

Exploring the relationship between the leadership role of the school principal and ICT integration in instruction and learning

by

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University of Pretoria

Declaration

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I declare that the dissertation, which I hereby submit for the degree Magister Educationis (General) in the Department of Science, Mathematics and Technology Education at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

.....

Signature of student

.....

Signature of supervisor

Ethical Clearance Certificate

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The author, whose name appears on the title page of this dissertation, has obtained, for the research described in this work the applicable research ethics approval. The author declares that she has observed the ethical standards required in terms of the University of Pretoria's *Code of ethics for researchers and the Policy guidelines for responsible research*.

Abstract

Title of thesis	Exploring the relationship between the leadership role of the school principal and ICT integration in instruction and learning
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Supervisor	Prof. Dr J.G. Knoetze
Department	Department of Science, Mathematics and Technology Education
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An education system plays a crucial role in empowering its school principals, teachers and learners to communicate information through the integration of ICT (Information Communications Technology) in instruction and learning at school level. The role and vision of the school principal are determining factors in the way in which ICT is implemented by the teachers and learners in a school.

The focus of this research study is twofold: firstly, to examine the priorities of school principals in the attainment of leadership competencies as a means to enhance ICT integration, and secondly, to examine the obstacles hindering the school's capacity to realise its' pedagogical goals through the integration of ICT in instruction and learning.

The human factors "vision" and "expertise", the two components of the adapted Four-in-Balance-Model of the Kennisnet Foundation 2011, have been used as conceptual framework for this study. This model guided the exploration of the leadership role of the South African school principal as ICT is integrated in instruction and learning in the participating South African secondary schools.

This study is a secondary data analysis that explores the previously gathered data from the South African principals' questionnaire of the SITES 2006 project. The SPSS V22 software package was used to analyse the data descriptively as well as inferentially. For the purpose of descriptive analysis, the Pearson Chi-Square and Fisher's Exact Tests of significance was utilised, while Kendall's Tau B/C or Cramer's V was used to calculate the strength of the relationships between the applicable dependent and independent variables.

The findings of this explorative study show that certain personal characteristics do have an influence on the way in which South African school principals view and experience their role as leaders in cross-curricular ICT integration. Furthermore, significant as well as strong relationships have been found between several variables, underlining the importance of the principal as innovative leader in cross-curricular ICT integration.

Key words:

Cross-curricular

Empowerment

ICT integration

Innovative leadership

Interrelated factors

Principal role

Principal vision

School leadership

Sites 2006

Transformation

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List of Acronyms

DALRO	Dramatic Artistic and Literary Rights Organization
DOE	Department of Education
ICT	Information Communications Technology
IEA	International Association for the Evaluation of Educational Achievement
NRCs	National Research Coordinators
ODC	Online Data Collection
OECD	Organization for Economic Cooperation and Development
PIRLS	Progress in International Reading Literacy Studies
SITES	Second International Technology in Education Study
SITES M1	Second International Technology in Education Study Module 1
SITES M2	Second International Technology in Education Study Module 2
SPSS	Statistical Package for Social Sciences
SPSS V22	Statistical Package for Social Sciences Version 22
TELI	Technology Enhanced Learning Initiative
TIMSS	Trends in Mathematics and Science Studies
TPCK	Technological, Pedagogical Content Knowledge
TUT	Tshwane University of Technology
UNESCO	The United Nations Educational Scientific and Cultural Organization

List of Terminology

Collaboration	“Collaboration between teachers involves their sharing expertise and materials in order to reach a common goal” (Kennisset Foundation, 2011:66).
Conceptual Framework	“... explains either graphically, or in narrative form, the main things to be studied – the key factors, concepts or variables – and the presumed relationship among them” (Miles & Huberman, 1994:18).
Cross-curricular	“...cross-curricular teaching involves a conscious effort to apply knowledge, principles, and or values to more than one academic discipline simultaneously” (Jacobs, 1989).
Epistemology	“... the nature of the relationship between the knower, or would-be knower and what can be known” (Guba & Lincoln, 1994:108).
Expertise	“This refers not only to technical skills, but also to pedagogical knowledge and to knowledge of the subject matter – as well as to the ability to meaningfully link all three” (Kennisset Foundation, 2011:9).
Exploring	“Inquire into or discuss (a subject) in detail” (Oxford University Press, 2014a).
ICT	“Stands for ‘Information and Communication Technologies’. ICT refers to technologies that provide access to information through telecommunications” (ICT, 2014).
ICT integration	“... integrating digital technologies in their classroom teaching” (Petko, 2012).
ICT skills	“... professional, pedagogical and didactic competencies to support learning processes for students being taught using digital media” (Petko, 2012:1352).
Instruction	“Instruction is the direct transfer of knowledge to a pupil, as it occurs in traditional classroom teaching” (Kennisset Foundation, 2011:19).
Leadership	“A demonstration of leadership can get teachers involved in innovation, motivate them, and allow them to develop a shared vision” (Kennisset Foundation 2011:12).
Learning	“The acquisition of knowledge or skills through study, experience, or being taught” (Oxford University Press, 2015a).

Macro-level	“Sociologists who conduct macro level research study interactions at the broadest level, such as interactions between nations or comparisons across nations” (Blackstone, n.d.).
Meso-level	“At the meso level, sociologists tend to study the experiences of groups and the interactions between groups” (Blackstone, n.d.).
Methodology	“How can the inquirer (would-be knower) go about finding out whatever he or she believes can be known?” (Guba & Lincoln (1994:108).
Micro-level	“At the micro level, sociologists examine the smallest levels of interaction; even in some cases, just “the self” alone” (Blackstone, n.d.).
Obstacle	“A thing that blocks one’s way or prevents or hinders progress” (Oxford University Press, 2014b).
Ontology	“... assumptions which concern the very nature or essence of the social phenomena being investigated” (Cohen, Manion & Morrison, 2008:7).
Priority	“A thing that is regarded as more important than others” (Oxford University Press, 2014c).
Relationship	“A relationship refers to the correspondence between two variables” (Trochim, 2006).
Role	“The function assumed or part played by a person or thing in a particular situation” (Oxford University Press, 2015c).
Teaching	“Impart knowledge to or instruct (someone) as to how to do something” (Oxford University Press, 2015b).
Transformational leadership	“Transformational leaders motivate followers by raising their consciousness about the importance of organisational goals and by inspiring them to transcend their own self-interest for the sake of the organization” (Marks & Printy 2003:375).
Vision	“... a clear idea of what it wants to achieve (vision)” (Kennisset Foundation 2012:28).

Chapter 1

Research Problem and Topic

1.1 Introduction

The value of Information Communication Technology (ICT) to improve and support education has been debated for the past decade (see, for example, Hannafin & Savenye, 1993; Ertmer, 1999; Kozma, 2003; Hargreaves, 2003; Flanagan & Jacobsen, 2003; Law, Pelgrum & Plomp, 2008; Voogt, Knezek, Cox, Knezek & Ten Brummelhuis, 2011). The global society demands of school-leavers to be able to execute 21st century skills. ICT does not only enhance the 21st century skills of learners, but has the potential to transform education (DoE, 2004; Voogt & Knezek, 2008). ICT can be used as a vehicle for problem-solving, collaboration, investigative thinking and individualised learning (Kankaanranta, 2005; UNESCO, 2008).

ICT and education are constantly changing and evolving; it is therefore a complex process to integrate these two ever-changing variables (Yuen, Law & Wong, 2003; Kankaanranta, 2005). To be able to stay abreast of the evolving nature of ICT and education, professional development should be a lifelong process for both educators and their leaders/managers to facilitate the enhancement of quality education through ICT integration (Cantrell & Visser, 2011; Flanagan & Jacobsen, 2003; UNESCO, 2008). ICT empowers school leaders, teachers and learners to reach their pedagogical goals (Voogt et al., 2011).

However, the success levels achieved through communicating information by means of technology at school level rely vastly on the human factors embedded in teachers and school principals (Drent & Meelissen, 2008; Kennisnet Foundation, 2011). An education system that does not empower its teachers and learners to master 21st century skills risks marginalisation (OECD, 2010; Kennisnet Foundation, 2011).

South Africa followed the example of other leading countries in implementing ICT in the pedagogical practice of their schools in order to facilitate the development of an information-literate society (Gudmundsdottir, 2010).

The Technology Enhanced Learning Initiative (TELI) originated at a national workshop of the Department of Education in 1995 with the purpose of providing a supportive network to educational decision-makers regarding the ICT implementation process in education (SchoolNet, 2000). SchoolNet SA originated in 1997 through the Department of Education's Centre for Educational Technology and Distance Education support, as well as commercial sponsors.

Provincial projects were launched in the Western Cape (Kanya) in 2000 where approximately 1000 schools were supplied with computers. In Gauteng, "Gauteng OnLine" was initiated in 2001 (Howie, 2010). The "Connectivity and Networking Project" was launched in the Northern Cape on 21 November, 2002. The focus of these initiatives was mainly to supply hardware and Internet connectivity to schools.

The Department of Education presented a White Paper on e-Education in 2004 which, according to the Minister of Education of the time, Ms Naledi Pandor, would provide a collaborative framework for Government as well as the private sector to transform schools into learning institutions enhancing 21st century skills through ICT implementation.

The strategic long-term plan of the White Paper on e-Education spanned three phases with 2004 as the starting date of Phase 1 and 2013 the completion date for phase 3. The three phases as set out in the White Paper are the following:

Phase 1: *Enhancing an institutional and system-wide readiness to implement ICT in administration, teaching and learning (2004 – 2007) (DoE, 2004).*

Phase 2: *A system-wide integration of ICT into teaching and learning (2007 – 2010) (Ibid).*

Phase 3: *ICT integration into all system-levels (2010 – 2013) (Ibid).*

With the completion of Phase 3, the integration process of ICT at all education system levels, namely instruction and learning, as well as management and administration should have been completed (DoE, 2004). The objective of the White Paper on e-Education was that "every South African manager, teacher and learner in the general and further education and training bands will be ICT capable by 2013" (DoE, 2004:17).

The Thutong Educational Portal was launched in 2005 and provides wide-ranging resource and support material in the form of educational resources, policy documents and interactive virtual communities. Although limited, professional development as stated above is available to South African principals and teachers (Thutong Educational Portal, 2005).

Teachers' professional development programmes in ICT leadership and implementation have been developed by SchoolNet. "SA Intel Teach to the Future" and "Partners in Learning" are two such professional development programmes for teachers. The "Intel Education: ICT in the Classroom Conference 2011" was held in Johannesburg with the focus on collaboration, ideas as well as effective pedagogical approaches to take full advantage of the potential of ICT in classrooms.

Howie and Blignaut (2009) argue that one of the main barriers to the integration of ICT, according to the South African data of the SITES M1 project (1999), was insufficient teachers' training. Seven years later, the data of the SITES 2006 project labelled South Africa as an "outlier" in ICT implementation compared to other participatory education systems (Howie & Blignaut, 2009; Law, Lee & Chan, 2010). Empirical research proves that there is a distinct correlation between the adoption-level of teachers' ICT implementation in pedagogy and their competence and confidence in using ICTs (Agyei & Voogt, 2011; Petco, 2012).

This study is a secondary data analysis based on the principals' questionnaire of the SITES 2006 project with the focus on investigating the school principals' role in ICT integration in South African secondary schools. The Second Information Technology in Education Study (SITES 2006) is a cross-sectional international survey of the pedagogical practices of schools, carried out under the guidance of the International Association for the Evaluation of Educational Achievement (IEA) (Blignaut, Els & Howie, 2010a; Voogt, 2010). A detailed discussion of the SITES 2006 project is given in the research design and methods chapter (Chapter 3).

According to the SITES 2006 findings, there are an insufficient number of South African teachers that use ICT in their pedagogical practice (Blignaut et al., 2010a). It is crucial that teachers understand the significance of ICT integration, the

fundamental role that ICT plays in innovative instruction and learning, and that lifelong learning is the key to facing a changing world (UNESCO, 2008).

The role of the principal as leader of transformation in sustainable ICT integration in instruction and learning is recognized by previous research studies (Yuen et al., 2003; Stuart, Mills & Remus, 2009; Eickelmann, 2011; Newhouse, 2012). There are various alternatives that can be prioritised by school principals to address the obstacles and priorities relating to ICT integration in South African schools. This, unfortunately, does not take place in a structured and continuing manner (Howie & Blignaut, 2009).

All principals and teachers should be ICT-skilled with improved technical abilities facilitating the engagement of innovative pedagogical methods through ICT-use. It is important that school leaders are in the forefront of participation in professional development for they are the leaders of transformation (Pelgrum & Voogt, 2009). School leadership in the information society demands transformed attitudes, commitment and skills to propagate and facilitate ICT integration (DoE, 2004; OECD, 2010).

The vision and expertise required to facilitate and enhance ICT integration through the lens of the South African school principal, are the focus of this study and are discussed in the next sections.

1.2 Statement of the problem and research problem

It is problematic that the implementation of ICT in the South African education system has been slow and less effective than in the case of other developing countries (Howie, 2010) despite the White paper on e-Education that was published in August 2004. Two of the main participants in ICT integration in instruction and learning, are school principals and teachers (Kennisset Foundation, 2011). The process of innovation not only demands cooperation between school leadership and teachers, but also requires the support and empowerment of teachers towards becoming decision-making partners (Marks & Printy, 2003).

Educators need and desire support (Howie, 2010; Blignaut, Hinostroza, Els & Brun, 2010b) as they integrate ICT into their instruction and learning. School leadership

and specifically school principals can and should play a crucial role in the development of teachers' vision, ICT skills and pedagogical orientation. School principals are seen by Blignaut et al. (2010b:1560) as the "main actors in the institutional promotion of innovative use of ICTs in their schools".

The South African school principals' leadership role in ICT integration cannot be overstated (Tondeur, Cooper & Newhouse, 2010; Newhouse, 2012). The school principal as leader of technology, should first understand technology, before clear direction can be given to teachers as to how this innovation should be integrated in instruction and learning. On-going professional development opportunities should be available to and required of teachers, while constant structured monitoring of the integration process should take place.

An increasing number of South African teachers wish to acquire the essential skills to use ICT innovatively in their pedagogy. This is reflected in the comparative SITES 2006 study by Blignaut et al. (2010b) stating that teacher desires regarding ICT-use are the highest in South Africa, Chile and Thailand.

The above-mentioned South African teachers' need for ICT empowerment (Blignaut et al., 2010b) and South Africa's comparative position in this regard (Howie, 2010), imply that school principals are struggling with effective ICT leadership to support and guide teachers with ICT integration in instruction and learning. This study explores the school principals' role in ICT integration in instruction and learning in South African secondary schools.

In exploring the school principals' role in ICT integration in the instruction and learning in South African secondary schools, the main research problem is twofold:

- What is the relationship between the priorities school principals allocate to the attainment of leadership competencies and the integration of ICT in instruction and learning in South African secondary schools?
- What is the relationship between the obstacles hindering the schools' capacity to realise their pedagogical goals and the integration of ICT in instruction and learning in South African secondary schools?

1.3 Purpose of the study and sub-research questions

The purpose of this study is firstly to explore the relationship between the priorities South African secondary school principals allocate to the attainment of leadership competencies and ICT integration in instruction and learning. Two such priorities identified by the SITES 2006 principals' questionnaire are (1) "Developing a common pedagogical vision among the teaching staff of the school", and (2) "Promoting the integration of ICT in the teaching and learning of traditional subjects" (See Addendum A). The sub-questions relating to these two principals' priorities, including the defined null hypothesis as well as the alternative hypothesis, are illustrated in Table 1.1.

