishments, reduces stress and lowers vulnerability to depression.*
>
> *In contrast, people who doubt their capabilities shy away from difficult tasks which they view as personal threats. They have low aspirations and weak commitment to the goals they choose to pursue. When faced with difficult tasks,*

they dwell on their personal deficiencies, on the obstacles they will encounter, and all kinds of adverse outcomes rather than concentrate on how to perform successfully. They slacken their efforts and give up quickly in the face of difficulties. They are slow to recover their sense of efficacy following failure or setbacks.

A study conducted by Sang *et al*. (in press) provided empirical proof that teacher self-efficacy directly predicts student teachers' future use of computers in teaching and learning, and indirectly, via its impact on the mediating variables, attitudes towards computers in education and computer self-efficacy. As many similar studies in the field of educational technology, Sang *et al*.'s (in press) study was conducted on prospective teachers in the Eastern countries, which includes, China and Singapore. These studies therefore do not necessarily represent the beliefs and perceptions of practicing teachers. There is thus a need for an exploration of practicing teachers' beliefs and the pedagogical integration of technology within the South African context.

2.3.5 Teachers' computer self-efficacy

Computer self-efficacy can be defined as a person's perceptions of and capabilities to use computers (Compeau and Higgins, 1995 cited in Sang *et al*., in press). Teachers' self-efficacy beliefs about their capabilities to use technology, more specifically computers, are perceived an influential factor in their utilisation of technology in teaching and learning.

The current study aims to confirm whether that is the case within a South African context since external barriers to ICT integration in education, for instance, access to the necessary technological tools and adequate teacher training, are perceived as the

most obvious or common barriers. The present study thus hypothesises that teachers with high levels of computer self-efficacy are more inclined to uptake computers in the classroom, while teachers with low levels of computer self-efficacy are more reluctant to incorporate computers into teaching and learning.

2.3.6 Computer anxiety

According to Sam *et al.* (2005), computer anxiety entails a person's emotional reaction towards using computers, more specifically, fear of computers when using one, or when one considers the possibility of computer utilisation. Sam *et al*. (2005:206) further observe that computer anxiety is characterised as "an affective response, an emotional fear of potential negative outcomes such as damaging the equipment or looking foolish". Rogers (2007) identified certain behaviour that is associated with computer anxiety. It includes: avoidance of computers and the area where they are located; excessive caution when using computers; negative remarks toward computers and computing; and attempts to shorten periods when computers are being used.

2.4 Principals' technology leadership

Lumpe and Chambers (2001:95) refer to the external factors that influence ICT adoption into teaching and learning as teachers' context beliefs and define it as follows: "Context beliefs are those beliefs about the ability of external factors or people to enable a person to reach a goal plus the belief that a factor is likely to occur." In terms of technology integration in schools, the environmental context includes students, administrators, parents, teachers, buildings, equipment and professional development. Additional to the factors intrinsic to teachers, the current study will also focus on the role that teachers' context beliefs play in their decision whether or not to utilise computers in

the classroom. The context beliefs that are of significance for the present study include the role of the principal as technology leader. The present study is concerned about the impact that the principal as technology leader has on teachers' decisions about ICT integration into teaching and learning.

This study hypothesises that principals' technology leadership has a direct influence on teachers' uptake of technology in the classroom. The assumption is made that if the teacher regards the principal as a key role player in the facilitation of technology integration into teaching and learning and sees that the principal has a positive attitude towards technology in the classroom, they are more likely to infuse computers into their teaching practice.

The SAIDE research project report (2003) on the use of ICTs in 21 schools in South Africa and research by other organisations has shown that one of the reasons why ICT integration in schools is not successful is that principals are not properly informed about the possibilities and constraints in the use of ICTs in education. This leads to their inability to manage the introduction of ICTs in their schools. A principal's guide on ICT integration was compiled to assist South African principals with the introduction of ICTs in their schools. The fundamental question therefore is: how successful are South African principals in realising the goals of the White Paper on e-Education?

The crucial role of school principals as technology leaders is recognised by the International Society for Technology and Education (ISTE) who identified different dimensions of technology leadership, namely: technology operations and concepts; planning and designing learning environments and experiences; teaching, learning and

the curriculum; assessment and evaluation; productivity and professional practice; social, ethical, legal, and human issues; procedures, policies, planning, and budgeting for technology environments; and leadership and vision. Chang, *et al.* (2008) adapted five of these dimensions: vision, planning and management; staff development and training; technology and infrastructure support; evaluation and research; and interpersonal and communication skills. These dimensions were used as a conceptual framework to investigate teachers' perceptions of principals' technology leadership in schools in Taiwan. The research findings on each of these dimensions, respectively, showed that: (1) principals should, as technology leaders, clearly articulate a shared vision for school leadership; (2) principals should help train and encourage teachers' technology skill acquisition; plan and design on-going and future technology staff development programmes and provide teachers adequate time for technology training; (3) principals need to provide adequate technology support, maintain and support school infrastructure, support personnel when technical assistance is needed; (4) principals should, as technology leaders, develop an evaluation and assessment plan for their schools; and (5) principals should maintain positive and constructive interpersonal relationships and communicate effectively with all stakeholders.

There appears to be no evidence in the available literature that the influence of principals' technology leadership on teachers' decision to use computers in the classroom has been examined within the South African context and that is one of the aims of the current study. In addition, an investigation on the effect of principals' technology leadership on teachers' technology integration can also be useful in understanding teachers' reluctance to integrate ICTs in their teaching practice.

3. METHODOLOGY

3.1 Introduction

A mixed method of qualitative and quantitative research has been used for this study. The research has been conducted at two schools in the Southern Suburbs of Cape Town, a primary and secondary ex-model C school. These schools have computer laboratories and internet connection for the pedagogical integration of ICTs.

3.2 Sampling

The researcher applied the convenience sampling technique because it is fast, inexpensive and the subjects were readily available. The institutions are also easily accessible to the researcher. The participants in this study were teachers from the participating schools. The only criterion used to select participating schools was that they should have computer laboratories for ICT integration. For the purpose of this study and to protect the anonymity of these schools, they will be referred to as School Z (primary school) and School B (secondary school). Both schools benefit from the Khanya project in the Western Cape and therefore the assumption is made that teachers and learners of these schools do have access to computers and other educational technology tools. Teachers were asked to participate voluntarily in the research project.

3.3 Data Collection

Data collection has been done through the distribution of qualitative and quantitative survey questionnaires. A quantitative survey was conducted to get an indication of the institutions' connectivity and access to ICTs, as well as the frequency and to what extent participants use the computer laboratory for pedagogical purposes.

The qualitative study illuminates the quantitative study. In the qualitative survey open-ended questions were employed to obtain teachers' views on the impact of ICTs on teaching and learning; ICT training they received; their principal's beliefs about ICTs; and ICT integration into teaching and learning.

3.4 Research Instruments

The data was collected using qualitative questionnaires (see Appendix B) and a quantitative questionnaires (see Appendix C). The research instruments used in the current study are not standardised within the South African setting. This study, therefore, serves as a preliminary exploration which forms the baseline for further investigation. The following questionnaires (scales) were used to collect the data:

3.4.1 Qualitative questionnaire

The qualitative questionnaire is an adapted version of the questionnaire used in the Pan African Research Agenda on the pedagogical uses of ICTs (2006). The questionnaire contains 12 open-ended questions which were used to obtain teachers' views on the impact of ICTs on teaching and learning; ICT training they received; their principal's beliefs about ICTs; and ICT integration into teaching and learning.

3.4.2 Q20 – Pedagogical Belief Scale (PB)

Teachers' pedagogical beliefs, cognitivist or behaviourist, were measured through the pedagogical belief scale (see Appendix B) adapted from Sass (2003). The participating teachers were asked to rate their level of agreement with a specific statement (from 1 = strongly disagree to 5 = strongly agree). The scale contains 12 items, divided into 6 behaviourist statements and 6 cognitivist statements.

3.4.3 Q21 – Teacher Self – Efficacy Belief Scale (SE)

Educators' self-efficacy beliefs were determined through the teacher self-efficacy belief scale (see Appendix B) adapted from Erdem and Demirel (2007). The instrument, containing 20 items, used a 5-point Likert-type scale with graduations ranging from 1 = strongly disagree to 5 = strongly agree. A high score indicates favourable respond towards the measured construct.

3.4.4 Q22 – Computer Self Efficacy (CSE)

Computer self-efficacy is regarded as a specific type of self-efficacy and refers more specifically to a person's beliefs of his or her capability to use a computer (Sam *et al*., 2005).

The participants' computer self-efficacy beliefs were measured through a computer self-efficacy scale (see Appendix B) adapted from Sam *et al*. (2005), which includes 24 items. Each item is preceded by the phrase "I feel confident". It is a 5-point Likert-type scale ranging from 1 = strongly disagree to 5 = strongly agree. A high score indicates a high degree of confidence in the participant's ability to use computers.

3.4.5 Q23 – Computer Anxiety Scale (CA)

A computer anxiety scale (see Appendix B), adapted from Sam *et al*. (2005), was employed to determine educators' anxiousness about computers. The computer anxiety scale consists of 12 items, divided into 7 negative items and 5 positive items. A high mean for the positive questions is an indication that teachers are confident computer users, while a high mean for the negative questions suggests a lack of confidence in their ability to use computers. The participants responded to a 5-point Likert-type scale (from 1 = strongly disagree to 5 = strongly agree).

3.4.6 Q24 – Computer Use Scale (CU)

A computer use scale was compiled by using questions from different existing scales (Sang *et al*., 2005 and Wilson-Strydom and Thomson, 2005). Current educators' reported computer use was examined through a 5-point Likert-type scale (from 1 = strongly disagree to 5 = strongly agree), containing 16 items.

The purpose of the scale was to determine to what extent educators use computers for administrative and pedagogical purposes. The scale was divided into 12 items that indicate pedagogical use and 4 items that indicate administrative use. By using computer use as an outcome variable, a correlation analysis was done with the other predictor variables: PB, SE, CSE, CA and PTL.

3.4.7 Q25-28 – Principals' technology leadership (PTL)

Teachers' perception of their principal's role as technology leader was examined by using a simplified questionnaire from Chang *et al*. (2008). Teachers were asked to rate their principal's technology leadership on a scale from 1 to 5 (1 = low and 5 = high). The questionnaire consists of four interrelated dimensions as identified by the International Society for Technology and Education (ISTE). These dimensions include: (a) vision, planning and management; (b) staff development and training; (c) technology and infrastructure support; and (d) interpersonal and communication skills.

Seventeen Likert-type items, comprised of the four dimensions, were employed to define and measure principals' technology leadership. A response of 1 is an indication that the principal never facilitates technology use in the school, and a response of 5 indicates that the principal facilitates technology use in the school.

3.5 Hypotheses

The major null hypothesis of the study is that teachers' behavioural intention, whether and how to use ICTs in the classroom whether it is for pedagogical or administrative purposes, is not significantly affected by their belief systems, which include, their pedagogical beliefs, self-efficacy beliefs and context beliefs.

3.6 Data Analysis

The qualitative and quantitative data were analysed to capture the major trends and themes emerging from the study.

Firstly, the quantitative data was standardised using the z-score, since the variance was quite different between the different questions in each scale. See Table 1 in Appendix A for descriptive statistics of all the questions. Each scale was created by calculating the mean of all the questions in that group. The reliability of each scale was tested by calculating the Cronbach's alpha. The results for SE, CSE, PB, CA, CU and PTL are summarised in Table 3 (see Appendix A). The alphas range from 0.718 to 0.988, which is an indication that the different questions included in each scale form a reliable measure of the concept which is covered by the scale.

In order to see if there were significant differences between the two schools and males and females, an independent t-test was conducted on the six scales. Each scale was created by calculating the mean of all the questions. An independent sample t-test was performed to test for significant difference between the means of the two schools for each scale. For the two schools, at the 5% level, there is only a slight significant difference in the CU group. The p Value is 0.049, which is close enough to 0.05 which allows for this significant difference to be ignored (Table 2.1 in Appendix A). There is

also no significant difference between the means of the scales for males and females (Table 2.2 in Appendix A). Due to the lack of significant difference in the six scales between the two different schools and males and females, the data was combined in the analysis, since the number of questionnaires are limited.

In preparation for further analysis, new scales were constructed. From the reliability analysis, there was an indication that certain questions should be deleted from the existing scales in order to increase the Cronbach's alpha (results not shown).

Bivariate correlation procedures were applied to explore the interrelations between the different scales. The nature of the relationships between the research variables can be derived from the results of the bivariate correlational analysis (Table 4 in Appendix A). For the purpose of the present study the correlations with computer use are of major concern. With computer use (CU) as an outcome variable, self-efficacy (SE), computer self-efficacy (CSE), pedagogical beliefs (PB), computer anxiety (CA) and principals' technology leadership (PTL) as predictor variables, a correlational analysis was performed.

Further analysis was done to determine whether the respondents' pedagogical beliefs were cognitivist or behaviourist; whether their computer use is administrative or pedagogical and whether they responded positively or negatively on the computer anxiety questions.

Frequency analysis of the resulting groups was done and the percentage of respondents in each group is shown in table 5 (see Appendix A). Pedagogical beliefs scale was grouped into behaviourist, cognitivist and none; computer use scale was grouped into pedagogical, administrative and none; and computer anxiety scale was

grouped into positive and negative or none. The results of the frequency analysis are discussed in relation to each variable.

4. DATA PRESENTATION

4.1 Introduction

The study employed a qualitative and quantitative research design to investigate primary and secondary school teachers' pedagogical beliefs, self-efficacy beliefs, computer self-efficacy beliefs, computer anxiety and computer use. In addition, teachers' perception of their principal's technology leadership was also examined. In this section an analysis of the research findings follows. The findings will be presented under the following headings: pedagogical beliefs, self-efficacy beliefs, computer self-efficacy beliefs, computer anxiety and principals' technology leadership. The qualitative data is also integrated in the discussions in this section.

4.2 Pedagogical beliefs

4.2.1 Hypotheses

The alternative hypothesis is that the beliefs that teachers hold about teaching and learning, that is, their pedagogical beliefs, directly impact their incorporation of technology into teaching and learning. The null hypothesis derived from the research question is that teachers' pedagogical beliefs, whether they be cognitivist or behaviourist, have no direct effect on the way they use computers in the classroom.

4.2.2 Data

Frequency analysis was done to determine whether the respondents' pedagogical beliefs were cognitivist or behaviourist. The mean of the responses to all the questions in each group was calculated. For each respondent, the group with the highest mean was selected and the respondent was classified as behaviourist or

cognitivist. In cases where the mean value obtained for both classes was the same, the respondent was classified as NONE.

The results of the frequency analysis, as shown in table 5 (see Appendix A), reveal that 35% of the respondents hold behaviourist beliefs about teaching and learning, while 26% tend to believe in cognitivist teaching. A group of 39% seems to be neutral, which means that they cannot be classified as behaviourist or cognitivist.

The results indicate that teachers' pedagogical beliefs directly influence teachers' self-efficacy beliefs, computer self-efficacy beliefs, computer anxiety and the technology leadership of principals, but it does not directly affect teachers' use of ICTs in the classroom.

4.2.3 Conclusion

The results of this study confirms the null hypothesis that suggests that teachers' pedagogical beliefs, whether it be cognitivist or behaviourist, have no direct effect on their intention, whether and how, to integrate technology into teaching and learning.

Since no direct relationship between teachers' pedagogical beliefs and their computer use in the classroom was found, it was not possible to draw a parallel comparison between cognitivist and behaviourist teachers' use of computers for pedagogical and administrative purposes, respectively.

The current study concludes that a higher percentage of teachers in this sample holds behaviourist teaching beliefs than cognitivist beliefs about teaching and learning, and that computers are mostly used to perform administrative tasks rather than employing them as instructional tools.

4.2.4 Discussion

The quantitative data indicates that the majority of the teachers hold pedagogical beliefs that are not aligned with a specific philosophy of teaching and learning, that is, they are neither cognitivist nor behaviourist. However, it is possible that this group of teachers leans more towards an approach of blending the two theories (cognitivism and behaviourism) and use it in conjunction when utilising technology in the classroom.

It is argued that these theories are rarely used independently of each other and that most skilled teachers adapt their teaching style, sometimes subconsciously, to produce the most effective results. This inclination towards the blending of cognitivism and behaviourism is inherent in the statements from some of the educators. This desire for this hybrid approach comes across in subtle but unmistaken sentiments and it also reflects a latent frustration among some of the educators with the *de facto* dominance of the behaviourist pedagogical culture in South Africa. Educators are caught inbetween the official Outcomes-based Education system, which is based on constructivism and the still influential behavourism while at the same time they see opportunities in cognitivism so the blending of cognitivism and behaviourism appears to be a conscious or unconscious response to the *de facto* behaviourist inertia and the *de jure* constructivist. These pedagogical tensions have created a pedagogical gap and the blending of pedagogy can be seen as a coping mechanism to these pedagogical tensions. This issue warrants further serious pedantic interrogation because it is at the heart of the key challenges that the South African education system faces in terms of learner performance as well as educator performance. It is an important public policy issue/education policy issue.

These issues and tensions are apparent in the qualitative data on the question of the use of ICT in classroom and improvement of access to information. The pedagogical blending impulses of the educators become apparent, as per the quantitative data. One educator noted that “Yes, it helps teachers cater for visual and auditory learning styles. Gives learners some variety and up to date information can be used.” While another educator observes that “it enables the learners to be more interactive only if used properly. You have to spend time finding interactive resources.” The pedagogical blending impulses and innuendos are apparent. This aspirational inclination towards pedagogical blending is also apparent in another educator’s view: “yes, easier, neater, knowledge immediate on the internet and visually appealing to learners.” Another educator submits that “wider variety of teaching resources enables more effective and efficient teaching.” While another one notes that ICT affords “graphics in teaching technology and information from internet.”

This impulse towards pedagogical blending is also the underlying motif in the educators’ response to the question focused on the possible mechanisms of integrating ICTs in teaching and learning in schools. One educator suggests that “it allows learners to do research using ICT”, while even more significantly from a pedagogical point of view, one educator submits that “sci-fi teaching aids, tests on the computer will make more regular testing possible. Would create software that monitor students' progress and generate individually-tailored learning programmes based on student performance, remedial and enrichment activities.” While another notes “When our computer lab is completed, I can take my entire class to do research and complete assignments on the computer.” Other educators note that “Having access to an interactive Whiteboard in

class, has revolutionised teaching and learning. Access to countless pieces of information has made teaching and learning more exciting because of the variety of lessons that can be presented. Learner interaction is also enhanced." While another submits that " I use music, video clips, You Tube, PowerPoint presentations, online interactive tests, audio clips, smart interactive software and DVDs quite often in the presentation of lessons."

The second highest percentage of teachers appears to be more behaviourist in their approach towards teaching and learning. According to Kagan (1992) teacher beliefs tend to be associated with a congruent teaching style. This group of teachers seems to focus more on teacher-centred teaching and learning techniques in their teaching practice. It seems that these teachers' pedagogical beliefs are deeply rooted in their belief systems and might have been formed during their years spent in the classroom, either as learner or pre-service teacher, when behaviourist teaching and learning practices were the order of the day. These beliefs therefore appear to be more resilient in nature.

Pajares (1992) posits that beliefs that are formed early in life are resistant to change. It is most likely that the teachers who participated in the current study, model their teaching practice on educators who had a great impact on them and that they subconsciously internalised these beliefs. Further investigation of the relationship between teachers' age and their pedagogical beliefs might provide a feasible explanation for some teachers' strong behaviourist teaching beliefs. Teo *et al*. (2008) examined the relationship between Singaporean pre-service teachers' beliefs about constructivist teaching and traditional teaching and their respective beliefs about the

utilisation of technology in the classroom. They concluded that these teachers were more inclined towards the view of teaching as transmissionist rather than an act of facilitating students' knowledge construction, which is in line with the findings of the current study.

The third group of teachers who is in the minority appears to hold cognitivist beliefs about teaching and learning. A study conducted by Ertmer (2006) on the relationship between teacher educators' beliefs and pre-service teachers' beliefs has proven that the learner-centred (constructivist) beliefs of the teacher educators have influenced the learner-centred beliefs of the pre-service teachers. Ertmer (2006) further argues that the instruction that pre-service teachers receive in teacher education programmes could have an impact on their pedagogical beliefs. The findings of Ertmer's study substantiate the argument that teachers' pedagogical beliefs are influenced by the teaching style and beliefs of their instructors.