Table 1.1: Sub-research questions relating to the priorities of school principals relating to the attainment of leadership competencies

No.	Sub-research question	Research hypotheses
1.	What is the relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to broaden their pedagogical repertoire and to widen their pedagogical competence?	H ₀ : There is no relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to broaden their pedagogical repertoire and to widen their pedagogical competence.
		H _a : There is a relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to broaden their pedagogical repertoire and to widen their pedagogical competence.
2.	What is the relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to provide teachers with incentives to integrate ICT in their instruction and learning?	H ₀ : There is no relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to provide teachers with incentives to integrate ICT in their instruction and learning.
		H _a : There is a relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to provide teachers with incentives to integrate ICT in their instruction and learning.
3.	What is the relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to improve the technical skills of teachers?	H ₀ : There is no relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to improve the technical skills of teachers.
		H _a : There is a relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to improve the technical skills of teachers.
4.	What is the relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving the technical skills of teachers?	H ₀ : There is no relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving the technical skills of teachers.
		H _a : There is a relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving the technical skills of teachers.

Table 1.1: Sub-research questions relating to the priorities of school principals relating to the attainment of leadership competencies (continued)

No.	Sub-research question	Research hypotheses
5.	What is the relationship between principals' priorities to promote the integration of ICT in traditional subjects and increasing the number of teachers using ICT for teaching and learning purposes?	H ₀ : There is no relationship between principals' priorities to promote the integration of ICT in traditional subjects and increasing the number of teachers using ICT for teaching and learning purposes?
		H _a : There is a relationship between principals' priorities to promote the integration of ICT in traditional subjects and increasing the number of teachers using ICT for teaching and learning purposes?
6.	What is the relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving student's ICT skills?	H ₀ : There is no relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving student's ICT skills?
		H _a : There is a relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving student's ICT skills?

The purpose of this study is secondly, to explore the relationship between the obstacles hindering the schools' capacity to realise their pedagogical goals and the integration of ICT in instruction and learning. Two such obstacles identified by the SITES 2006 principals' questionnaire are; (1) "Teachers' lack of ICT skills", and (2) "Insufficient qualified technical personnel to support the use of ICT" (See Addendum B). The sub-questions relating to these two obstacles, including the defined null hypothesis as well as the alternative hypothesis, are illustrated in Table 1.2.

Table 1.2: Sub-research questions relating to the obstacles hindering the school's capacity to realise their pedagogical goals

No.	Sub-research question	Research hypotheses
1.	What is the relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and promoting the collaboration between teachers of different subjects?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and promoting the collaboration between teachers of different subjects.
		H _a : There is a relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and promoting the collaboration between teachers of different subjects.
2.	What is the relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and improving the technical skills of teachers?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and improving the technical skills of teachers.
		H _a : There is a relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and improving the technical skills of teachers.

Table 1.2: Sub-research questions relating to the obstacles hindering the school's capacity to realise their pedagogical goals (continued)

No	Sub-research question	Research hypotheses
3.	What is the relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and to improve the ability of teachers to make good pedagogical use of ICT?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and to improve the ability of teachers to make good pedagogical use of ICT.
		H _a : There is a relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and to improve the ability of teachers to make good pedagogical use of ICT.
4.	What is the relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and managing the adoption of ICT-supported methods for assessing student progress?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and managing the adoption of ICT-supported methods for assessing student progress.
		H _a : There is a relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and managing the adoption of ICT-supported methods for assessing student progress.
5.	What is the relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and establishing/enhancing an online learning support platform and its management?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and establishing/enhancing an online learning support platform and its management.
		H _a : There is a relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and establishing/enhancing an online learning support platform and its management.
6.	What is the relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and organising cooperation with other schools regarding the development of ICT-based teaching and learning?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and organising cooperation with other schools regarding the development of ICT-based teaching and learning.
		H _a : There is a relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and organising cooperation with other schools regarding the development of ICT-based teaching and learning.
7.	What is the relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and developing a strategic plan for integrating ICT-use in teaching and learning?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and developing a strategic plan for integrating ICT-use in teaching and learning.
		H _a : There is a relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and developing a strategic plan for integrating ICT-use in teaching and learning.

Furthermore, this study will explore the influence of the following personal principal characteristics, as identified in the principals' questionnaire of the SITES 2006 study (See Addendum D), on the above-mentioned priorities and obstacles:

- Gender
- Age
- How often does the principal personally use a computer?
- Does the principal use a computer to connect to the Internet?
- Does the principal use a computer for school related activities?
- Years of experience as principal at any school.
- Years of experience as principal at this school.
- Years of experience in any capacity at this school.

1.4 Rationale for the study

The importance of ICT in instruction and learning escalated with the growing demand and use of ICT in society. This goes beyond the mere knowledge and skills required to use ICT for administrative purposes, personal benefit and growth; the goal is to find innovative methods to incorporate ICT in instruction and learning in order to enhance the quality and methods of knowledge transfer to equip learners for life in the knowledge society of today.

1.5 Limitations of the study

The fact that the data analysed for this study was collected in 2006 by the IEA for the SITES 2006 project and published in 2008 is considered a limitation. It is, however, worth mentioning that the SITES 2006 study is the latest international survey relating to ICT in education with South Africa as participating education system.

1.6 Chapter outline of the study

The chapter outline of this study is given in Table 1.3.

Table 1.3: The chapter outline of this study

Chapter	Title	Description
Chapter 1	Introduction	This chapter presents an orientation of this study, the main and sub-research questions as well as limitations.
Chapter 2	Literature review	This chapter presents insight into related literature as well as the conceptual framework used to guide this study.
Chapter 3	Research design and methods	This chapter presents a comprehensive explanation of the following: ➤ Underlying paradigm. ➤ Research design. ➤ Analysis of the SITES 2006 data of the principals' questionnaire. ➤ Trustworthiness. ➤ Ethical considerations.
Chapter 4	Analysis of data and interpretation of results	This chapter presents a complete clarification of the following: ➤ Description of the data. ➤ Analysis of the data. ➤ Review of the results.
Chapter 5	Summary, conclusions and recommendations	The concluding chapter synthesises the findings, states the recommendations resulting from the study and offers suggestions for further study.

Chapter 2

Literature Review

2.1 Introduction

The literature review relating to ICT in instruction and learning for this study explores previous research by several academics. Specific attention is given to the leadership role of school principals in promoting the integration of ICT in schools. This chapter also explores teachers' role in this integration process and the effect their lack of pedagogical and technological ICT skills and support has on curriculum delivery. Additionally, the review of the literature investigates how the ICT integration process is implemented in other countries as well as in South Africa.

2.2 Information and communication technology in instruction and learning

2.2.1 Introduction

Between 2004 and 2013 immense demands were placed on cross-curricular ICT integration in education, both internationally as well as in South Africa (DoE, 2004; Wong, Li, Choi, & Lee, 2008, Yuen, Lee & Law, 2009, Agyei & Voogt, 2011; Plomp, 2013). ICT is recognised as much more than a mere tool to enhance or replace current instruction and learning methods (Drent & Meelissen, 2008). It is regarded as a powerful instrument to revolutionise pedagogical practices in schools (*Ibid*).

ICT has the potential to transform a conventional classroom into a learner-centered, participatory and collaborative learning experience (Bingimlas, 2009; Gao, Wong, Choy & Wu, 2010; Ayub, Bakar & Ismail, 2012). Gudmundsdottir (2010) regards ICT as the “main facilitator of the knowledge society”. Unfortunately cross-curricular ICT integration is not practised successfully by all schools in South Africa and teachers need support and professional development to enhance the quality of the implementation of ICT in their curriculum delivery (Howie & Blignaut, 2009; Gudmundsdottir, 2010; Howie, 2010). Support for this interpretation comes from Blignaut et al. (2010a) stating that a vast number of learners in South Africa do not have the opportunity to reap the benefits of the knowledge age provided by cross-

curricular ICT integration. This shortcoming requires educational reform in South African schools, putting increasing demands on the ICT capabilities of educators to develop learners' lifelong learning competencies (Blignaut et al., 2010b). The required lifelong learning competencies or 21st century skills refer to problem-solving, collaboration, investigative thinking and individualised learning skills (UNESCO, 2008; Framework for 21st Century Learning, 2009; Binkley, Erstad, Herman, Raizen & Rumble, 2010). Empirical research of the value of cross-curricular ICT integration found that learning outcomes, specifically lifelong learning competencies can be achieved more successfully when ICT is integrated (Drent & Meelissen, 2008; Pelgrum & Voogt, 2009).

According to the study of Howie (2010) the pedagogical vision of South African principals' as well as of teachers' are more traditionally inclined. Blignaut et al. (2010a) found that South Africa is struggling to transform from a traditional learning approach to 21st century learning skills development, thereby restricting economic as well as social development.

According to Plomp (2013), the traditional approach to instruction and learning, even when it is enhanced through ICT-use, cannot prepare learners to participate in the information society crammed with new technological developments. Law (2009) describes classrooms where ICT is embedded in the 21st century skills development of learners as learner-centered environments compared to teacher-centered environments as in the case of traditional learning classrooms. The author further mentions that these learner-centered classrooms foster connectivity that extends further than the classroom walls and improve the problem-solving abilities of learners.

The 21st century skills are essential outcomes for learners to acquire in order to increase their employability in the knowledge society (Binkley et al., 2010; Plomp, 2013). Fisch, McLeod and Brenman (2009) report that today's educators have the immense task of preparing learners for occupations that are as yet, non-existing, where they will use ICTs that have not been developed yet in order to resolve problems that do not exist yet.

Petko (2012) recommends further exploration into the probable reasons why educators hesitate to integrate digital technologies into their instruction and learning and why the integration of ICT in schools is such a slow and unstructured process. Similar recommendations have been made by Harris, Mishra and Koehler (2009), urging educators to focus on ICT-use as a tool to reform instruction and learning and not only to enhance current teaching practices.

Several authors describe cross-curricular ICT integration as a complex and challenging process involving a vast range of inter-related factors (Flanagan & Jacobsen, 2003; Yuen et al., 2003; Tondeur et al., 2010; Eickelmann, 2011). The factors influencing ICT integration in instruction and learning are discussed in the next paragraphs.

2.2.2 Factors influencing ICT integration in instruction and learning

2.2.2.1 Introduction

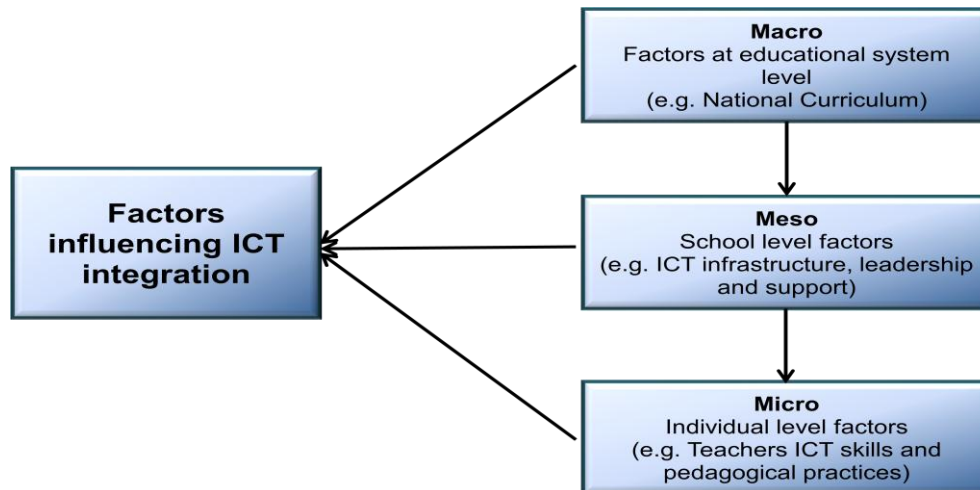
ICT integration is described by several authors as a “dynamic process” influenced and managed by a wide range of factors and their inter-relatedness (Tondeur et al., 2010; Hinostroza & Brun, 2010). Previous research on the integration of ICT into instruction and learning has suggested that no single factor can be isolated as the determining variable that affects the successful outcome of ICT integration into the school curriculum (Drent & Meelissen, 2008; Tondeur et al., 2010; Blignaut et al., 2010b; Eickelmann, 2011). Voogt et al. (2011) underline the importance of further research into these inter-related factors in order to maximise the potential of ICT integration in instruction and learning.

Gudmundsdottir (2010) observes that ICT integration is “highly” subjective to the individual school environment and all the complex social circumstances involved with the school. Howie (2010) reports that the residing community as well as the unique characteristics of the learners of each individual school needs consideration before any ICT integration strategy can be effected.

Petko (2012) differentiates between factors at educational system level, school

level as well as factors at individual level. These factors are illustrated in Figure 2.1.

Figure 2.1: The three level factors influencing ICT integration according to Petko (2012)



2.2.2.2 Factors at educational system level (Macro-level)

Strategic ICT policies at the macro-level act as a framework for goals, visions and rationales guiding schools to draw up their own ICT integration policies in order to attain the set ICT curriculum goals (Kozma, 2008). What happens in schools on ground level is largely determined by the national ICT policy goals of an education system (Blyderup, Larson & Trentel, 2009; Voogt et al., 2011).

National ICT implementation policies should, according to Voogt et al. (2011), assist schools in addressing factors such as a lack of infra-structure, private-public partnerships, teachers' professional development, content development and support. The authors state that these factors can cause a gap between intended national ICT policy and executed school level policy and practice.

In her study Howie (2010) demonstrates the effectiveness and speed of ICT implementation effected by the "top-down" and "bottom-up" national ICT in education policy of Chile. According to her, the foundation of these policies originates from the Enlaces programmeme. The strategic goals of the Enlaces programmeme were to enhance effective ICT-use in instruction and learning and to contribute to the improvement of ICT competencies in Chilean public schools

(Howie, 2010; Hinostroza & Brun, 2010). According to Howie (2010), the schools in Chile are responsible for their own ICT implementation (bottom-up), while the necessary financial and human resources are made available by the Chilean government (top-down). The author observes that the Chilean government's vision, mutual partnerships between the schools, universities and public as well as their synchronised policy development and implementation strategies are reasons for their success in ICT implementation.

Howie (2010) further compares the Chilean national ICT implementation policy to that of South Africa, where hardware equipment was supplied to schools (Khanya Project in the Western Cape and Gauteng Online in Gauteng), without the consent of the schools or the necessary strategies of how it should be used, often resulting in misuse or under-utilisation. Blignaut et al. (2010a) state that the poor performance results of South Africa in SITES 2006 should necessitate the re-assessment of strategic policies in order to create equal opportunities for all South African learners and teachers.

An interesting comparative study by Blyderup et al. (2009) using Denmark's SITES M1 data from 1998 and the SITES 2006 data found that policy changes towards a primarily traditional (curriculum-centered) paradigm lead to a decline in principals' support for a lifelong learning paradigm. According to the authors, this results in decreased teachers' support for the lifelong learning paradigm. The study of Blyderup et al. (2009) makes a strong case for how much the macro-variable "policy changes" influences principals' vision and teachers' classroom practice regarding ICT implementation.

Kozma (2008) identifies four rationales for macro-level investment in ICT integration. According to him, national ICT integration improves economic growth, promotes community development, enhances instruction and learning transformation and supports instruction and learning management. He states that it is imperative to align national strategic policies with operational policies in order to derive maximum benefit from the financial investment in national ICT integration. He further explains that if a macro-level ICT integration policy requires pedagogical reform to improve economic development; teachers should receive professional

development in pedagogical as well as technical skills to empower them to reach the curriculum goals of such a policy.

According to Kozma (2008) strategic policies provide the rationale and vision for cross-curricular ICT integration while operational policies will provide the methodology to realise this vision. Examples of such operational policies, according to him, are the provision of infrastructure, teacher professional development, technical support, curricular and pedagogical change and content development.