The barely subtle issue here is the silent "pedagogical war" or "pedagogical cold war'' that has been silently raging in the school corridors and corridors of power in South Africa since the introduction of the Outcomes-based Education system. The future role of ICT in classes is the new frontier of this pedagogical war and it is also the fault line of pedagogy and epistemological debate because inevitably pedagogical changes raise fundamental epistemological issues.

The blending pedagogical tendencies implied by the statements of some of the educators are extremely important because they have significant education policy implications, especially in relation to the use of technology in classes and what that means for the nature of pedagogy and the epistemological debate. Therefore,

educational technology has serious implications on pedagogical development and education policy itself.

Indeed, as Kelz (2009) contends, the demand for more complex, problem-solving and collaborative tasks in the workplace today calls for a more constructivist-based pedagogic framework, which provides a learning environment that fosters self-directed and collaborative learning. A conceptual change for teachers is thus imperative. Modern technology enables teachers to make that conceptual change by integrating these technologies into teaching and learning. Teachers can create more learner-centred, authentic, real-world and collaborative learning environments that will encourage learners to engage in critical and creative thinking, while they construct their own knowledge.

Sang *et al*. (in press) examined to what extent student teachers' gender and thinking processes, that is, constructivist teaching beliefs; teacher self-efficacy; computer self-efficacy; and attitudes toward computers in education, influence their future ICT integration in education. The results of this study provided empirical evidence that student teachers who hold strong constructivist teaching beliefs; strong teaching efficacy and computer self-efficacy; and more favourable attitudes toward computer use in teaching and learning, are more inclined to integrate computers into their prospective teaching practice. A study conducted by Teo *et al* (2008) on beliefs about teaching and the use of technology among pre-service teachers demonstrated that constructivist use of technology correlates positively with constructivist teaching. This outcome did not really come as a surprise, but it is noteworthy that it also revealed a correlation between constructivist teaching and traditional use of technology. An

inference drawn from the results of this study is that, although some educators are familiar with constructivist teaching they are not competent with the pedagogical use of technology, therefore the traditional use of technology. These two studies corroborate the supposition that educators' beliefs about teaching, in other words, their pedagogical beliefs, influence their use of technology, but it is based on surveys conducted within the Chinese context (Sang *et al*., in press) and Singaporean context (Teo *et al*., 2008).

Hence, the literature is consistent with the quantitative data and qualitative data on the complexity and importance of pedagogical evolvement and the hybridity aspects of that process has fundamental implications for education policy and the very nature of epistemology. The relationship between pedagogy and technology is also important especially the various ways in which technology can influence pedagogical frameworks.

4.3 Teachers' self-efficacy beliefs

4.3.1 Null hypothesis

The null hypothesis that derives from the research questions is that teachers' self-efficacy beliefs , whether they are strong or low, have no significant impact on their use of technology in the classroom.

4.3.2 Data

The results illustrate that 39% of the respondents experience low self-efficacy. This, in turn, suggests that 61% of the respondents hold strong self-efficacy beliefs (see Table 6 in Appendix A).

The data also shows that self-efficacy beliefs have a direct effect on computer use in the classroom. There is also a significantly strong relationship between teachers' self-efficacy beliefs and their computer anxiety. It also reveals an interrelationship

between teachers'self-efficacy beliefs, their pedagogical beliefs and principals' technology leadership.

4.3.3 Conclusion

The findings of this study falsify the null hypothesis and validate the alternative hypothesis that teachers' self-efficacy beliefs strongly affect their use of technology in the classroom. The results also confirm that there is a strong relationship between teachers' self-efficacy beliefs and their computer anxiety. It confirms that teachers with high self-efficacy experience low levels of computer anxiety, and therefore are confident users of technology in the classroom.

4.3.4 Discussion

This study has provided statistical evidence that the higher the self-efficacy beliefs of teachers the lower their computer anxiety, and the more confident they are in using computers. The majority of the teachers who participated in this study (61%) shows a strong sense of self-efficacy and 83% experience low computer anxiety. This implies that the majority of the participating teachers are confident users of computers and are more inclined to integrate computers into their teaching practice. The other 39% of teachers who experience low levels of self-efficacy are the ones who are more likely not to adopt technology into their classroom practice.

Bandura (1999) contends that "people are partly the product of their environment." People's environment thus influences their social identity, and by choosing their environment, they determine which course their lives take. According to Bandura (1999) efficacy beliefs play a vital role in shaping individuals' life paths by influencing the activities and environments which they choose to enter. In

contemporary society, our life paths are strongly impacted by technology. The rapid and constantly changing post-modern society, due to continuous technological development, also called a “liquid modernity” (Bauman, 2005) or “risk society” (Beck, 1992 cited in Martin 2008) contributes to feelings of uncertainty in individuals. Our society is robbed of predictability and certainty because “[t]he taken-for-granted structures of modern (that is, industrial) society – the nation state, institutionalized religion, social class – have become weaker and fuzzier as providers of meaning and, to that extent, of predictability” (Martin, 2008). These uncertainties, which include uncertainty about what the future holds, about career choices, about the outcome of one’s actions, affect people’s efficacy levels. If teachers, for example, experience uncertainty about how teaching with technology will impact their teaching performance and learners’ learning outcomes, they are bound to experience some anxiety towards technology, which in turn, can lead to low efficacy levels. They doubt their capability to successfully teach with technology and regard technology as a threat.

Bandura (1999) states that those who believe they cannot manage threats “experience high anxiety, dwell on their coping deficiencies, view many aspects of their environment as fraught with danger, magnify possible risks and worry about perils that rarely happen.” Low efficacy levels in teachers can further lead to a negative attitude towards technology, which means, they will totally shy away from computers in the classroom or their technology integration will be non-innovative. Ertmer & Ottenbreit-Leftwich (2009) suggest that for teachers to adopt technology as an innovation, they need to be willing to take risks, remain flexible, and be open to change. Teachers with strong self-efficacy levels are thus more likely to take risks, by adopting computers as a

teaching tool, persevere in the face of hardships and will be able to shape their environment to their liking.

The quantitative data thus shows that teachers with high self-efficacy experience low levels of computer anxiety, and therefore are confident users of technology in the classroom.

This trend in the quantitative data resonates with the qualitative data. The educators' responses indicate that they have a high self-efficacy and experience low levels of computer anxiety. They therefore have a strong propensity towards using technology in their work. The educators saw the impact of ICT on the production of teaching as positive and they offered a number of reasons to that effect. One educator indicated that "information can be downloaded from available websites". Another educator complimented this view by pointing out that information is easily available through the use of computers, thus reaffirming the high self-efficacy level reflected in the quantitative data.

One of the educators also indicated that one of the most significant impact of ICT on the production of teaching material is the opportunity to use PowerPoint presentations in class. Another educator also noted that through the use of ICT, the educator "was able to get information and ideas for use with different age groups". This confidence in the relevance of the use of ICT is also confirmed by another educator who indicated that the use of ICT creates opportunities to "make worksheets and searching the internet". One educator went further and also observed that "worksheets are neater and it is much faster to make on the computer". The low levels of computer anxiety among the educators is also emphasised by the educator who noted that "I have been

able to download images to use on worksheets". Another educator also pointed out that it is easier to develop "comprehension tests from newspapers'' through the use of ICT. One educator actually confessed that they "could not do without ICT" because it is "easy and fun". This again confirms the level of confidence that the educators have in the use of ICT. An educator noted that "it is a resource in producing material" while another educator observed that the impact of ICT has been positive in the production of teaching material because it made it possible to use "images for pictures not found in books and magazines". On the same theme, an educator submitted that "there are resources/material available on the internet that can be used as is or as inspiration. MS Word is an obvious benefit".

This trend in the quantitative and qualitative data is collaborated by some of the literature on the subject matter. For example, Sang *et al*'s. (in press) study that provided empirical evidence that teacher self-efficacy directly impacts student teachers' future use of computers in teaching and learning, and indirectly, via its impact on the mediating variables, attitudes towards computers in education and computer self-efficacy.

There is also ample evidence from the qualitative data from this study that further consolidates the quantitative data as well as the major findings of the Sang *et al*'s. (in press) study. Hence, when the educators were asked on the impact of ICT on their access to knowledge through the use of ICT, the responses reflected a high level of confidence in the use of ICT. One educator acknowledged that "more sources of information are available and in front of the teacher and well filed. ICT has a result of using a bigger variety of information". Another educator noted that "internet enables us

to get information easier". This high affinity to the comfortable use of ICT is also apparent on an educator who observed that he "was able to download information and so got more information about lessons I had to prepare. It was a great time saver - information at one's fingertips". Another educator pointed out that they "mastered a few ICT skills. The internet is effective and information is easy to find". One educator noted that access to ICT has resulted in "better lesson planning".

On the same theme of the impact of ICT on educators' access to knowledge, an educator submitted that "the internet helps you when you are unsure of certain aspects" and another noted that "you can read other ways of teaching" through the use of ICT. Reflecting this high confidence in the use of ICT, one educator observed that "it gives you extra information, more than the textbooks as internet information is regularly updated". Confirming the trend reflected by the quantitative data and the literature, one educator noted that "with access to the internet, I have been able to download resources to use in class. This allows me access to different types of learning materials, which allows me to be creative in my class by adopting different approaches to my subject".

In resonance with the quantitative data that reflects that teachers with high self-efficacy experience low levels of computer anxiety, and therefore are confident users of technology in the classroom, the qualitative data from the educators on the question of the impact of ICT communication between educators and learners underlines this trend further. One educator noted that "assignments can be placed on e-mail. Better communication between learner and teacher". Another educator also observed that the "use of ICT is encouraged for submission of assignments". An educator submitted that

ICT has “very good impact because resources can be shared easily and assignments can be submitted electronically” while another educator submitted that “assignments are sometimes e-mailed. Information is given to learners via a shared network for learners. Learners use the interactive whiteboard for presentations. The SMS web is used to send important notices.”

Therefore, the quantitative data, qualitative data and the literature confirm that teachers with high self-efficacy experience low levels of computer anxiety, and therefore are confident users of technology for teaching purposes.

4.4 Computer self-efficacy beliefs

4.4.1 Hypotheses

This study hypothesises that there is a significant relationship between teachers’ computer self-efficacy beliefs and their computer use. The assumption is made that teachers with high levels of computer self-efficacy beliefs are more likely to use computers in the classroom, while teachers with low levels of computer self-efficacy beliefs are hesitant to use computers in the classroom. The null hypothesis that was tested is that teachers’ computer self-efficacy beliefs, whether they are strong or low, have no significant impact on their use of technology in the classroom.