Macro-level operational ICT policies (See Figure 2.1) should provide strategies for the required financial and other resources (personnel, hardware, software and professional development programmes) to enable educational change through ICT integration (Kozma, 2008). National policies should also provide the shared vision necessary to guide and support schools nationally through the provision of educational goals and their rationale, to make best use of their cross-curricular ICT integration effort (*Ibid*).

Howie (2010) provides an example of inadequate South African ICT implementation policies, stating that South Africa was one of only two participatory systems of the SITES 2006 project that could not supply countrywide computer and Internet availability to all schools. Supporting evidence provided by Blignaut et al. (2010a), indicates that Internet access for South African learners was the second lowest of all the participating education systems.

Findings reported by Howie and Blignaut (2009) blame insufficient access to technology as well as the lack of teacher training in ICT implementation as the reasons for South Africa's poor performance in the SITES 2006 project. According to them, the inequalities between wealthy and less resourced provinces need to be addressed if South Africa as a whole wants to succeed with its implementation plan. Blignaut et al. (2010a) observed that it is impossible for South African schools to meet the requirements of the White Paper on e-Education of total ICT implementation by the year 2013, if they do not have the necessary infrastructure to do so.

2.2.2.3 School level factors (Meso-level)

2.2.2.3.1 School related factors

The environment where teachers function can restrain or promote ICT-use (Voogt et al., 2011). Wong et al. (2008) refer to the “school climate” which can encourage the creativity, collaboration and experimentation of teachers.

Cross-curricular ICT integration requires educational change (Al Sharija & Watters, 2012). The school is seen as the “unit of change” by Tondeur et al. (2010) and the vision of the school determines how the process of change enfolds (Phelps, Graham & Watts, 2011).

Flanagan and Jacobsen (2003) warn that inflexible network limitations enforced on teachers and learners can hinder innovative and collaborative use of ICT in classrooms. Inadequate simultaneous Internet access is seen as a barrier in cross-curricular ICT integration (Bingimlas, 2009; Brannigan, 2010).

Teachers’ professional development, technological and pedagogical support as well as monitoring the change process are regarded by researchers as key elements to lead the transformation process into innovative instruction and learning through ICT-use (Tondeur et al., 2010; Blignaut et al., 2010b).

An ICT school policy is important to guide the change process and should define clear goals as well as the ways and means to realise these goals (Tondeur et al., 2010). Such a policy should address hardware and software, Internet connectivity, a collaborative team, an ICT coordinator, cooperation with external partners, teacher training as well as innovative didactic and ICT support (Tondeur et al., 2010; Eickelmann, 2011).

Van der Linde, Van Braak and Tondeur (2010) describe a school-based ICT policy plan as the “blue-print” of all the proceedings that should take place in order to realise the curriculum goals of the school through ICT. Important aspects included in this policy, according to them, should be professional development, assessment, ICT curricula as well as vision building. The necessity to update an ICT school policy regularly due to the dynamic nature of technological development is stressed by the authors. They also underscore teachers’ participation in the development of

such an ICT integration policy as it is their responsibility to achieve the required outcome.

Eickelmann (2011) identified the following commonalities in schools that successfully achieved sustainable ICT integration:

- Intra-school cooperation is realised.
- The implementation of staff-development programmes.
- Cooperation with external partners is established.
- ICT-use and pedagogical goals are linked.
- The integration of technology and the curriculum.
- The potential of ICT to enhance instruction and learning throughout the whole school is realised.
- The ability of the school to solve ICT integration challenges and problems internally.
- The principal of the school has strong leadership skills with a clear understanding of ICT's potential to enhance instruction and learning.

2.2.2.3.2 School leadership

Newhouse (2012) describes an effective school leader as a person who has managerial as well as interpersonal skills enabling him or her to converse and associate with a diverse variety of educators. An effective ICT school leader should establish an innovative culture in a school where all the participants share the responsibility of innovation (Brannigan, 2010). Effective school leadership, according to Newhouse (2012), will result in the transformation of isolated ICT-use by educators and learners towards establishing powerful learning environments that will improve instruction and learning in schools. Sustainable cross-curricular ICT integration cannot be achieved without effective leadership (Bocconi, Kampylis & Punie, 2012; Kirkscey, 2012).

School principals are regarded as the direct link between the government and the school through policy implementation and accountability (Law et al., 2010). It is in

their power to influence the instruction and learning culture of a school towards innovation (Bocconi et al., 2012). They are the formal leaders of innovative change (Al Sharija & Watters 2012).

School principals have to be able to communicate their innovative vision and commitment with enthusiasm (Stuart et al., 2009). The school leaders' competence should also include the ability to link ICT and curriculum delivery as they are regarded by local communities as pedagogy and curriculum leaders (*Ibid*).

According to them, principals should encourage collaboration between teachers as well as promote and support cross-curricular ICT integration. Al Sharija and Watters (2012) explain that the principal should be able to identify and address the differences in ICT competence amongst staff members through continuing professional development.

Wong et al. (2008) measure school principals' ability to lead transformation in the following four domains:

- The ability to establish shared visions.
- The ability to empower and rely on teachers.
- The ability to sustain innovative teaching practices.
- The ability to support staff development.

The role of the ICT leader is described by Flanagan and Jacobsen (2003) as unfamiliar and challenging for many principals; for example, developing technical as well as human resources. According to them, principals need professional development to acquire the skills necessary to lead staff towards cross-curricular ICT integration. Effective ICT leadership demands a specific level of ICT competence (Stuart et al., 2009). The authors emphasise that effective ICT leaders should understand the potential of cross-curricular ICT integration in order to promote and build support for technology integration in their schools.

Law et al. (2010) describe the school level factor "principals' vision for ICT-use" to sustain lifelong learning practices in instruction and learning as the determining factor shaping the pedagogical practices of teachers. Blignaut et al. (2010b) describe principals as the "main actors" in the ICT integration process of schools.

The leadership and managerial skills of the principal are regarded by Blignaut et al. (2009) as the main facilitator of innovative change. An important characteristic of the leadership role of principals is the influence they have on the attitudes, vision and practice of teachers as teachers reach the required educational outcomes of the institution (Al Sharija & Watters, 2012).

Unfortunately the appointment of a principal in developing countries is often based solely on seniority (Howie, 2010). According to her this often results in an autocratic, non-participatory leadership style affecting the national leadership and vision in schools. This is confirmed by Gao et al. (2010) stating that a technology leadership position should not be acquired as a result of seniority, but through the development of a set of learnable skills and practices.

According to Isaacs (2007) the absence of effective ICT leadership is a crucial constraining factor for successful ICT integration in the South African Education system.

2.2.2.4 Individual level factors (Micro-level)

At the micro-level it is ultimately the responsibility of the teacher to prepare learners for the knowledge society that demands of them to not only realise required knowledge, but also to attain the necessary ICT skills to “access, analyse, evaluate, integrate, present and communicate” information (DoE, 2004:14). The success levels achieved through communicating information by means of technology at school level rely vastly on the human factors embedded in educators (Drent & Meelissen, 2008; Kennisnet Foundation, 2011). Blyderup et al. (2009) regard the role of the teacher as instrumental in implementing national educational policies.

The methods that teachers use to integrate ICT into their classroom practice and their reasons for ICT integration are, according to Voogt (2010), determined by their competence in ICT as well as their pedagogical vision. This view is supported by Phelps et al. (2011) declaring that teachers’ attitudes and pedagogical beliefs regarding ICT are the two most critical factors influencing if and how teachers embrace ICT integration in their instruction and learning. According to Drent and

Meelissen (2008) the attitude of teachers towards ICT integration has an indirect influence on their pedagogical orientation.

Teachers' pedagogical orientation is, according to Plomp and Voogt (2009) generally conceptualised as either a traditional learning approach or 21st century oriented. Voogt and Plomp (2010) explain that traditional instruction and learning practices comply with the requirements of the industrial society while 21st century learning practices answer to the "learner-centered" needs of the knowledge society. According to Wong et al. (2008) teachers who adopt a learner-centered teaching approach, usually share a vision on collaborative learning as well as a positive view towards ICT's role in the transformation of teaching practice. Blignaut et al. (2010a) imply that South African teachers hinder the 21st century skills development of learners due to their preference for the traditional learning approach.

When teachers are confronted with the challenge to integrate ICT in their pedagogical practices, they respond according to their realistic visualisation of the constraints at their school as well as their own limitations (Yuen et al., 2009).

Blignaut et al. (2010b) argue that South African teachers want to understand the correlation between ICT and instruction and learning but need support and training to achieve meaningful and enriched technology integration across the curriculum. Additional support for this statement comes from the study of Flanagan and Jacobsen (2003), stating that "educators are looking to the research and to images of successful ICT integration for an understanding of the relationship between technology, pedagogy and student learning". Howie (2010) in her study found that South African teachers as well as Chilean teachers had the strongest desire of all the SITES 2006 participants to integrate ICT in their instruction and learning.

The aforementioned three studies led to the hypothesis that teachers generally have a positive attitude towards cross-curricular ICT integration but their pedagogical practices are disadvantaged by feelings of self-inadequacy, computer anxiety and fear of change.

Voogt et al. (2011) refer to the empirically tested "will, skill, tool" model that was developed by Christensen and Knezek in 2008, where "will" is seen as teachers'

attitude towards the use of technology; their “skill” is described as their competencies and “tool” is regarded as their access to technology. This model is used to predict to which degree teachers are able to adapt to using technology in their classroom practice.

Agyei and Voogt (2011) declare that teachers’ attitude towards ICT influence their perceived value of ICT in instruction and learning and as a result determines whether they integrate ICT into their classroom practice.

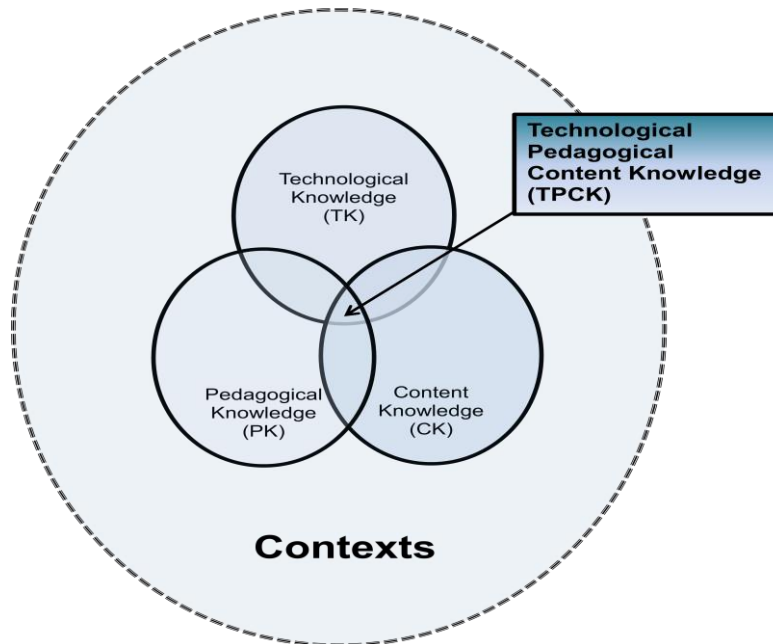
A significant body of evidence suggests a strong correlation between teachers’ positive attitude to ICT integration in instruction and learning and their mode of teaching (Phelps et al., 2011; Agyei & Voogt, 2011; Kirkscey, 2012; Petko, 2012; Ayub et al., 2012). The study of Yücel, Acun, Tarman and Mete (2010) found a positive correlation between teachers’ feelings of self-inadequacy and negative attitude. The authors concur that when teachers’ self-inadequacy is addressed by means of professional development this will result in a more positive attitude which in turn will reflect upon their classroom practice regarding ICT-use. The authors labeled this an “interesting and important” finding.

Several authors identify “computer anxiety” as a significant dimension of “attitude” with regard to teachers who are less competent in using ICT, which means that negative attitude can develop as a result of fear of ICTs (Agyei & Voogt, 2011; Ayub et al., 2012). According to Ayub et al. (2012) there is a strong correlation between teachers’ attitudes and school support, between school facilities and the general ICT culture among the teachers in a school. Teachers’ professional development should, according to Ngololo, Howie and Plomp (2012), focus on ICT competencies as well as the development of the correct attitude towards cross-curricular ICT integration.

Harris et al. (2009) report that it is imperative that teachers understand the interrelationships between content knowledge, pedagogical knowledge and technological knowledge, which are according to them, fundamental when ICT is integrated in instruction and learning. These authors describe this complex required knowledge as “technological pedagogical content knowledge” (TPCK).

The TPCK framework of Harris et al. (2009) demonstrates the interrelated components; Technological Knowledge, Pedagogical Knowledge and Content Knowledge in curriculum-based ICT integration. The TPCK framework is illustrated in Figure 2.2.

Figure 2.2: The Knowledge Components of the TPCK framework, adapted from Harris, Mishra and Koehler (2009)



The authors explain that the TPCK framework demonstrates the interrelatedness of the pedagogical, technological and content knowledge required of teachers to produce effective cross-curricular integration. According to them, teachers need continuing TPCK-based professional development due to the dynamic nature of this particular form of applied knowledge.

Voogt (2010) as well as Eickelmann (2011) refers to the development of teachers' technological pedagogical content knowledge (TPCK) as a prerequisite for frequent ICT-use in instruction and learning. According to Law (2009), ICT-related pedagogical professional development has a strong positive correlation with teachers' ICT adoption in their instruction and learning. Yuen et al. (2009) argue that teachers should be supported through professional development to understand the nature of the challenge cross-curricular ICT integration presents to them.

Support for this interpretation comes from Voogt et al. (2011), arguing that teachers' professional development is essential for their ICT skills development as well as the capability to apply the acquired ICT skills in their curriculum delivery.

The teacher level factor "personal entrepreneurship" has been identified by Drent and Meelissen (2008) as a key aspect influencing the collaboration with internal and external parties for the purpose of own professional development. These authors state that teachers, who engage in collaborative activities with other teachers, can be characterised as personal entrepreneurs. Collaborative activities, as well as the ability to reflect on their own cross-curricular ICT integration will, according to the authors, improve teachers' technological and pedagogical skills.

Hargreaves (2003) believes that teachers should "take their place among society's most respected intellectuals" through professional development and continuous research. He observes that it is important that teachers understand the demands of the knowledge society so that they can prepare their learners accordingly.

2.3 Conceptual framework: Four-in-Balance-Model

The review of the literature on how ICT is integrated in the curriculum delivery of teachers in South Africa as well as in other countries, coupled with the factors influencing ICT integration in instruction and learning, provides the necessary guidelines for the development of a conceptual framework to guide this study. The conceptual framework selected to guide this study is the Four-in-Balance-Model.

2.3.1 Description of the Four-in-Balance-Model

The Four-in-Balance-Model was developed by the Kennisnet Foundation, which is a Dutch semi-governmental organisation committed to improving innovative ICT integration in education. This model originated through research findings relating to the successful implementation of ICT in instruction and learning and is used to guide the introduction and sustainable integration of Information Technology into an educational environment (Kennisnet Foundation, 2011).

This model advocates that successful ICT integration at school level requires a balanced approach between the four fundamental components: vision, expertise,

digital learning materials and ICT infrastructure (Kennisnet Foundation, 2011). According to this model, these four components should be driven by leadership and strengthened by collaboration and support (*Ibid*). The Four-in-Balance-Monitor, based on this model, was developed by the Kennisnet Foundation, firstly to evaluate and secondly, to guide the ICT integration process at school level and is the result of collective research-based knowledge on ICT-use in education from 2001 to 2013 (*Ibid*).