4.4.2 Data

From the quantitative data results (Table 7 in Appendix A) one can conclude that 30% of the respondents have low computer self-efficacy beliefs. The implication is that 70% of the teachers who participated in the study hold high computer self-efficacy beliefs.

This data therefore suggests that teachers' computer use is strongly affected by their computer self-efficacy beliefs. Pedagogical beliefs have thus an indirect effect on computer use, via the impact on computer self-efficacy.

4.4.3 Conclusion

The results of the current study falsify the null hypothesis and confirm that there exists a significantly strong relationship between teachers' computer self-efficacy and their usage of technology in the classroom.

4.4.4 Discussion

The findings of the present study imply that teachers with high computer self-efficacy levels are highly efficient and are most likely to integrate technology into teaching and learning. Since teachers' pedagogical beliefs significantly correlate with their computer self-efficacy beliefs, and indirectly affect their computer use in the classroom, it is possible that these teachers employ technology in a constructivist and behaviourist manner to achieve the most desirable results.

Researchers have proved that teachers with high levels of computer self-efficacy use computers more often and experience less computer-anxiety, while teachers with low levels of self-efficacy about computers are more hesitant to use computers (Sang, *et al*., in press).

This trend is also reflected by the qualitative data. It is imperative to note that educators from the two schools which were part of the qualitative research spend considerable time every week using ICT for academic purposes. In addition, this pattern of high levels of computer self-efficacy are apparent in the educators' response to the question that focused on the impact of ICT on their lesson planning. One

educator noted that “it is much better as you can reflect the whole lesson from your PC directly onto the whiteboard. The lesson is well prepared and neat” while another indicated that the use of ICT “helps with the preparation of worksheets. Activities downloaded can be used in lesson plans. Additional information to the textbook.”

Another educator noted that ICT is useful for research. One educator submitted that: “It is much faster to work on the computer. The worksheets are neat.” There was also an interesting elaborate response from an educator to this issue: “Use software programmes to create rubrics and worksheets. The internet has made planning easier as there are many websites that cater for educators.” Other responses from the educators emphasised this point further: “Resources available for background information for lesson introduction.”; “Very easy and comfortable way of designing learning material.”; “Use the internet for downloading pictures and sound examples.”; “I prepare all assessments using the computer. I do research for lessons, especially in the sciences, on the computer”; “ It allows me to prepare my lessons well in advance and I am able to collate electronic folders to use for years to come, and can also make the necessary amendments quite easily if need be. It also allows me to share lesson plans quite easily with colleagues.”

It is therefore clear from these various submissions from the educators that they have high computer self-efficacy levels and are most likely to integrate technology into teaching and learning.

This trend was also reflected when the educators responded to a question that focused on the possible benefits that educators may derive from participating in incentive programmes related to the integration of ICT in their teaching. One educator

noted that “yes, we had a workshop where we received a national teachers guide and readers from Nasou via Afrika. This company even gave us a flash drive with all the information and teachers aid.” Even more impressive was an educator who noted that “I have not received any training. Taught myself MS Word and MS Excel.” While another educator submitted that “I have completed most of the computer skills I need at the moment. I am currently doing a computer course, where I am doing intermediate and advance work. This course is presented by the WCED, over 3 terms once a week.”

However, the educators also noted that there were a number of major barriers hindering the pedagogical integration of ICTs in schools. Some of these barriers identified by the educators included “not enough computers and it would have been perfect if every student had his/her own computer in front of him/her.”; “money, knowledge”; “…Classes too big for individuals to have access to computers.”; “…no internet access.”; “Lack of whiteboards and internet access in all classrooms.”; and “we are currently waiting for our new computer lab to be completed by Khanya.”

Thus the literature suggests that a combination of several factors influence teachers’ adoption of ICTs in their teaching practice, for instance, teachers’ beliefs (including pedagogical beliefs and self-efficacy beliefs) (Ertmer, 2005); computer self-efficacy (Sang, *et al*. in press); computer anxiety (Sam, *et al*. 2005); lack of in-service and pre-service training; lack of appropriate software and infrastructure; lack of technical support; and lack of proper technology leadership, to mention but a few.

4.5 Computer anxiety

4.5.1 Null hypothesis

Teachers' computer anxiety, whether it be high or low, has no significant influence on their adoption of ICTs into teaching and learning.

4.5.2 Data

The results show that 96% (22 out of 23) of the respondents responded positively on the computer anxiety scale. Only 1% (1 out of 23) responded negatively (see Table 8 Appendix A). The high percentage indicates that most of the respondents reflect a positive attitude towards computers, are less anxious about computers and are thus highly confident in using computers.

4.5.3 Conclusion

The findings of the study falsify the null hypothesis and confirm that there is a significant relationship between teachers' computer anxiety and their use of computers in the classroom.

4.5.4 Discussion

The strong positive relationship between teachers' computer anxiety and their self-efficacy beliefs indicates that they are more inclined to utilise technology in the classroom. Taking into account the influence of teachers' pedagogical beliefs (cognitivist or behaviourist) on both variables, it seems that these teachers will be able to identify pedagogically sound uses for ICTs and effectively integrate it into teaching and learning. There is though a small percentage of teachers who experience high computer anxiety and who experience a low level of self-efficacy. This group of

educators will possibly shy away from computers in the classroom and maybe only resort to the administrative use of computers.

The quantitative data, however, displays that there is a significant relationship between teachers' computer anxiety and their use of computers in the classroom, which means most of the respondents are highly confident in using computers. This trend is also reflected by the qualitative data. Indeed, it is imperative to note that all the 23 educators who participated in this study have access to a computer at their schools and all the 23 educators have a personal e-mail, reflecting their high confidence in using computers. The high confidence in computer use is apparent in their responses to the question on the impact of ICT on their reflection on their teaching. One educator noted ICT does have an impact in this regard and "old lessons are available and well filed to access when and where you need them". Another educator acknowledged getting "numerous ideas from the internet" while another one "can use examples of other teachers". In even greater detail, another educator submitted that "I get new worksheets from different education sites. It gives me the opportunity to see what other teachers are doing". Additionally, an educator noted that "ICT itself requires that you re-evaluate teaching strategies to incorporate it and utilise it fully". One educator observed that "it allows me the opportunity to explore new methods of teaching, and I am always adjusting my teaching methods to create an exciting learning environment. I am able to share teaching resources with colleagues abroad." Another educator noted that "I can go back to old PowerPoint presentations and teach from them ."

The high level of confidence in the use of computers is reflected by the wide range of ICT skills/competencies mastered by the educators. Most educators noted

they are comfortable using “MS Word, MS Excel, MS PowerPoint, Outlook Express and the internet”. Other educators noted a high level of confidence in the use of “MS Publisher, social networks, video conferencing, video presentations, mail merging and interactive whiteboard skills.”

Another indication of the educators’ confidence in the use of ICT became apparent in their response to the question centred on the value of training to the educators in their efforts to integrate ICT in their teaching. One educator noted that the training “gave me useful information and teaching aid and helped me to work out lesson plans. Useful ideas for teaching and even information for learners.” Another educator observed that they can now “do marks on the computer” while one educator noted that “you feel comfortable using ICT in the preparation of material.” Another educator acknowledged that “it has been very helpful”. This seems to suggest that training enhances even further educators’ confidence levels in using computers.

The current study postulates that there is a significant relationship between teachers’ computer anxiety and their intention to use, or not to use, computers in the classroom. The assumption is that if teachers experience high levels of computer anxiety, they will not use computers in the classroom and if teachers’ computer anxiety level is low, they will utilise computers in their teaching practice.

It is therefore clear from the quantitative data and qualitative data of the present study that the educators have a high level of confidence in the use of computers and therefore reflect traits that are largely the opposite of computer anxiety characteristics outlined by Sam *et al.* (2005) and Rogers (2007) in the literature.

4.6 Principal's technology leadership

4.6.1 Null hypothesis

The null hypothesis derived from the research questions is that the principal's technology leadership has no significant influence on teachers' intention, whether and how, to integrate technology into teaching and learning.

4.6.2 Data

The results indicate that there is no significant relationship between teachers' computer use and the principal's technology leadership.

4.6.3 Conclusion

These findings confirm the null hypothesis that suggests that teachers' computer use in the classroom is not significantly impacted by the principal's technology leadership.

4.6.4 Discussion

Since no direct correlation was found between teachers' computer use and the principal's technology leadership, this study concludes that teachers will integrate technology into their classroom practice, irrespective whether principals facilitate or do not facilitate technology integration into education. It is recommended though that principals provide the necessary leadership and support to realise the effective and successful integration of ICTs into education.

There seems to be a negative relationship between principals' technology leadership and teachers' self-efficacy beliefs, which, in turn, might have a negative effect on teachers' computer use in the classroom. It is also interesting that the principal as technology leader influences teachers' pedagogical beliefs. Principals,

thus, do have some influence on what happens in the classroom, that is, the way teachers teach. Principals as technology leaders, therefore, are influential in approving or disapproving new ideas, for instance, the use of technology as instructional tools.

The quantitative data further shows that teachers' uptake of computers in the classroom is only indirectly affected by the principal's technology leadership through effect of the teachers' self-efficacy.

This trend in the quantitative data is emphasised by the qualitative data especially on how the educators' uptake of computers in the classroom is only indirectly affected by the principal's technology leadership through teachers' self efficacy. Most educators indicated that the role of the principal is important in their self-efficacy and this is reflected in the scope of the educators' submissions on the question focusing on the influence of the attitude and beliefs of the principal on the pedagogical integration of ICTs in schools. One educator noted that the "principal has a positive attitude and a winning attitude. He believes in improvement." While another educator observed that the "principal is very supportive and encourages the use of ICTs." One educator's view on this matter was that "a positive, helpful attitude will encourage educators to go for training." Another educator noted that "our principal was instrumental in redesigning our outdated computer lab." While one educator contended that "the principal has to be onboard in the use of ICT in lessons. This makes introducing new methods into your teaching process much easier." Another educator outlined that "the principal is very forward thinking and innovative. The advanced IT resources and the condition they are in with constant upgrades, repairs, servicing is as a result of the principal's vision and planning."

This study suggests that if principals embrace the potential of ICTs to enhance the quality of teaching and learning, they can lead their schools to use “emerging technologies as the core resources for educational change” (Chang *et al.*, 2008). According to Gosmire and Grady (2007) principals can lead others to technology success if they ask the right questions about technology, for example, technology trends, research about schools and technology, guidelines, vision, policies and plans, funding, technology integration in the classroom, etc.