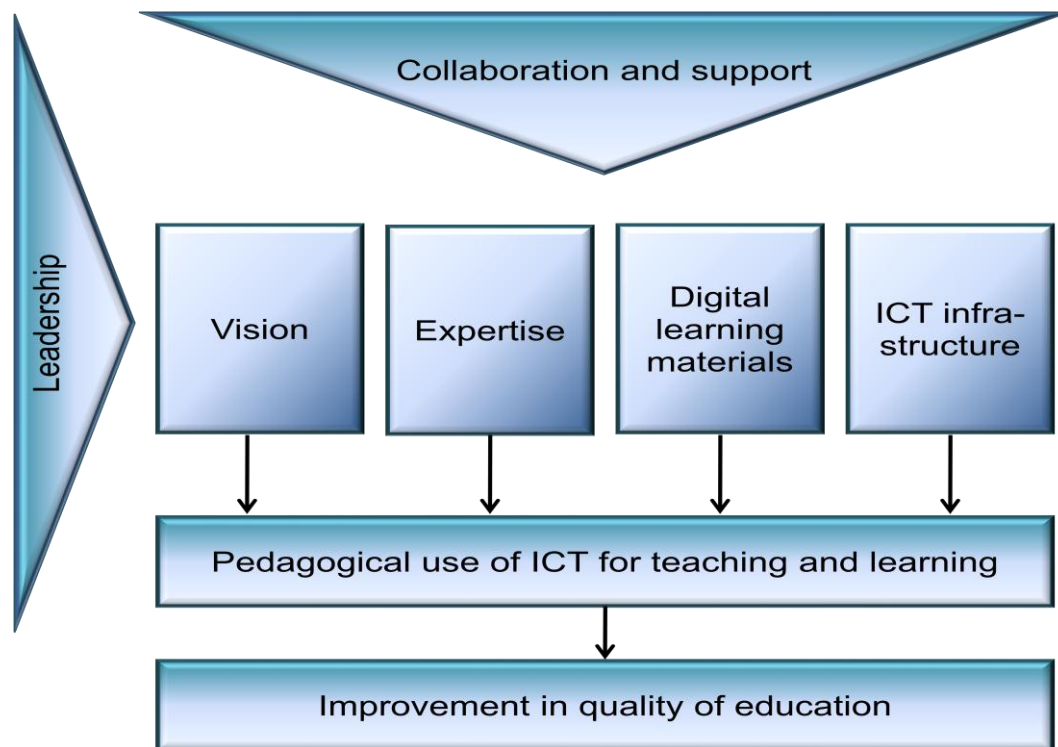
According to the Kennisnet Foundation (2012) the components of the Four-in-Balance-Model can be divided into human and material factors. Table 1 outlines the four main components and their significance.

Table 2.1: The main components of the Four-in-Balance-Model

Factors	Component	Significance
Human factors	Vision	The pedagogical objectives of the teachers, management as well as the school and the methodology they plan on using to achieve these objectives (Kennisnet Foundation, 2011).
	Expertise	The pedagogical knowledge, the knowledge of subject matter as well as the ICT skills of the teacher with a focus on the skills and ability to balance and combine these qualities in order to achieve pedagogical goals (<i>Ibid</i>).
Material factors	Digital learning materials	All educational content in digital format (computer programmes and other formal or informal digital material) (<i>Ibid</i>).
	ICT infrastructure	Includes the availability, management and sustainability of computing devices, network facilities as well as Internet connectivity (<i>Ibid</i>).

The importance of balancing the above-mentioned four components in the ICT integration process is stressed by the Kennisnet Foundation (2011). They not only highlight the role of the teacher, but emphasise the function of leadership to direct the integration process and to create the ideal environment for internal and external professional collaboration (technical as well as pedagogical). Figure 2.3 represents the relationships between the components of the Four-in-Balance-Model.

Figure 2.3: The components of the Four-in-Balance-Model (Kennisnet Foundation, 2011)



2.3.2 Application of the framework in this study

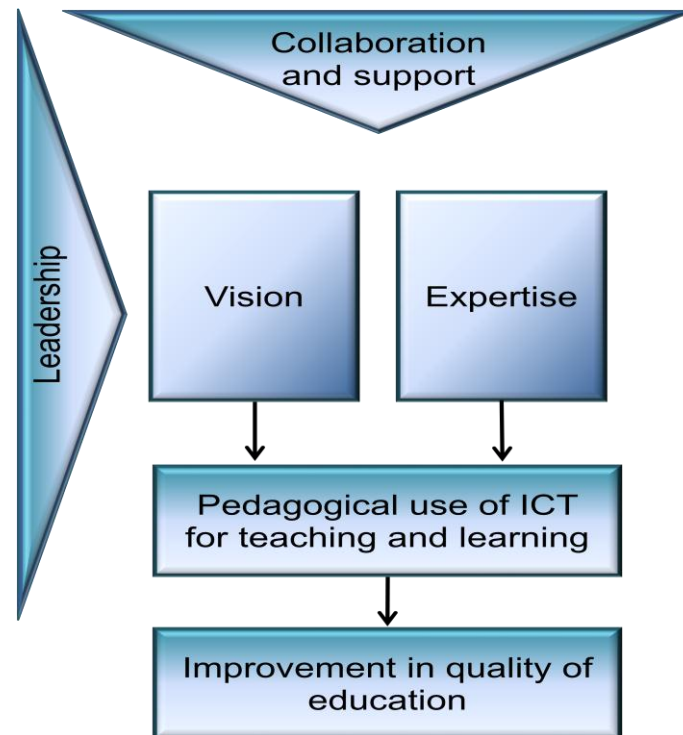
The focus of the study is to explore the integration of ICT in South African schools through the lens of the principals' pedagogical vision on ICT integration as well as specific priorities and obstacles involved in realising this vision.

An adapted Four-in-Balance-Model is used as conceptual framework for this study, using the human factors "vision" and "expertise" in order to understand the following:

- The obstacles hindering the school's capacity to realise its pedagogical goals through the integration of ICT in instruction and learning.
- The priorities school principals give to the attainment of leadership competencies through the integration of ICT in instruction and learning.

As illustrated by the model, "vision" and "expertise" are embedded in leadership (management) and collaboration (support). Figure 2.4 illustrates the adapted Four-in-Balance-Model.

Figure 2.4: The components of the adapted Four-in-Balance-Model (Kennisnet Foundation, 2011)



Kennisnet Foundation (2011) points out the importance of the human factors “vision” and “expertise” as the most “crucial” to facilitate effective and sustainable ICT integration in education. According to them, human factors should be in place before addressing the need for digital learning materials and ICT infrastructure. The authors refer to this specific sequential order as an “education-driven innovation”.

Kennisnet Foundation (2011) highlights the following four critical human factors:

- The ICT facilities in the school should correlate with the teacher’s pedagogical vision.
- The teacher is ICT skilled and able to integrate ICT in the curriculum.
- The teacher understands that cross-curricular ICT integration will improve learner achievement.
- Innovative leadership.

The vision of the principal as the leader, the initiator and motivator of transformation of a school is fundamental in influencing teachers’ vision as the vehicle for transformation (Law et al., 2010). For this transformation to result in an improved,

quality education towards developing 21st century skills, teachers need professional development to obtain the necessary expertise empowering them to fulfill their task (Law 2009).

Kennisnet Foundation (2011) differentiates between two types of leadership: transactional leadership and transformational leadership. According to them, the main focus of transactional leadership is the provision of hardware and software. Transformational leadership focuses on ongoing teachers' professional development, providing guidance and encouraging teachers towards a shared vision (Kennisnet Foundation, 2011). The authors emphasise that transformational leadership is required to empower teachers' efforts towards enhancing learner performance.

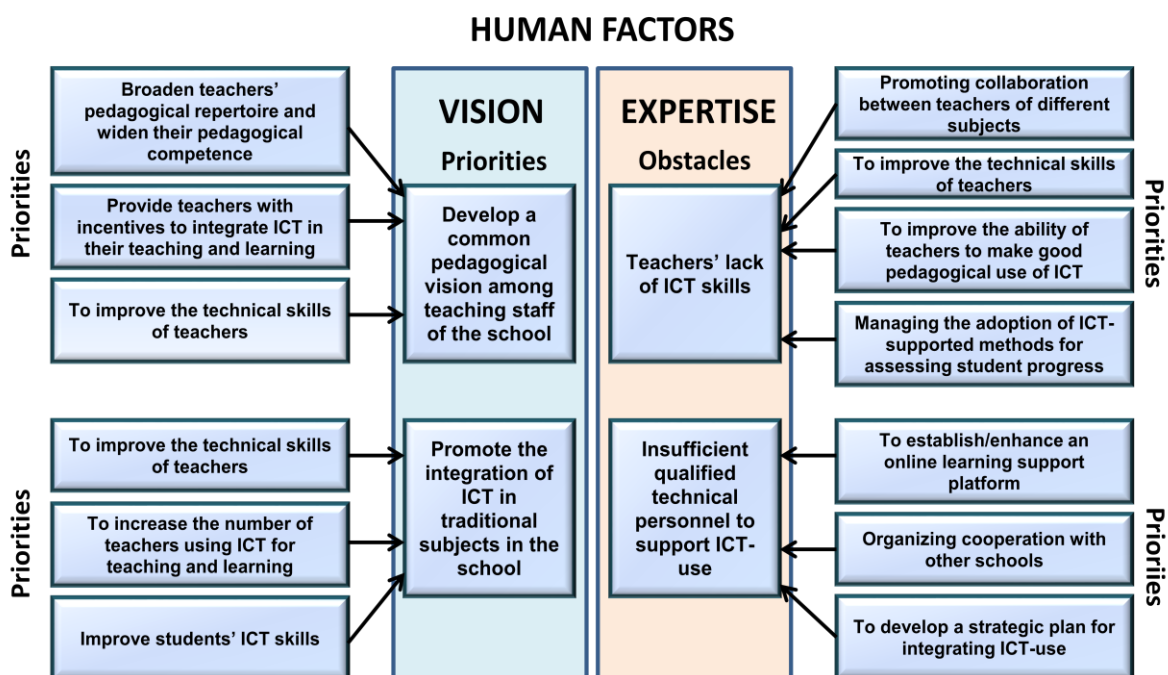
Collaboration and support in the form of sharing knowledge with internal or external professionals are constructive methods to improve competency and sustain ICT integration (Plomp & Voogt, 2009; Pelgrum & Voogt, 2009; Blignaut et al., 2010b; Eickelmann, 2011). Collaboration among teachers sharing knowledge, expertise and resources can create new challenges as they discover the advantages of improved pedagogical practices through ICT-use (Kennisnet Foundation, 2011).

The data from the principals' questionnaire created by the IEA for the purpose of SITES 2006 was used for this study. Firstly, this study investigates to what extent the priorities school principals give to the attainment of leadership competencies such as "developing a common pedagogical vision among teaching staff in the school" and "promoting the integration of ICT in the teaching and learning of traditional subjects", affect the ICT integration process in a school (See Addendum A). The principal in his role as leader of technology can "develop a common pedagogical vision among the teaching staff in the school" and "promote the integration of ICT in traditional subjects" by means of prioritising resources to enhance the use of ICT in instruction and learning (See Addendum C). Secondly, this study investigates to what extent the obstacles, "teachers' lack of ICT skills" and "insufficient qualified technical personnel to support ICT-use", affect the ability to reach the pedagogical goals of a school (See Addendum B). The principal, in his role as leader, can address "teachers' lack of ICT skills" and "insufficient qualified

technical personnel” as obstacles by prioritising resources and by acquiring leadership competencies in specific areas affecting the development of the ICT skills of educators (See Addendum C and A).

Figure 2.5 provides an illustration of how the selected variables were embedded into the sub-research questions, grouped into the human factors, “vision” and “expertise”.

Figure 2.5: Variables embedded into the sub-questions, grouped into the human factors: “vision” and “expertise”



2.4 Conclusion

The literature review of this study outlines the importance of sustainable ICT integration and the promise it holds for innovative transformation of instruction and learning towards 21st century skills development. The potential of ICT is recognised as a medium to speed up social development in the emerging information-based economies of developing countries such as South Africa and Chile (Blignaut et al., 2010b). Gudmundsdottir (2010) argues that it is critical to recognise emerging technology as a fundamental aspect of our society and to prepare learners to utilise technologies.

Through the literature review the complex interrelationships, as well as inter-dependency between the macro-, meso- and micro-level factors involved in ICT integration, become unmistakably clear. This is confirmed by Somekh (2008), stating that teachers do not function in isolation, but that they form part of a socio-cultural community. According to her, this socio-cultural community can enable or constrain the transformation process towards ICT integration in schools. Teachers, on the micro-level, need support, collaboration and guidance from macro-, meso- as well as micro-level to facilitate successful cross-curricular ICT integration.

It is argued that meso-level factors such as an effective school-based ICT policy (Tondeur et al., 2010) and an effective school leader will facilitate sustainable cross-curricular ICT integration (Eickelmann 2011). The principal is described in the literature as a leader of technology, a leader of learning, a leader of competence building, a leader of resource management and a community leader (Flanagan & Jacobsen, 2003). In order to guide innovative change (Yuen et al. 2009), principals need a multi-level type of leadership, on system-level, on school-level as well as on teacher-level.

At macro-level, broader policy frameworks demand transformation towards a new culture of 21st century learning through ICT integration. Sustainable cross-curricular ICT integration is, according to Flanagan and Jacobsen (2003), interdependent on meso- as well as micro-level factors.

2.5 Gaps in the literature reviewed and rationale for the study

Howie (2010) argues that it is not easy to find literature on the implementation of ICT in instruction and learning in the South African context. According to her, much work needs to be done to understand the ICT policy implementation problems faced by the South African education system. South Africa was labelled an outlier due to a vast number of obstacles, such as professional development and ICT access in the implementation of ICT in instruction and learning (Howie & Blignaut, 2009).

The literature review of this study indicates that more research is required to comprehend the relationship between transformational leadership and how it influences sustainable ICT integration in instruction and learning (Wee Leng, 2008;

Stuart et al., 2009; Voogt et al., 2011). Flanagan and Jacobsen (2003) argues that constant research is required to understand the changing role, skills and visions needed by school principals to be effective leaders of cross-curricular ICT integration.

The literature identifies a school principal as the most important factor influencing teachers' ICT integration (Eickelmann, 2011; Tondeur et al., 2010). Teachers' lack of ICT and pedagogical skills is also identified by the literature as an obstacle in cross-curricular ICT integration (Drent & Meelissen, 2008; Agyei & Voogt, 2011). Eickelmann (2011) identifies the failure to implement a technical support structure for ICT-using schools as a "hindering factor".

Chapter 3

Research Design and Methods

3.1 Introduction

Chapter 3 describes the underlying paradigm, the research design as well as the research methods used to answer the main and sub-research questions. A detailed description of how the secondary data from the principals' questionnaire of the SITES 2006 project was used to explore the role of the school principal in the integration of ICT in South African secondary schools is provided. This chapter also includes an illustration of how the SITES 2006 data was accessed and a description of the types of data and how the data was managed and analysed. Concluding this chapter is a discussion relating to the trustworthiness and ethical considerations of this study.

3.2 Underlying paradigm (Philosophical foundation)

A paradigm is described by Willis (2007) as a wide-ranging structure of thoughts and beliefs guiding the researcher in a specific field of study. According to Cohen, Manion and Morrison (2008), there are a number of paradigms with different theories on instruction and learning guiding examination into human behaviour, educational practices, forms of assessment, curriculum as well as policies.

Research involves three types of philosophical assumption. The first assumption underpinning the philosophical foundation of research is ontology - the view on reality of the phenomena being researched (Cohen et al., 2008). Ontology leads to the second assumption, epistemology - research can uncover knowledge of a phenomenon and this knowledge can be communicated (*Ibid*). Markie (2013) describes epistemology as the branch of philosophy devoted to exploring the nature, source and limits of knowledge. These aforementioned two assumptions inform the third assumption, the methodology used to generate knowledge (Cohen et al., 2008).