It is therefore clear from the quantitative data, qualitative data and literature that principals have the potential to create a conducive environment that can make it easier for educators to be motivated towards the use computers.

5. DISCUSSION

The study has employed qualitative and quantitative research methods to explore the following general research question: To what extent do teachers' beliefs (i.e. their pedagogical beliefs, self-efficacy beliefs and context beliefs) influence their behavioural intention, whether and how, to use computers in the classroom? Based on this general question the study also sought to address the following research questions: (a) Is there a significant relationship between teachers' pedagogical beliefs and their uptake of computers in the classroom? (b) Is there a significant relationship between teachers' self-efficacy beliefs and their integration of technology into teaching and learning? (c) Is there a significant relationship between teachers' computer self-efficacy beliefs and their uptake of technology in the classroom? (d) Is there a significant relationship between teachers' computer anxiety and their uptake of technology in the classroom? and (e) Is there a significant relationship between teachers' perception of the principal's technology leadership and their integration of technology into teaching and learning? The implications of these research questions and the research findings of this study will be contextually discussed in this section.

It is also imperative to note that the major hypothesis of this study is that teachers' behavioural intention regarding the use of ICTs in the classroom is determined by a set of teacher-related variables, which include, their pedagogical beliefs, self-efficacy beliefs and context beliefs. These variables are considered the main contributing factors to the utilisation of technology to its maximum in the classroom situation.

The findings of the study further confirm that teachers' pedagogical integration of ICTs is impacted by a set of teacher-related thinking processes – either directly or indirectly. These teacher thinking processes or teacher beliefs can be perceived either as barriers that impede the uptake of technology into education or as factors that promote technology integration into teaching and learning.

The data of the quantitative survey reveals a series of complex interrelationships between the different variables. The data suggests that teachers' computer use, their self-efficacy beliefs, computer self-efficacy beliefs and computer anxiety are highly interrelated.

The results firstly, confirm the null hypothesis that teachers' self-efficacy beliefs are significantly related to computer use in the classroom. Secondly, it illustrates a direct relationship between teachers' computer self-efficacy beliefs and their use of computers in their classroom practice. Thirdly, it indicates that computer anxiety directly impacts the classroom use of computers. A conclusion that can be drawn from these findings is that if teachers have a high self-efficacy level, high confidence in their capability to use technology (high CSE) and a low level of computer anxiety, they are more inclined to incorporate technology into teaching even if they encounter obstacles. Low self-efficacy and low computer self-efficacy levels, combined with high computer anxiety levels, can affect the adoption of ICTs into teaching and learning negatively, or it can lead to mediocre technology integration into education.

The quantitative data further shows that teachers' pedagogical beliefs is the only variable that directly affect the other predictor variables, i.e. self-efficacy, computer self-efficacy, computer anxiety and principals' technology leadership. Computer use in the

classroom is thus indirectly affected by teachers' pedagogical beliefs and the principal's technology leadership, mediated by teachers' self-efficacy beliefs, computer self-efficacy and computer anxiety. Pestridge (2010) contends that teachers form their own beliefs about the role of technology as an instructional tool, its value for student learning outcomes, and their own personal confidence and competence. These teacher beliefs intersect with teachers' traditional pedagogical beliefs, which consequently, affect how technology is used in the classroom – as an add-on to conventional curriculum practices or as a tool that brings about change in their teaching practice (Pestridge, 2010). Teachers' beliefs in their capacity to work effectively with technology (i.e. their computer self-efficacy beliefs) are a significant factor in determining classroom computer use (Albion, 1999). If teachers, for example, anticipate that they will not be able to reach a desirable result with computers in the classroom, they will be reluctant to undertake a specific action (i.e. utilising computers pedagogically). Teachers who foresee that they will be unsuccessful in their efforts to integrate technology in their teaching practice due to personal and/or contextual constraints, will be less inclined to incorporate technology into teaching and learning. It is thus imperative that teachers believe in their own abilities to effectively and efficiently integrate technology, but only believing will not realise the aim of integrating technology into teaching practices. Training on how to use technology for pedagogical purposes is the other major factor that can boost their competence and confidence levels. Teachers should feel positive about educational technology and believe that it will enhance teaching and student learning. For teachers to change their pedagogical beliefs, they need to be convinced that the pedagogy they adopt will bring out the best in their learners. Efforts to change teachers' pedagogical

beliefs should focus on assisting teachers to develop a better understanding of how student-centred teaching practices (i.e. constructivist teaching), supported by technology, can affect student learning outcomes (Ertmer & Ottenbreit-Leftwich, 2009). The inference is, if teachers observe the usefulness of ICTs and how it can be effectively incorporated into teaching, the more attitudes and beliefs will change, providing students the opportunity to have the optimal learning experience. Students' auditory and visual senses will be stimulated in the learning process.

In order to develop a better understanding of teachers' beliefs about the pedagogical integration of ICTs one has to look at the bigger picture, which means, the system in which these teachers operate. This poses another significant factor that impacts teachers' beliefs. Teachers' attitudes and beliefs towards technology can be explained with reference to the society or environment in which they grew up and the society in which they are living today. Whether we are living in a modern, post-modern or digital society is debatable. Martin (2008) argues that we are living in "a society permeated by the digital, where our actions are frequently mediated by digital tools, and the objects we encounter are frequently shaped by digital intervention". From a sociological viewpoint, we are living in a post-modern society, characterised by pluralism, which refers to the fact that the modern individual faces a plethora of choices about issues like race, gender, politics, sexuality, education, etc. These choices also include the decisions that teachers make regarding the use of ICTs in education. The decisions that teachers make concerning pedagogy and technology integration are influenced by the way teachers define themselves in the digital world. There is a significant shift in the ways that identity is defined and lived out in the modern world and

digital technology plays a vital role in bringing about this shift in identity construction (Buckingham, 2008). Buckingham (2008) further elaborates on the effects of technology in contemporary society by writing the following:

> *It has produced new styles of playful learning, which go beyond the teacher-dominated, authoritarian approach of old style education. It is creating new competencies or forms of 'literacy', which require and produce new intellectual powers, and even 'more complex brain structures'. It provides new ways of forming identity, and hence new forms of personhood; and by offering communication with different aspects of the self, it enables young people to relate to the world and to others in more powerful ways.*

Because of the effect that technology has on identity construction of youths, it is suggested that teachers should alter their teaching style in order to accommodate their digital native learners. Prensky (2001a) uses a native/immigrant analogy to explain why teachers and their students interact differently with technology in the classroom. Teachers are digital immigrants due to the fact that they are not born into the digital world but have to adapt to the technology-mediated environment and they speak the digital language with an "accent", that is their foot in the past (Prensky, 2001a). Like immigrants struggle with a strange culture and language, so do digital immigrants struggle to fit into the digital culture and speaking the digital language. The accent of the digital immigrants refers to their behaviour that differentiates them from digital natives, e.g. printing out e-mails to read it and printing documents in order to edit them instead of editing it on the computer.

Toledo (2007) sees the “accent” as the level of comfort with technology and postulates, “The more comfortable a user is with technology use, the more daring he or she is to try new technologies, the less accent is evident; he or she seems to be able to manipulate the digital language”. Toledo (2007) puts forward the idea of a varied accent thickness, which means, digital immigrants’ accents vary with the level of their technology comfort. This implies that teachers have varied levels of technology experience and expertise. The current study supports this argument and suggests that teacher development programmes should be designed in such a manner that it caters for teachers at different levels of digital literacy.

In designing appropriate learning experiences teachers need to recognise that their modern students (‘digital natives”) learn and think differently from their predecessors due to a different brain structure. Because of the fact that they are born into a digital world, their brains are organised differently due to the digital input they received throughout their lives. “They develop hypertext minds” (Prensky, 2001b). Prensky (2001b) advocates that learning through digital games [tools] is one good way to reach the digital natives in their native language. This statement has implications for education today. Gibson, *et al*. (2001) suggest that digital natives and digital immigrants will have to recognise the differences that exist as a result of the impact that technology has on education, and that they should come together and “create new best practices and ideas in education”. The teacher is not a guru at all the new digital technologies but he/she should be aware of the technologies and be able to identify pedagogically sound application of these new technologies in education. Since the teacher is not a master at technology some cooperative learning is suggested, which

entails the student helping the teacher with technology while the teacher guides the student to appropriately apply these technologies in their learning situation.

Digital immigrant teachers and their digital native students are also approaching learning in the digital environment differently and have their respective beliefs and expectations of what should happen in the classroom. The different behaviours of teachers and learners towards teaching and learning are summarised in the following table:

DIGITAL IMMIGRANTS	DIGITAL NATIVES
Prefer slow and controlled release of information from limited sources.	Prefer receiving information quickly from multiple multimedia sources.
Prefer singular processing and single or limited tasking.	Prefer parallels processing and multitasking.
Prefer to provide text before pictures, sounds, and video.	Prefer processing pictures, sounds, and video before text.
Prefer to provide information linearly, logically, and sequentially.	Prefer random access to hyperlinked multimedia information.
Prefer students to work independently rather than network and interact.	Prefer to interact/network simultaneously with many others.
Prefer to teach “just-in-case” (it’s on the exam).	Prefer to learn “just-in-time”.

Prefer to teach to the curriculum guide and standardized tests.	Prefer learning that is relevant, instantly useful, and fun.
Prefer deferred gratification and deferred rewards.	Prefer instant gratification and instant rewards.

(Toledo, 2007)

The qualitative investigation was conducted to determine teachers' perceptions about: the impact of ICT on teaching and learning; ICT training; barriers to the pedagogical integration of ICTs as well as the role of their principal as technology leader. The qualitative study illuminates the results of the quantitative study. On the questions about the impact of ICT on teaching and learning, teachers' responses indicated that they make extensive use of the internet to find resources for lesson planning but some of them do not make optimal use of technology to improve lesson planning and to collaborate with colleagues. The results also show that they make use of audio and visual materials to improve their in-class teaching. A high percentage of the participating teachers indicated that ICT makes teaching more interactive, while a smaller percentage believes that ICT has no impact on their teaching.

Participants were further asked what factors they think contribute to the lack of ICT integration at their institution. The responses of the participants report that the lack of technology equipment (including software, hardware and internet connection) and ICT training are major hindering factors. The results of the qualitative study reveal that a higher percentage of the teachers experience first-order barriers (lack of equipment,

lack of internet connection and lack of ICT training) than second-order barriers (teachers' set of different beliefs).

Only a minority of the respondents indicated that they are afraid to use new technology in the classroom, which corroborates the findings of the quantitative study which suggest that the majority of the participants experience low levels of computer anxiety. The quantitative study confirms that factors intrinsic to teachers (e.g. their beliefs) do impact their computer use – positively or negatively. However, it does not confirm that these intrinsic factors are experienced as barriers to ICT integration. In light of these responses, one can conclude that first-order barriers still need to be resolved before ICTs can be successfully integrated into teaching and learning in South African schools. Ertmer *et al*. (1999) recommend that first- and second-order barriers should be addressed simultaneously, because different types of barriers may be more or less critical at different levels of use.

It is possible that the availability of technology in schools affect teachers' decisions on how to use ICTs in the teaching process. The data has shown that the group of teachers who utilise technology for pedagogical purposes in some way do have access to the necessary technological tools in the classroom, e.g. interactive whiteboards and computers. They also received some ICT training, such as, training in interactive whiteboards. These are the teachers who spend the most hours (between 5 and 49 hours per week) on computers for academic purposes and are more innovative with technology in the classroom. In a meta-analysis of relevant literature regarding perceived barriers to technology adoption into science education, Bingimlas (2009) also reported lack of access to technology as a major barrier to ICT integration. Bingimlas

(2009) further found that there is a complex relationship between lack of accessibility to technology, lack of confidence, and lack of competence.

Furthermore, lack of accessibility to technology is also found to be closely related to other barriers, which include, lack of time, lack of pedagogical and ICT training and lack of technical support. It is also reported that lack of competence is directly linked to the lack of effective training to pedagogically integrate technology into teaching (Bingimlas, 2009). Teachers' competence is also linked to their confidence in using technology in the classroom. If teachers are not effectively trained to pedagogically integrate ICTs, it is most likely that they will experience a lack of competence in utilising these technologies in their teaching practice, which, in turn, can lead to lack of confidence to use ICTs in the classroom. These findings corroborate the results of the current study that suggest a direct relationship between teachers' efficacy beliefs and their computer utilisation in the classroom. Teachers' lack of technological competence is listed as one of the main barriers to the adoption and effective utilisation of technology in education (Pelgrum, 2001), which imply that ICT training for teachers is imperative in order to facilitate technology integration.

The participating teachers stated in the survey that training programmes at their institutions were only once-off or they received training at other institutions, hence the mediocre employment of technology in some classrooms, especially the teachers at the school that has only one computer laboratory. The importance of ICT training is recognised by several researchers. Baylor and Richie (in press) state that, despite "the amount of technology or its sophistication, technology will not be used unless faculty members [teachers] have the skills, knowledge, and attitudes necessary to infuse it into

the curriculum". ICT training, according to Jung (2005), take many forms, for instance, training on how to use ICT and training via ICT. ICT training efforts in different countries can also be divided into four categories, namely: ICT as main content focus; ICT as core delivery technology; ICT as part of content/methods; and ICT as facilitating or networking technology (Jung, 2005). The best way to develop teachers' ICT skills and promote the pedagogical integration of ICTs is to provide ICT-based training environments where they have on-demand access to materials, peers, and networks of experts (Jung, 2005). Virtual learning environments like Blackboard and professional social networking websites (e.g. LinkedIn) are excellent platforms to facilitate networking and continuous professional development of teachers. Teachers can engage in discussions and share ideas and advice with colleagues and other experts worldwide. Furthermore, principals are regarded as key role players in providing teachers opportunities to develop and enhance their ICT skills in order to accelerate the adoption of ICTs into the classroom practice.

This study has proven that teachers' integration of ICTs into their teaching practice is significantly impacted by intrinsic factors, but there are some extrinsic or contextual factors that also need to be investigated. Ertmer & Ottenbreit-Leftwich (2009) state that teacher beliefs are heavily influenced by contextual factors, such as, the subject, the school culture and the [school principal]. The results of the present study corroborate the notion that the principal as technology leader influences teachers' beliefs, although it does not directly affect teachers' computer use. Teachers' pedagogical beliefs and their self-efficacy beliefs are significantly affected by the technology leadership of the principal.

The study further indicates that teachers' self-efficacy beliefs are directly and indirectly impacted by the principal's technology leadership. Principals' technology leadership affects teachers' pedagogical beliefs, which, in turn, affects their self-efficacy. From the quantitative data it seems that teachers' self-efficacy beliefs are negatively impacted by the principal's technology leadership but the qualitative data reflects a different picture. This might be an indication that the principal at one of the institution does not articulate a clear vision for technology use in the school; does not encourage and support technology training for teachers; does not ensure the provision of appropriate technology and infrastructure support; and does not maintain positive relationships with staff and learners with regards to technology, it has a negative effect on teachers' self-efficacy and, in turn, on their integration of technology into teaching and learning. Bandura (1999) claims that supportive relationships can improve personal efficacy in several ways. "Enabling supporters", according to Bandura (1999), "can model effective coping attitudes and strategies for managing problem situations, demonstrate the value of perseverance, and provide positive incentives and resources for efficacious coping". The principal of an institution can raise the staff's self-efficacy levels by being supportive.

Although principals' technology leadership is not found to be significantly related to ICT use in the classroom, it is vital to sustainable technology integration. The principal as technology leader plays a crucial role in encouraging in-service technology training, supporting these staff development programmes and ensuring technology support to school personnel when assistance is needed. Participating teachers reported that their principals' attitudes and beliefs have a positive influence on the

pedagogical integration of ICTs at their institutions. They perceive their principal as a leader who clearly expresses a shared vision for technology integration in education. For principals to become effective and competent technology leaders, they also need training and support.

In relation to the research questions of this study, the research findings show that teachers' computer use, their self-efficacy beliefs, computer self-efficacy beliefs and computer anxiety are indeed highly interrelated.

6. CONCLUSION

This study contributes to the development of a better understanding of teachers' thinking processes regarding the pedagogical integration of ICTs. Based on the findings of this study and a review of the related literature, the crux of the matter seems to be the lack of continuous and sustainable ICT training programmes, which not only focus on the provision of ICT knowledge and skills but also on training how to use technology as a pedagogical tool. The results further imply that digital literate teachers will have a strong sense of self-efficacy and computer self-efficacy, and will experience a low level of computer anxiety, which in turn, will lead to innovative uses of technology as an instructional tool.

The findings of this study have implications for educational leaders on national, provincial and school level, in terms of professional development of teachers and ICT policy development. ICT training for current and prospective teachers is still a matter of great concern in South Africa. Despite the efforts initiated by government, that is, the SCOPE project, the Khanya project, the INTEL "Teach to the Future" Teacher Development Programme, and the Gauteng Online project, it seems that there is a need for an ongoing training programme for in-service teachers.

The provision of ICT training and support from national, provincial and school-based authorities can positively impact teachers' competence and confidence to effectively and efficiently use computers in the classroom. The ideal method to develop teachers' self-efficacy for computer use, according to Albion (1999), is the provision of training and support to teachers to successfully incorporate ICTs in the classroom. A shift from learning how to use technology (that is, providing computer skills) to using

technology to teach and learn is essential in order to ensure smooth infusion of ICT into the classroom. Teacher educators and ICT facilitators should use technology in their teaching practice providing student teachers and in-service teachers the opportunity to observe how technology can be effectively employed to enhance teaching and learning. When designing teacher ICT development programmes, they should bear in mind that all teachers are not at the same level of digital literacy.

A first step should be to assess teachers individually in order to gauge their digital literacy level. Once that is established, appropriate development programmes can be designed for teachers' individual computer literacy needs. In the rapid and continual changing digital society, teachers are required to use a variety of technical, cognitive, and sociological skills in order to perform tasks and solve problems in the digital environment (Eshet-Alkalai, 2004). Teachers, thus, need to be digitally literate. Gilster (cited in Fieldhouse and Nicholas, 2008) identifies the following four core competencies for digital literacy: knowledge assembly; internet searching; hypertextual navigation; and content evaluation.

The responses in the qualitative survey reveal that a high percentage of the participating teachers do embrace technology in education and thus, recognise the value of ICTs in improving teaching and learning. These teachers can therefore be regarded as enthusiastic advocates of the pedagogical integration of ICTs, who emphatically employ technology in the classroom in order to improve student learning and teaching efficiency, despite the lack of continuous ICT training and support. They have strong self-efficacy beliefs, strong computer self-efficacy beliefs and low computer anxiety.

In conclusion, teachers with a strong sense of self-efficacy, high computer self-efficacy beliefs, low computer anxiety, and principals with a positive attitude towards technology integration are vital ingredients in an infallible recipe for the successful incorporation of ICTs into education.

6.1 Limitations

There are some limitations that need to be emphasised. Due to time constraints, lack of resources and teachers' and principals' unwillingness to participate, the current study was conducted at only two schools in the Southern Suburbs of Cape Town. The ideal would have been to test a representative sample of the population and to conduct the present study in an ICT-rich environment but within the South African school setup it is almost impossible to find such schools since ICT integration in our schools is still at its infancy. Providing schools with the necessary technological tools to make successful ICT integration possible, is still a challenge for our government. Only one of the participating schools has computers and interactive whiteboards in their classrooms, while the other school only has one computer laboratory.

The participants in this study are only 23 teachers from the two ex-model C schools. Despite the small sample it was possible to conduct a correlational analysis but it does affect the generisability of the results. These schools are not representative of the different types of schools in South Africa, which include private schools, ex-model C schools and previously disadvantaged schools. A comparative study of the different types of schools would have been ideal but due to the reluctance of principals and teachers at the identified schools, it was impossible. Numerous attempts were made to encourage teachers to participate in the study. Teachers who reported that they use

technology in the classroom for pedagogical purposes were not observed. The results of this study are entirely based on teachers' responses to the different questionnaires. Since teachers were asked to voluntarily participate in the study, it was mostly teachers who utilise ICTs in the classroom who volunteered to participate. This limitation made it impossible to identify teachers' reasons for not integrating ICTs. The above mentioned factors limit the generalisability of the present study and the validity of the results. This study, nevertheless, can serve as a pilot for a larger study. A further longitudinal study can also be conducted to investigate how teachers' beliefs about the pedagogical integration of ICT change over time and how it impacts ICT use in South African schools.