The ontological, epistemological and methodological assumptions used by the researcher during the process of data analysis are discussed in the next paragraphs.

3.2.1 Ontological assumptions

Two possible ontological lenses through which the researcher views social phenomena are an objective or a subjective view. Two contrasting schools of ontology named by Cohen et al. (2008) that form the basis of different types of educational research, are positivism and interpretivism.

In the analysis of the data from the principals' questionnaire of the SITES 2006 project, the researcher followed the ontological assumptions of positivism. This study involves objective hypotheses testing. This was done through hypotheses statements relating to the effect an independent variable has on a dependent variable for the purpose of predicting and confirming behavioural patterns in a scientific and objective manner.

This study endeavours to reveal objective truths relating to the human behaviour of the participating South African school principal in the ICT integration process in instruction and learning by means of proving or disproving hypotheses.

3.2.2 Epistemological assumption

As this study is a secondary data analysis, the researcher followed the epistemological stance of rationalist theory, believing that the sources for the justification of knowledge are positioned in logical and mathematical principles. The rationalist theory is discussed in the following paragraphs.

3.2.2.1 Rationalist theory

The rationalist theory relies on intellectual and deductive reason in order to understand reality - reality has a rational structure that can be understood by means of mathematical and logical principles (Markie, 2013).

The exploration of the data depends on mathematical principles to measure relationships between the various dependent and independent variables identified from the principals' questionnaire of the SITES 2006 project.

3.2.3 Methodological assumption

Guba and Lincoln (1994:108) define the main question relating to the term methodology as “How can the inquirer (would-be knower) go about finding out whatever he or she believes can be known?”

This integrated qualitative and quantitative secondary data analysis study attempts to analyze the categorical data relating to the applicable variables collected by the SITES 2006 project through statistical methods.

3.3 Research design

An integrated qualitative-quantitative study method was employed by using the data of the principals' questionnaire of the SITES 2006 project. It involved analysing the qualitative data collected by the IEA for SITES 2006. The qualitative data was transformed into numerical data for the purpose of analysis by means of quantitative analysis methods (Srnka & Koeszegi, 2007).

A secondary data analysis study is explained in the succeeding paragraphs.

3.3.1 Secondary data analysis study

A secondary data analysis study is described by Irwin and Winterton (2011) as the re-use of previously gathered data for the purpose of gaining new methodological, scientific or sociological understandings of a phenomenon.

This study re-used the data from the South African principals' questionnaire of the SITES 2006 project. The SITES 2006 study provides an extraordinary opportunity to explore data related to ICT implementation in instruction and learning of 22 education systems across the world. A Technical Report User Guide (Carstens & Pelgrum, 2009) as well as an International Report (Brese & Carstens, 2009) was published by the IEA that can be used collectively to enable accurate research on the data and findings of the SITES 2006 project.

3.3.2 The South African SITES 2006 sample

Globally 22 education systems providing Mathematics and Science education to Grade 8 learners participated in SITES 2006 (Carstens & Pelgrum, 2009). A representative sample of between 400 and 500 schools was drawn from each of the 22 participating education systems (Howie & Blignaut, 2009). A total number of 445 South African schools were sampled by means of stratified probability sampling (Carstens & Pelgrum, 2009). According to Carstens and Pelgrum (2009) explicit stratification was carried out for the South African school sample by means of expected ICT usage, region (for unknown ICT-use) and school size whereas implicit stratification was done by province.

Carstens and Pelgrum (2009) distinguish between two target populations: the school sample and the teachers' sample. The school sample comprised one principal and one school-based ICT coordinator per participating school (*Ibid*). The teachers' sample consisted of two, and in some cases four (depending on school-size) Grade Eight Mathematics and Science teachers from the participating schools (*Ibid*).

This study analysed the data collected with the South African school principals' questionnaire for the SITES 2006 project. The data relating to the following three questions was extracted from the principals' questionnaire: Question 13 (See Addendum A: Question 13 A, E, F, H, I and J), Question 16 (See Addendum B: Question 16 A, and I), Question 6 (See Addendum C: Question 6 E, F, G, H, I, J and K), as well as Question 27, 28, 29, 31 and 34 (See Addendum D).

3.3.3 Data collection methods of SITES 2006 (South Africa)

The collection of the qualitative data for the SITES 2006 project for South African participants took place during October and November of the year 2006 (Law et al., 2008). According to Howie (2010) trained fieldworkers were used to collect the South African data from schools. In the case of isolated South African schools, instruments were left at schools by means of couriers, to be collected again after completion (*Ibid*). Plomp and Voogt (2009) state that of the 22 participating education systems, 18 made use of an online data collection method (ODC),

whereas three participating education systems used a combination of ODC and a pen-and-paper response method. South Africa was the only participating education system using only a pen-and-paper response method (Blignaut et al., 2010b).

The data of all the participating education systems was captured by means of WinDEM (Windows Data Entry Manager), an IEA software package designed for the purpose of capturing large amounts of survey data (Blignaut et al., 2010a). The Data Processing Centre of the IEA performed the data cleaning, processing and weighting where after the data was analyzed by the IRCs of the 22 participating education systems (*Ibid*). The final international SITES 2006 report was released in 2008 (*Ibid*).

3.3.4 Data gathering instruments

SITES 2006 administered questionnaires for the National Research Coordinators (NRCs) of each participating education system (Howie, 2010). One of the questions directed to the NRCs of the different education systems was whether the development of 21st century skills was promoted by their policy documents (Law et al., 2010).

According to Carstens and Pelgrum (2009) SITES 2006 developed and administered questionnaires at two additional levels:

- At school level, a principal and a technical questionnaire.
- At teacher level, a teacher questionnaire.

The contents of the principals' questionnaire covered issues relating to teaching practice, school and teacher development, support and obstacles related to ICT-use as well as the background and characteristics of schools (Plomp & Voogt, 2009).

Question 13 of the principals' questionnaire consists of the priority school principals could give to the acquisition of various leadership competencies in order to enhance ICT integration in instruction and learning. Question 16 comprises the ICT-related obstacles that could hinder the school's capacity to realise its' pedagogical

goals, whereas question six comprises the priority school principals could give to resource allocation in order to enhance the use of ICT in instruction and learning.

The obstacles and priorities that form the categories of question 13, 16 and six were used as the dependent and independent variables of this study. Finally, question 27, 28, 29, 31 and 34 relating to the personal characteristics of the participating school principals were used as control variables.

Table 3.1 illustrates the dependent and independent variables grouped into the human factors “vision” and “expertise” of the Four-in-Balance-Model.

**Table 3.1: Dependent and independent variables of the human factors
“vision” and “expertise”**

Factors	Component	Dependent variable	Independent variable
Human factors	Vision	Developing a common pedagogical vision among teaching staff in the school (BCP13A1).	To broaden teachers' pedagogical repertoire and to widen their pedagogical competence to engage in new methods of teaching and learning (BCP06H1).
		Developing a common pedagogical vision among teaching staff in the school (BCP13A1).	To provide teachers with incentives (including salary adjustment, promotion) to integrate ICT-use in their teaching and learning (BCP06J1).
		Developing a common pedagogical vision among teaching staff in the school (BCP13A1).	To improve the technical skills of teachers (BCP06F1).
		Promoting the integration of ICT in the teaching and learning of traditional subjects (BCP13I1).	To improve the technical skills of teachers (BCP06F1).
		Promoting the integration of ICT in the teaching and learning of traditional subjects (BCP13I1).	To increase the number of teachers using ICT for teaching and learning purposes (BCP06K1).
		Promoting the integration of ICT in the teaching and learning of traditional subjects (BCP13I1).	To improve student's ICT skills (BCP06I1).

**Table 3.2: Dependent and independent variables of the human factors
“vision” and “expertise” (continued)**

Fac-tors	Com-po-nent	Dependent variable	Independent variable
Human factors	Expertise	Teachers' lack of ICT skills (BCP16I1).	Promoting the collaboration between teachers of different subjects (BCP13E1).
		Teachers' lack of ICT skills (BCP16I1).	To improve the technical skills of teachers (BCP06F1).
		Teachers' lack of ICT skills (BCP16I1).	To improve the ability of teachers to make good pedagogical use of ICT (BCP06G1).
		Teachers' lack of ICT skills (BCP16I1).	Managing the adoption of ICT-supported methods for assessing student progress (BCP13F1).
		Insufficient technical personnel to support ICT-use (BCP16A1)	To establish/enhance an online learning support platform and its management so that teaching and learning can take place anytime, anywhere (BCP06E1)
		Insufficient technical personnel to support ICT-use (BCP16A1)	Organising cooperation with other schools regarding the development of ICT-based teaching and learning (BCP13H1)
		Insufficient technical personnel to support ICT-use (BCP16A1)	To develop a strategic plan for integrating ICT-use in teaching and learning (BCP13J1)

Question 13 (See Addendum A) asked of school leaders/principals to select options from a four-point Likert scale ranging from “not considered” to “high priority” in reply to the following question:

How much of a priority is it for your school leadership to acquire competencies in the following areas?

- *Developing a common pedagogical vision among teaching staff in the school.*
- *Promoting collaboration between teachers of different subjects.*
- *Managing the adoption of ICT-supported methods for assessing student progress.*
- *Organising cooperation with other schools regarding the development of ICT-based teaching and learning.*
- *Promoting the integration of ICT in the teaching and learning of traditional subjects.*

- *Developing a strategic plan for integrating ICT-use in teaching and learning.*

Question 16 (See Addendum B), asked school leaders/principals to select an option from a five-point Likert scale ranging from “not at all” to “not applicable” as answer to the following question:

To what extent is your school's capacity to realise its pedagogical goals hindered by each of the following obstacles?

- *Teachers' lack of ICT skills.*
- *Insufficient qualified technical personnel to support the use of ICT.*

The “not applicable” option was removed before analysing any relationship relating to the two aforementioned obstacles of Question 16.

Question 6 (See Addendum C), required school leaders/principals to select options from a four-point Likert scale ranging from “not a priority” to “high priority” in response to the following question:

What priority level do you give to resource allocation in your school in order to enhance the use of ICT in teaching and learning?

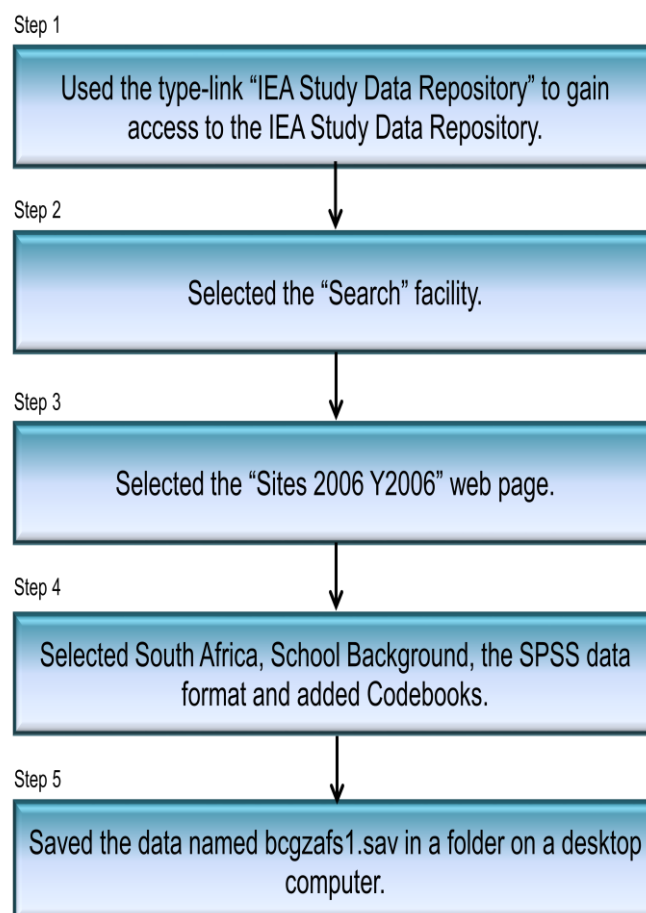
- *To establish/enhance an online learning support platform and its management so that teaching and learning can take place anytime, anywhere.*
- *To improve the technical skills of teachers.*
- *To improve the ability of teachers to make good pedagogical use of ICT.*
- *To broaden teachers' pedagogical repertoire and to widen their pedagogical competence to engage in new methods of teaching and learning.*
- *To improve students' ICT skills.*
- *To provide teachers with incentives to integrate ICT-use in their teaching and learning.*
- *To increase the number of teachers using ICT for teaching/learning purposes.*

Questions 27, 28, 29, 31 and 34 (See Addendum D) related to the personal background characteristics of the South African principals and were computed as control variables for the purpose of examining the possible causal nature of the relationships between the different variables. The aforementioned questions asked of principals to indicate their years of experience, age, gender, frequency of computer use as well as whether they use a computer for school related activities and/or to connect to the Internet.

3.3.5 Data gathering methods

The five steps used to gather the data of the South African principals' questionnaire from the IEA database are illustrated in Figure 3.1.

Figure 3.1: The five steps used to gather the data of the South African principals' questionnaire from the IEA database



3.4 Analysis of the SITES 2006 data of the principals' questionnaire

3.4.1 Statistical techniques and data types

Pallant (2013) distinguishes between two different types of statistical techniques: non-parametric as well as parametric techniques. The author explains that the word *parametric* is derived from “parameter”, or the attribute of a specific population. The purpose of using parametric tests (Pallant, 2013) is to make assumptions about a sample of the population, which at times includes assumptions about the distribution shape of such a population. However, distribution-free non-parametric techniques do not make assumptions about the underlying distribution of the sample of a population and are ideal for the measurement of categorical data scales (*Ibid*).

The data collected by the SITES 2006 project is qualitative data of categorical character. For the purpose of this study, non-parametric techniques, such as Chi-Squares, Fisher’s Exact Tests, Cramer’s V and Kendall’s Tau-B/C were used for the measurement of categorical data. Categorical data can further be divided into ordinal and nominal data. Nominal data involves categories that do not have a particular order, such as gender, colour or race (Agresti, 2007). However, ordinal data consists of inherent ordered scales, such as a response to a question in the form of “low priority”, “medium priority” or “high priority” (*Ibid*).

3.4.2 Statistical analysis

The analysis of the qualitative data of the principals’ questionnaire was done descriptively as well as inferentially by means of the statistical software package SPSS V22.

Descriptive statistics are generated to portray whether the proportions between two or more groups within the various personal characteristics of the participating school principals are equal (null hypothesis) or different (alternative hypothesis) by means of the statistical test of significance (Pearson Chi-Square). To determine statistical significance, the “Sig. value” needs to be equal to .05, or smaller (Pallant,

2013). In addition frequencies and percentages are illustrated by means of column graphs.

Inferential statistics were calculated by means of bivariate (two variables) and multivariate (three variables) cross-tabulations to verify frequencies, statistical significance (two-way Pearson Chi-Square or Fisher's Exact Test of significance) as well as strength of associations. In cross-tabulations between two categorical variables, observed cases are distributed between the cells of the table. The increase in the number of cells in a cross-tabulation often results in smaller numbers of observed cases, which complicates efficient interpretation and the generation of meaningful results. When the observed number of cases is small, statistical inferences can be generated by means of Fisher's Exact Test of significance (Agresti, 2007).

The strength of the association between two (bivariate cross-tabulations) or three variables (multivariate cross-tabulations) was determined by making use of the Chi-Square based Cramer's V in the case of a cross-tabulation between ordinal and nominal variables. In the case of a measurement between two ordinal variables, the Kendall's Tau-B was used for square tables (equal number of rows and columns), and the Kendall's Tau-C in the case of rectangular tables.

Ordinal data with many categories can be transformed (collapsed) into manageable categories by means of re-coding, a process that results in cell counts of more equal numbers (Pallant, 2013). The variables that have been re-coded by means of SPSS V22 will appear at the bottom of the data file (*Ibid*).