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APPENDICES

APPENDIX A: STATISTICAL TABLES

Table 1: Descriptive statistics on non-standardised questions

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Q20a	23	2	5	4.13	.815	.664
Q20b	23	4	5	4.57	.507	.257
Q20c	23	2	5	3.78	.850	.723
Q20d	23	2	5	4.00	.739	.545
Q20e	23	4	5	4.48	.511	.261
Q20f	23	3	5	4.22	.518	.269
Q20g	23	3	5	4.26	.619	.383
Q20h	23	4	5	4.43	.507	.257
Q20i	23	1	5	3.87	1.014	1.028
Q20j	23	1	5	4.26	.864	.747
Q20k	23	4	5	4.22	.422	.178
Q20l	23	4	5	4.48	.511	.261
Q21a	23	3	5	4.26	.619	.383
Q21b	23	4	5	4.30	.470	.221
Q21c	23	3	5	4.17	.491	.241
Q21d	23	3	5	3.96	.767	.589
Q21e	23	2	5	4.13	.694	.482
Q21f	23	2	5	3.83	.834	.696
Q21g	23	2	5	4.17	.717	.514
Q21h	23	2	5	4.30	.822	.676
Q21i	23	3	5	4.22	.736	.542
Q21j	23	3	5	4.13	.694	.482
Q21k	23	3	5	4.09	.668	.447
Q21l	23	3	5	4.22	.600	.360
Q21m	23	2	5	3.87	.757	.573
Q21n	23	3	5	4.35	.573	.328
Q21o	23	1	5	3.83	.887	.787
Q21p	23	3	5	4.04	.638	.407
Q21q	23	3	5	4.04	.638	.407
Q21r	23	3	5	3.74	.689	.474
Q21s	23	3	5	3.91	.668	.447

Q21t	23	2	5	3.78	.671	.451
Q22a	23	3	5	4.43	.662	.439
Q22b	23	2	5	3.91	.949	.901
Q22c	23	2	5	4.04	.928	.862
Q22d	23	2	5	4.39	.783	.613
Q22e	23	3	5	4.52	.593	.352
Q22f	23	3	5	3.91	.793	.628
Q22g	23	2	5	3.96	.878	.771
Q22h	23	2	5	4.09	.900	.810
Q22i	23	1	5	3.96	1.107	1.225
Q22j	23	3	5	4.39	.656	.431
Q22k	23	2	5	4.39	.783	.613
Q22l	23	2	5	4.30	.822	.676
Q22m	23	2	5	4.39	.783	.613
Q22n	23	3	5	4.48	.593	.352
Q22o	23	4	5	4.65	.487	.237
Q22p	23	3	5	4.61	.583	.340
Q22q	23	2	5	4.00	.798	.636
Q22r	23	3	5	4.17	.717	.514
Q22s	23	2	5	4.48	.730	.534
Q22t	23	1	5	4.39	.891	.794
Q22u	23	2	5	4.30	.765	.585
Q22v	23	2	5	3.83	.937	.877
Q22w	23	2	5	3.87	.869	.755
Q22x	23	1	5	4.04	.976	.953
Q23a	23	1	4	2.04	.928	.862
Q23b	23	2	5	4.04	.825	.680
Q23c	22	4	5	4.41	.503	.253
Q23d	22	3	5	4.18	.733	.537
Q23e	22	4	5	4.59	.503	.253
Q23f	22	1	5	2.05	1.046	1.093
Q23g	22	3	5	4.36	.581	.338
Q23h	22	1	5	3.05	1.397	1.950
Q23i	22	1	5	2.59	1.333	1.777
Q23j	22	1	5	2.09	1.377	1.896
Q23k	22	3	5	4.45	.596	.355
Q23l	22	1	5	1.91	1.269	1.610
Q24a	23	2	5	3.70	1.146	1.312
Q24b	23	1	5	3.52	1.201	1.443

Q24c	22	2	5	4.09	.811	.658
Q24d	22	1	5	3.14	1.356	1.838
Q24e	23	2	5	3.57	.945	.893
Q24f	22	1	5	3.59	1.221	1.491
Q24g	23	1	5	3.61	1.118	1.249
Q24h	23	1	5	3.26	1.096	1.202
Q24i	23	1	5	3.00	1.243	1.545
Q24j	23	1	5	2.39	1.270	1.613
Q24k	23	1	5	3.57	1.376	1.893
Q24l	23	1	5	3.61	1.158	1.340
Q24m	23	1	5	4.30	.974	.949
Q24n	23	1	5	4.13	.968	.937
Q24o	23	2	5	4.35	.775	.601
Q24p	23	1	5	3.00	1.128	1.273
Q25a	23	1	5	3.87	1.325	1.755
Q25b	23	1	5	3.52	1.163	1.352
Q25c	23	1	5	3.83	1.230	1.514
Q25d	23	1	5	3.61	1.158	1.340
Q25e	22	1	5	4.05	1.174	1.379
Q26a	23	1	5	3.96	1.261	1.589
Q26b	23	1	5	3.78	1.204	1.451
Q26c	23	1	5	3.70	1.146	1.312
Q26d	23	1	5	3.30	1.020	1.040
Q27a	23	1	5	3.70	1.222	1.494
Q27b	23	1	5	3.57	1.273	1.621
Q27c	23	1	5	3.61	1.270	1.613
Q27d	23	1	5	3.57	1.161	1.348
Q28a	23	1	5	3.78	1.166	1.360
Q28b	23	1	5	3.74	1.176	1.383
Q28c	23	1	5	3.65	1.265	1.601
Q28d	23	1	5	3.78	1.204	1.451
Valid N (listwise)	21					

Table2.1: T-test to test for mean differences between School Z and School B

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Q20 PB	Equal Var	.144	.708	.064	21	.950	.01427	.22455	-.45271	.48126
	Non-Equal Var			.064	20.745	.950	.01427	.22475	-.45348	.48203
Q21 SE	Equal Var	2.089	.163	-.366	21	.718	-.10580	.28933	-.70749	.49590
	Non-Equal Var			-.371	19.827	.714	-.10580	.28502	-.70067	.48907
Q22 CSE	Equal Var	.494	.490	-.670	21	.510	-.21701	.32402	-.89085	.45683
	Non-Equal Var			-.658	17.362	.519	-.21701	.32958	-.91126	.47723
Q23 CA	Equal Var	2.844	.107	-.279	21	.783	-.05771	.20661	-.48737	.37195
	Non-Equal Var			-.286	17.301	.778	-.05771	.20158	-.48245	.36703
Q24 CU	Equal Var	1.286	.270	2.092	21	.049	.49193	.23518	.00285	.98100
	Non-Equal Var			2.117	20.350	.047	.49193	.23233	.00782	.97603
Q25_28 PTL	Equal Var	4.025	.058	1.807	21	.085	.65559	.36289	-.09908	1.41026
	Non-Equal Var			1.850	17.485	.081	.65559	.35428	-.09030	1.40148

Table 2.2: T-test to test for mean differences between Males and Females

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q20 PB	Equal Var	.146	.706	1.027	21	.316	.24440	.23790	-.25034	.73913
	Non-Equal Var			1.068	12.626	.305	.24440	.22877	-.25133	.74012
Q21 SE	Equal Var	.886	.357	-.415	21	.683	-.13010	.31382	-.78272	.52253
	Non-Equal Var			-.359	8.656	.728	-.13010	.36257	-.95529	.69509
Q22 CSE	Equal Var	2.754	.112	1.206	21	.241	.41460	.34380	-.30036	1.12957
	Non-Equal Var			.963	7.647	.365	.41460	.43045	-.58605	1.41526
Q23 CA	Equal Var	.543	.469	.472	21	.642	.10550	.22353	-.35935	.57036
	Non-Equal Var			.526	15.060	.606	.10550	.20038	-.32146	.53246
Q24 CU	Equal Var	.022	.884	-.313	21	.758	-.08755	.28000	-.66984	.49474
	Non-Equal Var			-.299	10.453	.771	-.08755	.29271	-.73593	.56083
Q25_28 PTL	Equal Var	1.779	.197	.690	21	.498	.28883	.41875	-.58201	1.15967
	Non-Equal Var			.595	8.604	.567	.28883	.48555	-.81732	1.39498

Table 3: Internal consistency measured with Cronbach's alpha

Scale	Chronbach's alpha	Number of items
PB	0.762	12
SE	0.939	20
CSE	0.969	24
CA	0.718	10
CU	0.880	24
PTL	0.988	17

Table 4: Correlation coefficients for pairs of variables

Correlations						
Statistics=Pearson Correlation						
	Q24CU	Q21SE	Q22CSE	Q23CA	Q20PB	Q25_28PTL
Q24CU	1	.424*	.461*	.467*	.186	.013
Q21SE	.424*	1	.115	.558**	.302	-.135
Q22CSE	.461*	.115	1	.082	.128	-.071
Q23CA	.467*	.558**	.082	1	.258	-.022
Q20PB	.186	.302	.128	.258	1	.309
Q25_28PTL	.013	-.135	-.071	-.022	.309	1
*. Correlation is significant at the 0.05 level (2-tailed).						
**. Correlation is significant at the 0.01 level (2-tailed).						

Table 5: PB Group

		Frequency	Percentage	Cumulative Percentage
Valid	Behaviourist	8	34.8	34.8
	Cognitivist	6	26.1	60.9
	None	9	39.1	100.0
	Total	23	100.0	

Table 6: SE

		Frequency	Percent	Cumulative Percent
Valid	3.35	1	4.3	4.3
	3.50	1	4.3	8.7
	3.55	1	4.3	13.0
	3.60	2	8.7	21.7
	3.70	1	4.3	26.1
	3.80	2	8.7	34.8
	3.85	1	4.3	39.1
	4.00	3	13.0	52.2
	4.05	2	8.7	60.9
	4.20	3	13.0	73.9
	4.25	1	4.3	78.3
	4.45	1	4.3	82.6
	4.70	2	8.7	91.3
	5.00	2	8.7	100.0
	Total	23	100.0	

Table 7: CSE

		Frequency	Percent	Cumulative Percent
Valid	2.46	1	4.3	4.3
	3.54	1	4.3	8.7
	3.63	1	4.3	13.0
	3.71	1	4.3	17.4
	3.83	2	8.7	26.1
	3.88	1	4.3	30.4
	4.00	2	8.7	39.1
	4.04	1	4.3	43.5
	4.08	1	4.3	47.8
	4.13	1	4.3	52.2
	4.33	1	4.3	56.5
	4.63	1	4.3	60.9
	4.67	1	4.3	65.2
	4.71	2	8.7	73.9
	4.75	1	4.3	78.3
	4.79	1	4.3	82.6
	4.83	1	4.3	87.0
	4.88	1	4.3	91.3
	4.92	1	4.3	95.7
	4.96	1	4.3	100.0
	Total	23	100.0	

Table 9: CAGroup

		Frequency	Percent	Cumulative Percent
Valid	Negative	1	4.3	4.3
	Positive	22	95.7	100.0
	Total	23	100.0	

APPENDIX B: QUALITATIVE QUESTIONNAIRE

EDUCATOR QUESTIONNAIRE

FOR EDUCATORS AT ALL LEVELS

This project aims to better understand educators' beliefs about the pedagogical integration of ICTs and their perception of the role of their principals in the integration of ICTs.