The following personal principal characteristics have been re-coded for the purpose of the data analysis of this study and appear at the bottom of the bczafs1.sav file:

- Age (BCP28A1) re-coded and named NewAge.
- How often does the principal personally use a computer (BCP31A1) re-coded and named FrequencyComputerUse.
- Years of experience as principal at any school (BCP27A1) re-coded and named ExperienceAsPrincipalAnySchool.

- Years of experience as principal at this school (BCP27B1) re-coded and named ExperienceAsPrincipalAtThisSchool.
- Years of experience in any professional capacity at this school (BCP27C1) re-coded and named AnyProfessionalCapacityAtThisSchool.

3.5 Trustworthiness

The IEA originated in 1958 and has been involved in comparative educational research for the past 50 years (Carstens & Pelgrum, 2009; Plomp & Voogt, 2009). Examples of such studies are the Progress in International Reading Literacy Studies (PIRLS) and the Trends in Mathematics and Science Studies (TIMSS). Between 1998 and 2006 the SITES M1, SITES M2 and SITES 2006 studies were carried out by the IEA (Voogt & Plomp, 2010). The data collection procedures followed by the SITES 2006 study complied with the international guidelines of SITES and answered to the international standards of the IEA (Howie, 2010).

An international conglomerate comprising the University of Hong Kong, University of Twente, the Data Processing and Research Center of the IEA in Germany as well as the IEA Secretariat in the Netherlands managed the SITES 2006 project (Carstens & Pelgrum, 2009). NRCs (National Research Coordinators) were appointed for each country for the purpose controlling the compilation and capturing of data in the national language (Blignaut et al., 2010a). The South African NRCs were commended for their data integrity as well as the quality of their fieldwork (*Ibid*).

The researcher endeavoured to generate research findings for this study that are credible (internal validity), dependable (reliability) and transferable (external validity). These research concepts have been used by researchers to describe trustworthiness (Guba, 1981; Shenton, 2004).

Shenton (2004) states that data gathering and data analysis procedures should be derived from prior documented research projects. This study has been shaped by prior documented research projects (See Chapter 2), with specific reference to prior research relating to the SITES 2006 project in order to attain credibility (internal validity). Furthermore, the research questions selected for this study are similar to

those used for the principals' questionnaire of the SITES 2006 project, an important aspect influencing the validity of a study, as affirmed by prior research (Long-Sutehall, Sque & Addington-Hall, 2010; Irwin & Winterton, 2011).

Dependability was achieved by comprehensive reporting (See Chapter 4) of the research methods used for this study, enabling repeatability as well as understanding.

Srnka and Koeszegi (2007) affirm that the process of changing qualitative matter into categorical data, enables the researcher to generalise results and to develop hypotheses from statistics.

3.6 Ethical considerations

Each participating education system had to comply with the international guidelines and procedures of SITES 2006 as well as with the national ethical codes of the different education systems (Brese & Carstens, 2009). South African National Research Coordinators (NRCs) obtained permission from the Department of Education to administer the questionnaires in South African schools (Blignaut et al., 2010a). The fieldwork was carried out by trained master's students of Tshwane University of Technology (TUT) who received survey research course material (*Ibid*). Formal consent was obtained from the Dramatic Artistic and Literary Rights Organization (DALRO) before this material was distributed to fieldworkers (*Ibid*).

For the purpose of this study the researcher obtained ethics clearance from the ethics committee of the University of Pretoria. Additionally the researcher obtained permission to use the South African data from Prof. Sarah Howie, who was one of the South African NRCs for the SITES 2006 project. Prof. Sarah Howie is currently a Professor in the Department of Science, Mathematics and Technology Education at the University of Pretoria and the Director of the Centre for Evaluation and Assessment in Education and Training. The ethical process compels the researcher to use the SITES 2006 data in a responsible way while following the ethics guidelines of the University of Pretoria.

Chapter 4

Analysis of Data and Interpretation of Results

4.1 Introduction

The data analysis process undertaken for this study is described in this chapter.

The researcher analysed the data generated by the South African school principals' sample of the SITES 2006 project by making use of the statistical software package SPSS V22. Descriptive as well as inferential analysis was conducted to explore the South African school principals' data of SITES 2006. The SPSS V22 data outputs for the descriptive (Addendum E) and inferential analysis (Addendum F, G and H) are available on a Compact Disk and included in this dissertation.

4.2 Description of data (Descriptive analysis)

According to Carstens and Pelgrum (2009) SITES 2006 developed and administered two questionnaires at school level, one completed by the principal as manager of the school, and one by the schools' ICT coordinator. The contents of the principals' questionnaire covered issues relating to teaching practice, school and teacher development, support and obstacles related to ICT-use as well as the background and characteristics of schools (Plomp & Voogt, 2009).

The 451 school principals' personal background characteristics and the missing cases of each of the aforementioned characteristics, are specified in Table 4.1.

Table 4.1: Personal background characteristics and missing cases

Personal background characteristic	Respon- dents	Classification of missing data codes	Missing cases	Total cases
Gender	439	Not reached*	4	451
		Omitted†	2	
		System‡	6	

Table 4.1: Personal background characteristics and missing cases
(continued)

Personal background characteristic	Respon- dents	Classification of missing data codes	Missing cases	Total cases
Age	440	Not reached	3	451
		Omitted	2	
		System	6	
How often does the principal personally use a computer?	376	System	7	451
Does the principal use a computer to connect to the Internet?	383	Logically not applicable [§]	50	451
		Not reached	9	
		Omitted	3	
		System	6	
Does the principal use a computer for school related activities?	385	Logically not applicable	50	451
		Not reached	7	
		Omitted	3	
		System	6	
Years of experience as principal at any school	413	System	38	451
Years of experience as principal at this school	426	System	25	451
Years of experience in any professional capacity at this school	393	System	58	451

*The respondent started to complete the questionnaire, but did not reach a specific question (Carstens & Pelgrum, 2009).

[†]Questions that were read by the respondents, but left unanswered (*Ibid*).

[‡]First replacement schools replaced by system due to similar implicit stratification (by province) characteristics of sampled schools.

[§]Answers to a filter questions making the response to a follow-up question logically impossible (*Ibid*).

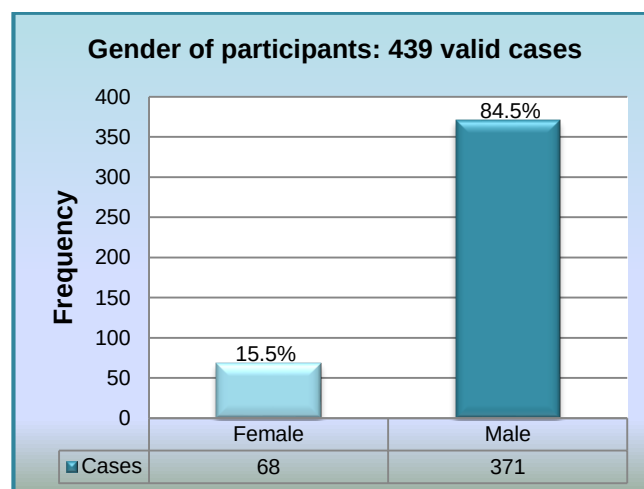
The descriptive analysis of the data focuses on various principal personal background characteristics that could possibly influence the school principals' vision and perception towards the expertise of school management and teachers in order to enhance ICT integration in instruction and learning in South African secondary schools. The following principal personal background characteristics are presented in the form of column graphs:

- Gender of participants.
- Age of participants.
- How often does the principal personally use a computer?
- Does the principal use a computer to connect to the Internet?
- Does the principal use a computer for school related activities?
- Years of experience as principal at any school.
- Years of experience as principal at this school.
- Years of experience in any professional capacity at this school.

4.2.1 Gender of participants

The gender distribution of the South African principals who took part in the SITES 2006 project is illustrated in Figure 4.1. The principal questionnaire covered issues related to the ICT policy and practice of instruction and learning in South African secondary schools. Figure 4.1 indicates that 84.5% (n = 371) of the sample

Figure 4.1: Gender of participants



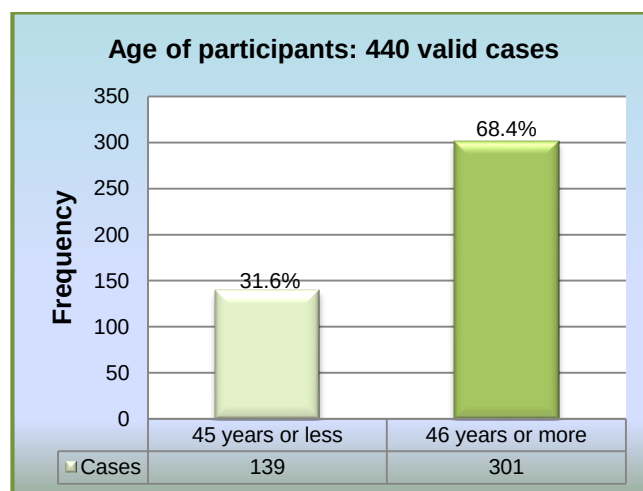
Graph compiled from data available in Addendum E.1. consisted of male principals while 15.5% (n = 68) were female.

The frequencies of the number of “Female” and the number of “Male” participants of the “Gender” variable differ significantly as shown by a one-way Chi² analysis (See Table 4.2 for a summary of the one-way Chi² analysis).

4.2.2 Age of participants

Respondents were asked to indicate their age category from the following five options: “30 years or less”; “31 to 35 years”; “36 to 45 years”; “46 to 55 years” and “more than 55 years”. Data consisting of several categories can be transformed (combined) by means of recoding, particularly if the frequencies in some of the categories have zero or very small counts relative to the total sample size of these variables (Northwestern University Medical School and the Office of Basic Science Research Computing, 1997). The data relating to the “Age” variable was re-coded into the following two categories: “45 years or less” and “46 years or more”. As illustrated in Figure 4.2, 68.4% (n = 301) of the sample consisted of principals who were older than 46 years and 31.6% (n = 139) of principals were 45 years old or younger.

Figure 4.2: Age of participants



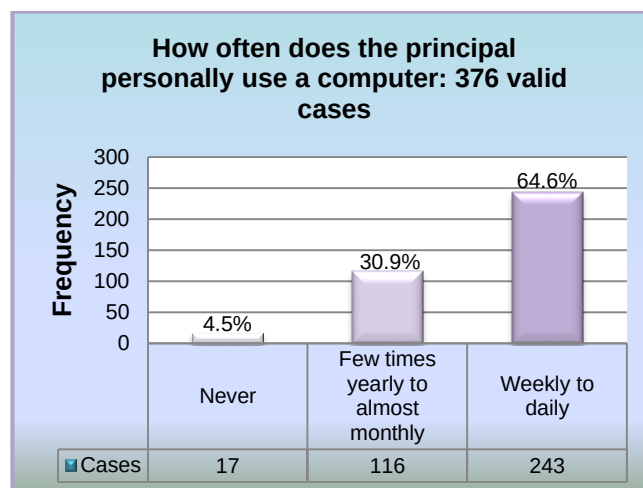
Graph compiled from data available in Addendum E.2.

A one-way Chi² analysis shows that the number of principals in the categories “45 years or less” and “46 years or more” of the “Age” variable, is statistically significantly different.

4.2.3 How often does the principal personally use a computer?

In answer to the question how often the respondents personally use a computer, they had to choose one from five options: “Never”; “A few times per year”; “Almost monthly”; “Weekly” and “Daily”. The data relating to the variable “How often do you personally use a computer?” was re-coded and renamed into the following three options: “Never”; “Few times yearly to almost monthly” and “Weekly to daily”. Figure 4.3 shows that 4.5% (n = 17) of South African principals never use a computer, whereas 30.9% (n = 116) use a computer only a few times yearly to almost monthly and the computer use of 64.6% (n = 243) is weekly to daily.

Figure 4.3: How often does the principal personally use a computer?



Graph compiled from data available in Addendum E.3.

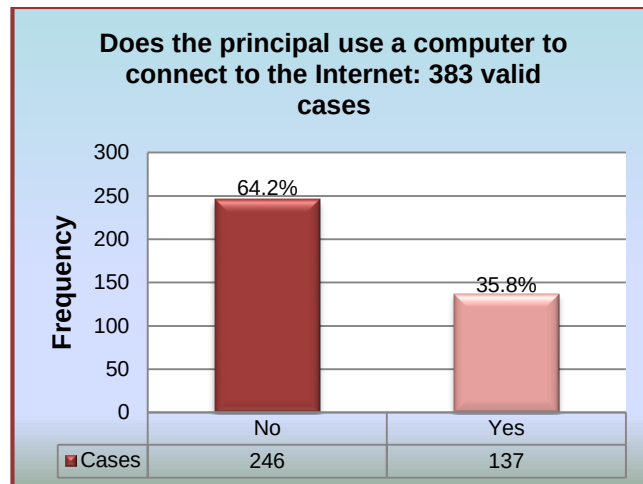
According to a one-way Chi² analysis the frequencies in the categories “Never”; “Few times yearly to almost monthly” and “Weekly to daily” are not uniformly distributed. This means that the frequencies differ significantly.

4.2.4 Does the principal use a computer to connect to the Internet?

The principals were asked whether connecting to the Internet was a computer-related activity they participated in. The respondents had to answer “No” or “Yes”. Figure 4.4 shows the distribution of principals using a computer to connect to the Internet as opposed to those who do not. The number of respondents who do not

use a computer for the purpose of connecting to the Internet, was 246 (64.2%) while 35.8% (n = 137) did.

Figure 4.4: Does the principal use a computer to connect to the Internet?



Graph compiled from data available in Addendum E.4.

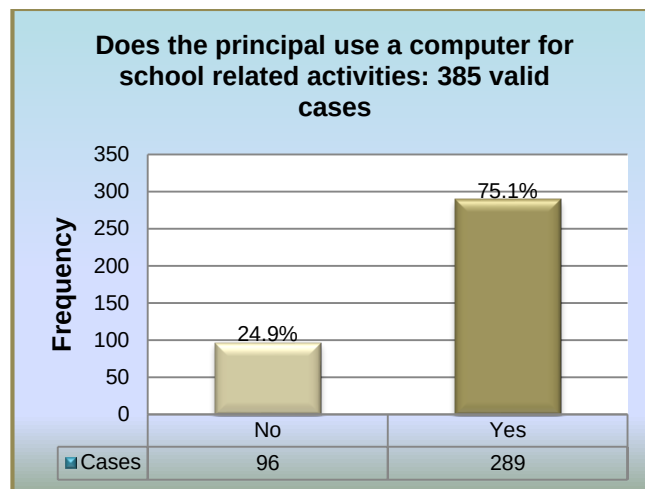
The frequencies of the number of principals answering “Yes” and the number of principals answering “No” differ significantly as shown by a one-way Chi² analysis.

4.2.5 Does the principal use a computer for school related activities?

The participants had to make a choice between “No” or “Yes” to indicate their computer use for the purpose of school related activities. The results that emerge from Figure 4.5 show that 24.9% (n = 96) do not use a computer for school related activities, whereas 289 (75.1%) of the respondents do.

A one-way Chi² analysis shows that the number of principals answering “No” and the number of principals answering “Yes” is statistically significantly different.

Figure 4.5: Does the principal use a computer for school related activities?



Graph compiled from data available in Addendum E.5.