1. Name of institution

_____

2. Are you?

Female _____Male _____

3. Do you have access to a computer in your institution?

Yes _____No _____

4. Do you have a personal email address?

Yes _____ No _____

5. How many hours per week do you use ICT for academic purposes?

_____

6. Describe any impact that ICT has had on your lesson planning (how you prepare for classes).

7. Describe any impact ICT has had on your in-class teaching (what you teach, how you teach it, etc.)

8. Describe any impact that ICT has had on communication between yourself as an educator and your learners (do you encourage questions asked via email, submission of assignments via email, etc.)

9. Do you think ICT helps you reflect on your teaching? (what you teach, how you teach) – if so, explain briefly examples.

10.Explain briefly how ICT may have improved your own access to knowledge (information) as an educator.

11. Explain briefly how ICT has helped you in producing teaching material.

12. List the various ICT skills/competencies that you consider you have mastered.

13. Indicate whether you have been benefited from any incentive programmes related to the integration of ICT in your teaching – either from institution or from the government (please describe in detail these incentive programmes)

14. How has this training been useful to you (or not) in the integration of ICT in teaching.

15. In your opinion (as an educator), what are the major barriers hindering the pedagogical integration of ICTs in your institution?

16. Describe how the attitude and beliefs of the principal influence the pedagogical integration of ICTs in your institution.

17. Describe how you (as educator) can integrate ICTs in teaching and learning at your institution.

ADAPTED (Panafrican Research Agenda on the pedagogical integration of ICT, 2006)

APPENDIX C: QUANTITATIVE QUESTIONNAIRES

PRINCIPAL'S TECHNOLOGY LEADERSHIP

FOR EDUCATORS AT ALL LEVELS

This project aims to better understand educators' beliefs about the pedagogical integration of ICTs and their perception of the role of their principals in the integration of ICTs.

PLEASE INDICATE HOW YOU PERCEIVE THE PRINCIPAL'S ROLE AS TECHNOLOGY LEADER.

DIMENSIONS	1	2	3	4	5
VISION, PLANNING AND MANAGEMENT					
1. Clearly articulates a shared vision for technology use in the school.					
2. Empowers a diverse and inclusive technology planning team.					
3. Advocates for school technology resources.					
4. Manages technology change effectively.					
5. Uses technology to efficiently manage administrative operations.					
STAFF DEVELOPMENT AND TRAINING					

1. Encourages technology in-service training.					
2. Supports technology in-service training program design.					
3. Supports technology in-service training delivery.					
4. Provides technology training release time.					
TECHNOLOGY AND INFRASTRUCTURE SUPPORT					
1. Ensures appropriate technology facilities.					
2. Ensures equal access to technology resources.					
3. Ensures technology support to school personnel when assistance is needed.					
4. Ensures equipment timely repair and maintenance.					
INTERPERSONAL AND COMMUNICATION SKILLS					
1. Demonstrates an understanding of technology needs and concerns staff and learners.					
2. Maintain positive relationships with staff and learners in regard to technology.					
3. Communicates effectively with staff and learners about					

technology.					
4. Encourages staff to utilise information sources about technology for professional development.					

ADAPTED (Chang *et al*., 2008)

Computer Self-efficacy Scale

I feel confident:	Strongly Disagree 1	Disagree 2	Unsure 3	Agree 4	Strongly Agree 5
Working on a personal computer					
Getting software up and running					
Using the users' guide when help is needed					
Entering and saving data (numbers and words) into a file					
Calling up a data file to view on the computer screen					
Understanding terms/words relating to computer hardware					
Understanding terms/words relating to computer software					
Learning to use a variety of programmes (software)					
Learning advanced skills within a specific programme (software)					
Making selections from an onscreen menu					
Using a printer to make "hardcopy" of my work					
Copying a disc					
Copying an individual file					
Adding and deleting information from a data file					
Moving the cursor around the monitor screen					

Using the computer to write a letter or essay					
Describing the function of computer hardware (e.g. keyboard, monitor, disc drives, computer processing unit)					
Getting help for problems in the computer system					
Using the computer to organize information					
Getting rid of files when they are no longer needed					
Organizing and managing files					
Troubleshooting computer problems					
Explaining to students how to use the computer.					
Employing the computer to present lessons.					

Computer Anxiety Scale

	Strongly Disagree 1	Disagree 2	Unsure 3	Agree 4	Strongly Agree 5
I do not think I will be able to learn a computer programming language.					
The challenge of learning about computers is exciting.					
I am confident that I can learn computer skills.					
Anyone can learn to use a computer.					
Learning to operate computers is like learning any new skill, the more you practice, the better you become.					
I am afraid if I begin to use computers more, I will become more dependent upon them and lose some of my reasoning skills.					
I am sure that with time and practice I will be as comfortable working with computers as I am in working by hand.					
I have difficulty in understanding the technical aspects of computers.					
It scares me to think that I could cause the computer to destroy a large amount of information by hitting the wrong key.					
I hesitate to use a computer for fear of making mistakes that I cannot correct.					

I feel computers are necessary tools in both educational and work settings.					
I have avoided computers because they are unfamiliar and somewhat intimidating to me.					

Teacher Self-efficacy Belief Scale

	Strongly Disagree 1	Disagree 2	Unsure 3	Agree 4	Strongly Agree 5
I can organize learning activities effectively.					
I can organize learning materials concerned with learning objectives appropriately.					
I can organize learning activities taking into account my learners' characteristics.					
I can operate learning activities by taking into account the social factors affecting my learners in order to prevent undesired behaviours.					
I can ensure my learners to trust me by expressing my ideas and behaviours clearly.					
I can decide on the most effective way to teach a subject.					
I can give appropriate clues when my students are struggling with their learning.					
I can direct my learners to reinforce their learning.					
I can communicate with my learners effectively in order to understand each other in the learning process.					
I can collaborate with my colleagues during the learning-teaching process.					

I can motivate my learners who are not interested in their work.					
I can be a good role model to my learners both inside and outside of the classroom.					
I can improve the achievements of my learners who do not get adequate support from their families.					
I can work hard to get the physical environment ideal for learning.					
I can give appropriate reinforcement to improve the desired behavior of my students.					
I can orientate my learners to use alternative learning strategies to reach their learning objectives.					
I behave calmly and patiently when I come across a problem in the classroom.					
I can train individuals to offer creative solutions by investigating the problems from alternative viewpoints.					

Computer Use Scale

	Strongly Disagree 1	Disagree 2	Unsure 3	Agree 4	Strongly Agree 5
I use the computer as a tool for demonstration working with existing presentations, or those someone else has made for me.					
I use the computer as a tool to teach new subject knowledge, i.e. the learners acquire knowledge directly from the computer.					
I encourage learners in class to search information on the internet.					
I use educational software with my learners for learning subject knowledge through drill and practice.					
I teach learners to consider the implications and opportunities of computer use.					
I use the computer as a tool for demonstration working with presentations I have made myself (e.g. PowerPoint).					
I ask learners to undertake tasks or follow up class work at home on the computer.					
I use the computer to assist with differentiation or implementing individual learning plans.					
I encourage learners to work collaboratively when using a					

computer.					
I use e-mail to communicate with learners out of school (or class time).					
I use e-mails to communicate with parents.					
I give learners opportunity to type assignments on computers.					
I use a computer to conduct my own research.					
I use computers to design rubrics to assess learners' work.					
I use a computer to design learning material and learning activities.					
I give learners opportunity to access CD-ROMS.					

Pedagogical Beliefs Scale

	Strongly Disagree 1	Disagree 2	Unsure 3	Agree 4	Strongly Agree 5
Learners need praise, good grades, or other rewards in order to learn effectively.					
The best learning occurs when learners discover answers for questions and problems themselves rather than having the answers told to them.					
Learning has occurred when there is a measurable change in student behavior.					
True learning requires the active creation of knowledge structures (schemes or concept systems).					
Learning occurs best when the overall task is broken down into a sequence of short, easily-accomplished steps.					
It is important to help learners organize their thinking by teaching them general concepts (or schemes) before they learn more specific information.					
Learners learn best when they have the opportunity to observe a demonstration or example of what is being taught.					
Meaningful learning occurs when learners mentally create knowledge structures by combining new ideas with their prior knowledge (existing					

schemes or concepts).					
Learning objectives or outcomes should be identified and stated before the teaching process begins.					
Learners learn best when they are actively involved in solving problems or completing tasks that lead to the creation of knowledge structures.					
Learning requires the mental processing of information, in other words, the acquisition, organization, and storage of knowledge.					
Practicing the skills being taught is essential for effective learning.					

CONSENT FORM FOR RESEARCH PARTICIPANTS

Dear Sir/Madam

My name is Zelna Cloete, a student at the University of the Witwatersrand. I hereby wish to invite you to participate in my Masters in Education Research Project on the pedagogical integration of Information and Communication Technologies (ICTs). This project aims to better understand educators' beliefs about the pedagogical integration of ICTs and their perceptions about the role of management in the integration of ICTs in their schools.

For the needs of this project, questionnaires will be completed by participants. At any time, you can decide not to fill out the questionnaires. In addition, be assured that efforts will be made to retain the confidentiality of the study. No names or personal information will be divulged. All data will be confidential.

This agreement form aims to give you a general idea of the nature of the research. Please do not hesitate to ask for more details by communicating directly with the researcher.

Please sign this form and return to the person who gave it to you, if you have decided to participate in this research project. Your signature attests that you have understood the above information concerning your participation in the research project and indicates that you agree to participate, knowing that you can revoke your consent at any time. Please do not hesitate to ask for clarification or new information during the project.

Thank you for your participation.

Signatures

_____		
Name of School		
_____	_____	_____
Name of participant	**Signature**	**Date**
Zelna Janet Cloete	_____	_____
Name of researcher	**Signature**	**Date**