4.2.6 Years of professional experience

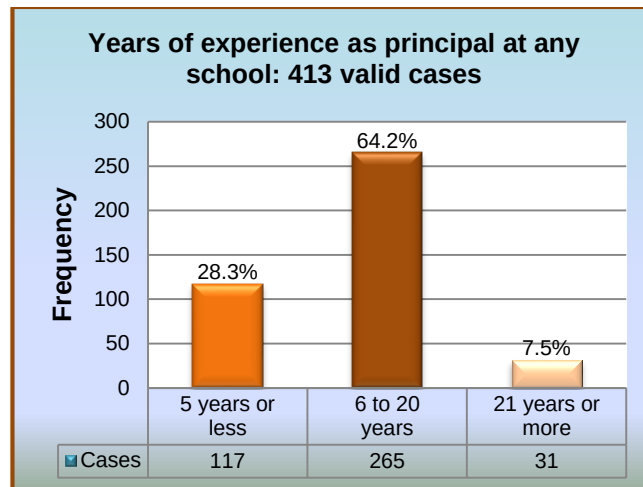
Participants had to answer the following three sub-questions relating to their professional experience in years: “(A) Principal of any school (Including years as principal in this school); (B) Principal of this school and (C) Working in any professional capacity at this school (including years as teacher, vice-principal or principal)” (Brese & Carstens, 2009).

The principals had to indicate their years of professional experience by means of choosing one of the following five categories: “Less than 3 years”; “3 – 5 years”; “6 – 10 years”; “11 – 20 years” and “21 years or more”. The data pertaining to the three variables involving the years of professional experience of the participants, was re-coded into the following three categories: “5 years or less”; “6 to 20 years” and “21 years or more” (See Addendum E.6, E.7 and E.8).

4.2.6.1 Years of experience as principal at any school

According to Figure 4.6 the statistics show that the greater part of the participants (64.2%) had 6 to 20 years of experience, while 28.3% had 5 years or less experience and only 7.5% had more than or equal to 21 years of experience as principal at any school.

Figure 4.6: Years of experience as principal at any school



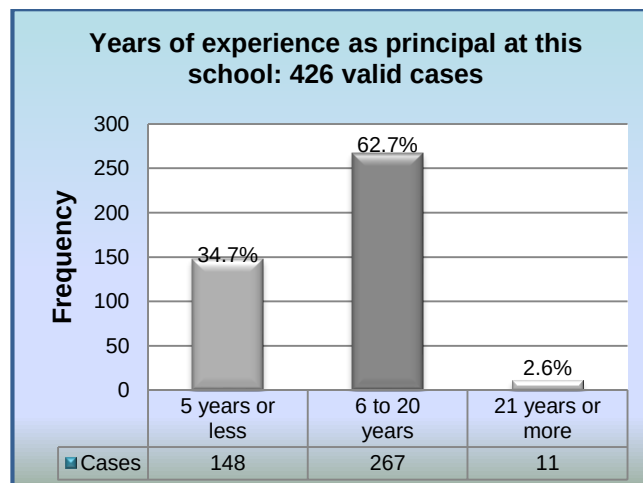
Graph compiled from data available in Addendum E.6.

A one-way Chi² analysis shows that the number of principals in the categories “5 years or less”; “6 to 20 years” and “21 years or more” is statistically significantly different.

4.2.6.2 Years of experience as principal at this school

The years of experience as principal at this school is illustrated by Figure 4.7. A number of 267 (62.7%) of the participants had 6 to 20 years of experience at their

Figure 4.7: Years of experience as principal at this school



Graph compiled from data available in Addendum E.7.

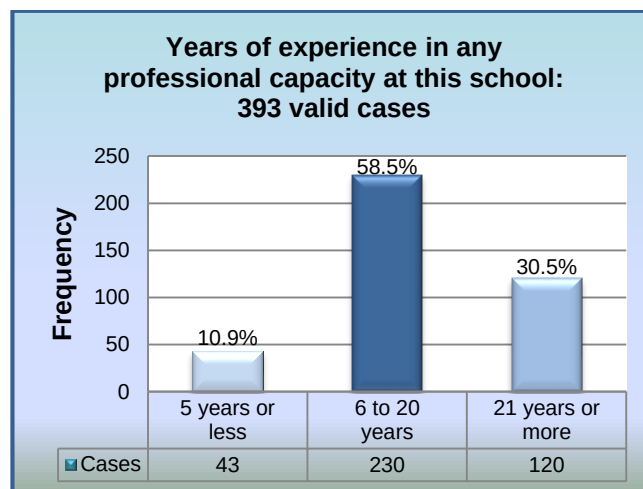
current school. The number of principals with five years or less experience was 148 (34.7%), while 2.6% (n = 11) had 21 years or more experience at their current school.

According to a one-way Chi² analysis the frequencies in the categories “5 years or less”; “6 to 20 years” and “21 years or more” are not uniformly distributed. This means that the frequencies differ significantly.

4.2.6.3 Years of experience in any professional capacity at this school

Figure 4.8 reveals that 58.5% (n = 230) of principals had “6 to 20 years” of experience in any professional capacity at their current school. The number of principals with “21 years or more” experience was 120 (30.5%), while 43 (10.9%) principals had “5 years or less” years of experience.

Figure 4.8: Years of experience in any professional capacity at this school



Graph compiled from data available in Addendum E.8.

The frequencies of the number of principals with “5 years or less”; “6 to 20 years” and “21 years or more” years of experience differ significantly as shown by a one-way Chi² analysis.

4.2.7 Summary of principal personal background characteristics

A summary of the principal personal background characteristics and their significance, is given in Table 4.2.

Table 4.2: Summarised personal background characteristics

Personal background characteristics	Chi ²	Categories	Frequency	Significantly different
Gender	$X^2 (1, n = 439) = 209.132, p \leq .05$	Female	68 (15.5%)	✓
		Male	371 (84.5%)	
Age	$X^2 (1, n = 440) = 59.645, p \leq .05$	45 years or less	139 (31.6%)	✓
		46 years or more	301 (68.4)	
How often does the principal personally use a computer?	$X^2 (2, n = 376) = 204.803, p \leq .05$	Never	17 (4.5%)	✓
		Few times yearly to almost monthly	116 (30.9%)	
		Weekly to daily	243 (64.6%)	
Does the principal use a computer to connect to the Internet?	$X^2 (1, n = 383) = 31.021, p \leq .05$	No	246 (64.2%)	✓
		Yes	137 (35.8%)	
Does the principal use a computer for school related activities?	$X^2 (1, n = 385) = 96.751, p \leq .05$	No	96 (24.9%)	✓
		Yes	289 (75.1%)	
Years of experience as principal at any school	$X^2 (2, n = 413) = 203.525, p \leq .05$	5 years or less	117 (28.3%)	✓
		6 to 20 years	265 (64.2%)	
		21 years or more	31 (7.5%)	
Years of experience as principal at this school	$X^2 (2, n = 426) = 231.141, p \leq .05$	5 years or less	148 (34.7%)	✓
		6 to 20 years	267 (62.7%)	
		21 years or more	11 (2.6%)	

Table 4.2: Summarised personal background characteristics (continued)

Personal background characteristics	Chi ²	Categories	Frequency	Significantly different
Years of experience in any professional capacity at this school	$\chi^2 (2, n = 393) = 134.855, p \leq .05$	5 years or less	43 (10.9%)	✓
		6 to 20 years	230 (58.5%)	
		21 years or more	120 (30.5%)	

All categories of the control variables (personal background characteristics of principals) are statistically significantly different ($p \leq .05$).

4.3 Analysis of data (Inferential analysis)

The inferential analysis of the data was completed in four phases. The first phase was conducted by determining the Pearson Chi-Square/Fisher's Exact Tests of significance to understand the relationship between each of the dependent and independent variables relating to the human factors "vision" and "expertise". The Fisher's Exact Test of significance was used in the case of expected cell counts less than five.

Due to the complexity of the Fisher's Exact calculation, if done by hand, the test is only viable in the case of contingency tables containing two rows and two columns (Mehta & Patel, 1996). However, according to the authors, a software package like SPSS enables fast, efficient and accurate computations of the Fisher's Exact Test of significance. When used for the data of this study, the Fisher's Exact Test of significance was computed by means of the Monte Carlo algorithm of the SPSS V22 software package. "Monte Carlo algorithms provide an estimate of the exact P value, called the Monte Carlo P value ... typically; their result is 99% accurate" (Mehta & Patel 1996:23).

The dependent and independent variables selected from Question 13, 16 and 6 of the principal questionnaire, were explored to examine the relationship between the leadership role of the principal and the integration of ICT in instruction and learning in South African schools.

To determine how strong the association between the two variables is, the Chi-Square-based Cramer's V was also calculated in the case of a cross-tabulation between ordinal and nominal variables.

When the level of measurement was between two ordinal variables, the Kendall's Tau-B was used in the case of square tables (equal number of rows and columns) and Kendall's Tau-C for tables with unequal number of rows or columns.

Table 4.3 was used to interpret the strength of the association based on the Kendall's Tau-B/C or Cramer's V values.

Table 4.3: Interpretation of Kendall's Tau-B/C or Cramer's V measures of association

Kendall's Tau-B/C or Cramer's V	Strength
Less than + or -0.10	Very weak association
+ or -0.11 to 0.18	Weak association
+ or -0.19 to 0.29	Moderate association
+ or -0.30 or above	Strong association

If the bivariate relationship was one of significance (the observed frequency was significantly different from the expected frequency at a p-value of $\leq .05$) and if the relationship was at least of moderate strength, further exploration would be required.

In the second phase, the personal background characteristics of the principals were introduced as control variables to examine the contributory effect these characteristics have on the original cross-tabulation. This was done in the form of multivariate cross-tabulations using SPSS V22.

For the third phase of analysis, the control variables (personal background characteristics) were cross-tabled with the dependent variable to examine if the relationship differs from the multivariate relationship in the second phase of analysis.

The possible algorithm for exploration during the fourth phase of analysis could be whether the multivariate relationship is a direct, extraneous, joint, interactive, intervening or suppressed relationship (in the same order of exploration):

- Direct relationship – the correlation of the original bivariate relationship between the dependent and independent variable remains almost the same (within $|\cdot 10|$ of each other) through all categories of the control variable (Losh, 2009).
- Extraneous relationship – the correlation of the original bivariate relationship between the dependent and independent variable remains almost the same (within $|\cdot 10|$ of each other) through all categories of the control variable, but the Kendall's Tau-B/C or Cramer's V value of the Dependent and control variable is very weak (*Ibid*).
- Joint relationship – the independent as well as the control variable “jointly” influence the dependent variable (both relationships are significant) (*Ibid*).
- Interactive relationship – the correlation between the original dependent and independent variables changes through the categories of the control variable (equal to, or more than $|\cdot 10|$ of each other) (*Ibid*).
- Intervening relationship – the correlation between the original dependent and independent variables becomes smaller through the categories of the control variable (less than $|\cdot 10|$ of each other) (*Ibid*).
- Suppressed relationship – the separate correlations of each of the categories of the control variables are within $|\cdot 10|$ of each other, but are at least $|\cdot 10|$ bigger than the original bivariate correlation of the dependent and independent variables (*Ibid*).

The “eyeball” rule (no formal test of statistical inference) was used to compare the association between the relevant values of the multivariate tables. These values had to remain within $|\cdot 10|$ (the rule of thumb) of one another.

Significant relationships are illustrated by means of a coloured background as well as an asterisk if the relationship is significant with $p \leq .05$. The output of the SPSS V22 inferential analysis is available on a Compact Disk and accompanies this dissertation.

4.3.1 Developing a common pedagogical vision among teaching staff in the school and to broaden teachers' pedagogical repertoire and to widen their pedagogical competence

4.3.1.1 First phase of analysis

During the first phase of analysis the Fisher's Exact Test of significance was used as three cells had an expected count of less than five. The relationship between the two variables "developing a common pedagogical vision among teaching staff in the school" and "to broaden teachers' pedagogical repertoire and to widen their pedagogical competence" illustrated in Table 4.4, proved to be statistically significant ($p \leq .05$, Fisher's Exact Test) (See Addendum F.1). The Kendall's Tau-C measure of association was used in the original bivariate table between the dependent variable and independent variable. The association is weak, measuring .182.

Table 4.4: Developing a common pedagogical vision among teaching staff in the school and to broaden teachers' pedagogical repertoire and to widen their pedagogical competence

Broaden teachers' repertoire	Develop a common pedagogical vision				
	Not a priority	Low priority	Medium priority	High priority	Total
Low priority	3	1	5	5	14
%	21.4	7.1	35.7	35.4	100
Medium priority	16	12	21	26	75
%	21.3	16	28	34.6	100
High priority	29	15	56	215	315
%	9.2	4.7	17.7	68.2	100
Total	48	28	82	246	404
%	11.8	6.9	20.2	60.8	100

Chi-square/Fisher's Exact Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	37.200 ^a	6	.000
Fisher's Exact Test	36.632	-	.000
No of valid cases	404		
a. 3 of the cells (25.0%) have expected counts of less than 5. The minimum expected count is .97.			
Symmetric Measures			
	Value		
Kendall's Tau-C	.182		
No of valid cases	404		

Table 4.4 reveals that 68.2% (n = 215) of principals indicated that “broadening teachers’ pedagogical repertoire and widening their pedagogical competence” was a “high priority” as well as “developing a common pedagogical vision amongst the teaching staff in a school”.

Although the bivariate relationship was significant, the association was weak; therefore no further exploration was required.

4.3.2 Developing a common pedagogical vision among teaching staff in the school and to provide teachers with incentives to integrate ICT-use in their teaching and learning

4.3.2.1 First phase of analysis

During the first phase of analysis, the Fisher’s Exact Test of significance was used as four cells had an expected count of less than five. The relationship between the two variables “developing a common pedagogical vision among teaching staff in the school” and “to provide teachers with incentives to integrate ICT in their teaching and learning” is illustrated in Table 4.5. This relationship proved to be statistically significant ($p \leq .05$, Fisher’s Exact Test) (See Addendum F.2). The Kendall’s Tau-C measure of association was used in the original bivariate table between the dependent variable and independent variable. The association is weak measuring .135.

Table 4.5 reveals that 36.3% (n = 113) of principals indicated that “developing a common pedagogical vision among teaching staff in the school” was a “high priority” while they also regarded “providing teachers with incentives to integrate ICT-use in their teaching and learning” as a “high priority”.

Although the bivariate relationship was significant, the association was weak; therefore no further exploration was required.

Table 4.5: Developing a common pedagogical vision among teaching staff in the school and to provide teachers with incentives to integrate ICT-use in their teaching and learning

Provide teachers with incentives Develop a common pedagogical vision	Not a priority	Low priority	Medium priority	High priority	Total	Chi-square/Fisher's Exact Tests			
							Value	Df	Asymp. Sig. (2-sided)
Low priority	5	3	5	1	14	Pearson Chi-Square	18.836 ^a	6	.004
%	35.7	21.4	35.7	7.2	100	Fisher's Exact Test	20.347	-	.002
Medium priority	30	17	17	11	75	No of valid cases	401		
%	40	22.7	22.7	14.6	100	a. 4 of the cells (33.3%) have expected counts of less than 5. The minimum expected count is 2.62.			
High priority	79	55	65	113	312	Symmetric Measures			
%	25.3	17.6	20.8	36.3	100		Value		
Total	114	75	87	125	401	Kendall's Tau-C	.135		
%	28.4	18.7	21.7	31.2	100	No of valid cases	401		

4.3.3 Developing a common pedagogical vision among teaching staff in the school and to improve the technical skills of teachers

4.3.3.1 First phase of analysis

During the first phase of analysis, the Fisher's Exact Test of significance was used as three cells had an expected count of less than five. The relationship between the two variables "developing a common pedagogical vision among teaching staff in the school" and "to improve the technical skills of teachers" is illustrated in Table 4.6.

This relationship proved to be statistically significant ($p \leq 0.05$, Fisher's Exact Test) (See Addendum F.3). The Kendall's Tau-C measure of association was used in the original bivariate table between the dependent variable and independent variable. The association is weak, measuring .171.

Table 4.6: Developing a common pedagogical vision among teaching staff in the school and to improve the technical skills of teachers

Improve teachers' technical skills Develop a common pedagogical vision					
	Not a priority	Low priority	Medium priority	High priority	Total
Low priority	4	1	4	5	14
%	28.6	7.1	28.6	35.7	100
Medium priority	13	11	24	27	75
%	17.3	14.7	32	36	100
High priority	30	20	47	215	312
%	9.6	6.4	15.1	68.9	100
Total	47	32	75	247	401
%	11.7	8	18.7	61.6	100

Chi-square/Fisher's Exact Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	34.003 ^a	6	.000
Fisher's Exact Test	33.902	-	.000
No of valid cases	401		
a. 3 of the cells (25.0%) have expected counts of less than 5. The minimum expected count is 1.12.			
Symmetric Measures			
	Value		
Kendall's Tau-C	.171		
No of valid cases	401		

Table 4.6 reveals that 68.9% (n = 215) of principals indicated that “developing a common pedagogical vision among teaching staff of the school” was a “high priority” while they also regarded “improving the technical skills of teachers”, as a “high priority”.

Although the bivariate relationship was significant, the association was weak; therefore no further exploration was required.

4.3.4 Promoting the integration of ICT in the teaching and learning of traditional subjects and to improve the technical skills of teachers

4.3.4.1 First phase of analysis

During the first phase of analysis, the Fisher's Exact Test of significance was used as two cells had an expected count of less than five. The relationship between the two variables “promoting the integration of ICT in the teaching and learning of traditional subjects” and “to improve the technical skills of teachers” is illustrated in

Table 4.7. This relationship proved to be statistically significant ($p \leq .05$, Fisher's Exact Test) (See Addendum F.4). The Kendall's Tau-C measure of association was used in the original bivariate table between the dependent variable and independent variable. The association is moderate measuring .199.

Table 4.7 reveals that 78.7% ($n = 133$) of principals indicated that "promoting the integration of ICT in the teaching and learning of traditional subjects" was a "high priority" while they also regarded "improving the technical skills of teachers" as a "high priority".

The bivariate relationship was significant, the association was weak; therefore further exploration was required.

Table 4.7: Promoting the integration of ICT in the teaching and learning of traditional subjects and to improve the technical skills of teachers

Improve teachers' technical skills Pro-moting the inte-gration of ICT in tradi-tional subjects						
	Not a priority	Low priority	Medium priority	High priority	Total	
	Low priority	7	9	12	16	44
	%	15.9	20.4	27.3	36.4	100
	Medium priority	5	9	36	88	138
	%	3.6	6.5	26.1	63.8	100
	High priority	13	6	17	133	169
	%	7.7	3.6	10	78.7	100
	Total	25	24	65	237	351
	%	7.2	6.8	8.5	67.5	100

Chi-square/Fisher's Exact Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	44.203 ^a	6	.000
Fisher's Exact Test	41.937	-	.000
No of valid cases	351		
a. 2 of the cells (16.7%) have expected counts of less than 5. The minimum expected count is 3.01.			
Symmetric Measures			
	Value		
Kendall's Tau-C	.199		
No of valid cases	351		

4.3.4.2 Second phase of analysis

If the bivariate relationship between the original dependent and independent variable in Phase 1 was statistically significant and was, at least of moderate

strength, control variables were introduced to determine the possible causal nature of the association. A detailed summary of all the personal background characteristics of the principal, introduced as control variables during the second phase, is provided in Table 4.8 (See Addendum G.1 (a) – G.1 (h)).

4.3.4.3 Third phase of analysis

For the third phase of analysis, the control variables (personal background characteristics) were cross-tabled with the dependent variable (See Addendum H.1), as illustrated in Table 4.9, to examine if the relationship differs from the multivariate relationship.

All the data of the control variables showed no statistical significance with the exception of the following three control variables:

- Gender indicating a weak association ($r(373) = .130, p < .05$).
- Principals who used a computer to connect to the Internet indicating a weak association ($r(326) = .188, p < .05$).
- Principals who used a computer for school related activities indicating a weak association ($r(328) = .148, p < .05$).

4.3.4.4 Fourth phase of analysis

The possible algorithm for exploration during the fourth phase of analysis could be whether the multivariate relationship is a direct, extraneous, joint, interactive, intervening or suppressed relationship (in the precise order of exploration). The “eyeball” rule (no formal test of statistical inference) was used to compare the association between the relevant values of the multivariate tables. These values had to remain within $|.10|$ (the rule of thumb) of one another. The following changes emerged across the multivariate cross-tabulations (See Table 4.10 and Addendum I):

- Direct Relationship – Age and principals who used a computer for school related activities.
- Extraneous Relationship – Age

- Joint Relationship – Gender, principals who used a computer to connect to the Internet and principals who used a computer for school related activities.
- Statistical Interaction – Frequency of computer use, years of experience as principal at any school, years of experience as principal at the current school and years of experience in any professional capacity at the current school.

Table 4.8: Promoting the integration of ICT in the teaching and learning of traditional subjects and to improve the technical skills of teachers/Control variables

Promoting the integration of ICT in traditional subjects/Improving the technical skills of teachers	Principal personal characteristics	Categories	Number of participants	P-value	Significance	Multivariate relationship	Kendall's Tau-B/C or Cramer's V	Strength of association
	Gender	Female	52	.016*	Yes	$r^{\dagger}(n = 52) = .351, p \leq .05, FET^{\S}$	.351	Strong
		Male	294	.000*	Yes	$r(n = 294) = .254, p \leq .05, FET$	.254	Moderate
	Age	45 years or less	102	.015*	Yes	$r(n = 102) = .185, p \leq .05, FET$	.185	Weak
		46 years or more	245	.000*	Yes	$r(n = 245) = .204, p \leq .05, FET$	.204	Moderate
	How often does the principal personally use a computer?	Never	15	.273	No	$r(n = 15) = .133, p = .273, FET$	.133	Weak
		Few times yearly to almost monthly	85	.159	No	$r(n = 85) = .171, p = .159, FET$	.171	Weak
		Weekly to daily	211	.000*	Yes	$r(n = 211) = .249, p \leq .05, FET$	.249	Moderate
	Does the principal use a computer to connect to the Internet?	No	184	.004*	Yes	$r(n = 184) = .231, p \leq .05, FET$	.231	Moderate
		Yes	119	.000*	Yes	$r(n = 119) = .314, p \leq .05, FET$	.314	Strong
	Does the principal use a computer for school related activities?	No	61	.086	No	$r(n = 61) = .257, p = .056, FET$	.257	Moderate
		Yes	244	.000*	Yes	$r(n = 244) = .275, p \leq .05, FET$	.275	Moderate

Table 4.8: Promoting the integration of ICT in the teaching and learning of traditional subjects and to improve the technical skills of teachers/Control variables (continued)

Promoting the integration of ICT in traditional subjects/improving the technical skills of teachers	Principal personal characteristics	Categories	Number of participants	P-value	Significance	Relationship	Kendall's Tau-B/C or Cramer's V	Strength of association
	Years of experience as principal at any school	5 years or less	86	.000*	Yes	$r(n = 86) = .251, p \leq .05, \text{FET}$	.251	Moderate
		6 to 20 years	221	.001*	Yes	$r(n = 221) = .187, p \leq .05, \text{FET}$	.187	Weak
		21 years or more	22	.446	No	$r(n = 22) = .111, p = .446, \text{FET}$	.111	Weak
	Years of experience as principal at this school	5 years or less	110	.000*	Yes	$r(n = 110) = .287, p \leq .05, \text{FET}$	.287	Moderate
		6 to 20 years	221	.006*	Yes	$r(n = 221) = .168, p \leq .05, \text{FET}$	.168	Weak
		21 years or more	7	0 [‡]	0	$r(n = 7) = .245, p = 0, \text{FET}$	.245	Moderate
	Years of experience in any professional capacity at this school	5 years or less	32	.027*	Yes	$r(n = 32) = .272, p \leq .05, \text{FET}$	.272	Moderate
		6 to 20 years	177	.000*	Yes	$r(n = 177) = .265, p \leq .05, \text{FET}$	.265	Moderate
		21 years or more	101	.060	No	$r(n = 101) = .083, p = .060, \text{FET}$	.083	Very Weak

*The association is significant at $\leq .05$ (2-sided).

[†]r: Relationship

[‡]4 of the cells (100%) have expected counts of less than 5. The minimum expected count is .43.

[§]FET: Fisher's Exact Test

Table 4.9: Promoting the integration of ICT in the teaching and learning of traditional subjects/Control variables

Promoting the integration of ICT in the teaching and learning of traditional subjects	Principal personal characteristics	Number of participants	P-value	Significance	Relationship	Kendall's Tau-B/C or Cramer's V	Strength of association
	Gender	373	.042*	Yes	$r^{\dagger} (n = 373) = .130, p = \leq 0.05$	.130	Weak
	Age	374	.580	No	$r (n = 374) = .049, p = .580$	.049	Very weak
	How often does the principal personally use a computer?	333	.754	No	$r (n = 333) = -.050, p = .754, \text{FET}^{\ddagger}$	-.050	Very weak
	Does the principal use a computer to connect to the Internet?	326	.003*	Yes	$r (n = 326) = .188, p = \leq 0.05$	.188	Weak
	Does the principal use a computer for school related activities?	328	.028*	Yes	$r (n = 328) = .148, p = \leq 0.05$	.148	Weak
	Years of experience as principal at any school	355	.359	No	$r (n = 355) = -.082, p = .359, \text{FET}$	-.082	Very weak
	Years of experience as principal at this school	363	.234	No	$r (n = 363) = -.091, p = .234, \text{FET}$	-.091	Very weak
	Years of experience in any professional capacity at this school	334	.598	No	$r (n = 334) = .059, p = .598, \text{FET}$	.059	Very weak

*The association is significant at $\leq .05$ (2-sided).

$\dagger r$: Relationship

$\ddagger \text{FET}$: Fisher's Exact Test

Table 4.10: Multivariate table elaboration summary

Promoting the integration of ICT in the teaching and learning of traditional subjects/To improve the technical skills of teachers	Relationship	Explanation	Control variables							
			Gen-der	Age	How often does principal use a computer	Use com-puter to connect to Internet	Use computer for school related activities	Experience as principal at any school	Experience as principal at this school	Experience in any pro-fessional capacity at this school
	Direct	[2] = [3(a)] = [3(b)] = [3(c)]	No	Yes	No	No	Yes	No	No	No
	Extraneous	[2] = [3(a)] = [3(b)] = [3(c)] and [5] is small	No	Yes	No	No	No	No	No	No
	Joint	[6] and [7] = significant	Yes	No	No	Yes	Yes	No	No	No
	Statistical Interaction	[3(a)] <> [3(b)] <> [3(c)]	No	No	Yes	No	No	Yes	Yes	Yes
	Intervening/Spurious	[3(a)] < [2] and [3(b)] < [2] and [3(c)] < [2]	No	No	-	No	No	-	-	-
	Suppressed	[3(a)] > [2] and [3(b)] > [2] and [3(c)] > [2]	No	No	-	No	No	-	-	-

[2] Original bivariate cross-tabulation (Dependent and Independent variables) Kendall's Tau-B/C or Cramer's V value (See Addendum F4).

[3(a)] Multivariate cross-tabulation (Dependent and Independent and Control variables) Kendall's Tau-B/C or Cramer's V category (a) value (See Addendum G1 (a) – G1 (h)).

[3(b)] Multivariate cross-tabulation (Dependent and Independent and Control variables) Kendall's Tau-B/C or Cramer's V category (b) value (See Addendum G1 (a) – G1 (h)).

[3(c)] Multivariate cross-tabulation (Dependent and Independent and Control variables) Kendall's Tau-B/C or Cramer's V category (c) value (See Addendum G1 (a) – G1 (h)).

[5] Bivariate cross-tabulation (Dependent and Control variables) Kendall's Tau-B/C or Cramer's V value (See Addendum H1 – H8).

[6] Original bivariate cross-tabulation (Dependent and Independent variables) Chi²/Fisher's Exact significance (see Addendum F4).

[7] Bivariate cross-tabulation (Dependent and control variables) Chi²/Fisher's Exact significance (See Addendum H1 – H8).

4.3.5 Promoting the integration of ICT in the teaching and learning of traditional subjects and to increase the number of teachers using ICT for teaching and learning purposes

4.3.5.1 First phase of analysis

During the first phase of the analysis the Fisher's Exact Test of significance was used as two cells had an expected count of less than five. The relationship between the two variables "promoting the integration of ICT in the teaching and learning of traditional subjects" and "to increase the number of teachers using ICT for teaching and learning purposes" is illustrated in Table 4.11. This relationship proved to be statistically significant ($p \leq .05$, Fisher's Exact Test) (See Addendum F.5). The Kendall's Tau-C measure of association was used in the original bivariate table between the dependent variable and independent variable. The association is moderate, measuring .258.

Table 4.11: Promoting the integration of ICT in the teaching and learning of traditional subjects and to increase the number of teachers using ICT for teaching and learning purposes

Increase the number of teachers using ICT Promoting the integration of ICT in traditional subjects	Chi-square/Fisher's Exact Tests				
	Not a priority	Low priority	Medium priority	High priority	Total
Low priority	10	9	15	10	44
%	22.7	20.5	34.1	22.7	100
Medium priority	9	7	45	78	139
%	6.5	5	32.4	56.1	100
High priority	15	5	21	130	171
%	8.8	2.9	12.3	76	100
Total	34	21	81	218	354
%	9.6	5.9	22.9	61.6	100

Chi-square/Fisher's Exact Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	61.410 ^a	6	.000
Fisher's Exact Test	57.847	-	.000
No of valid cases	354		
a. 2 of the cells (16.7%) have expected counts of less than 5. The minimum expected count is 2.61.			
Symmetric Measures			
	Value		
Kendall's Tau-C	.258		
No of valid cases	354		

Table 4.11 reveals that 76% ($n = 130$) of principals indicated that “promoting the integration of ICT in the teaching and learning of traditional subjects” was a “high priority” while they also regarded “increasing the number of teachers using ICT for teaching and learning purposes” as a “high priority”.

The bivariate relationship was significant and the association was moderate; therefore further exploration was required.

4.3.5.2 Second phase of analysis

If the relationship between the original dependent and independent variable in Phase 1 was statistically significant and was at least of moderate strength, control variables would have to be introduced to determine the possible causal nature of the association. A detailed summary of all the personal background characteristics of the principal, introduced as control variables to the bivariate cross-tabulations during the second phase, is illustrated in Table 4.12 (See Addendum G.2 (a) – G.2 (h)).

4.3.5.3 Third phase of analysis

For the third phase of the analysis, the control variables (personal background characteristics) were cross-tabled with the dependent variable, as illustrated in Table 4.13, to examine if the relationship differs from the multivariate relationship of the second phase (See Addendum H.1).

All the data of the control variables showed no statistical significance with the exception of the following three control variables:

- Gender indicating a weak association ($r(373) = .130, p < .05$).
- Principals who used a computer to connect to the Internet indicating a weak association ($r(326) = .188, p < .05$).
- Principals who used a computer for school related activities indicating a weak association ($r(328) = .148, p < .05$).

4.3.5.4 Fourth phase of analysis

The possible algorithm for exploration during the fourth phase of the analysis could be whether the multivariate relationship is a direct, extraneous, joint, interactive,

intervening or suppressed relationship (in the precise order of exploration). The “eyeball” rule (no formal test of statistical inference) was used to compare the association between the relevant values of the multivariate tables. These values had to remain within $|\cdot 10|$ (the rule of thumb) of one another. The following changes emerged across the multivariate cross-tabulations (See Table 4.14 and Addendum I):

- Direct Relationship – Age, principals who used a computer to connect to the Internet and principals who used a computer for school related activities.
- Extraneous Relationship – Age
- Joint Relationship – Gender, principals who used a computer to connect to the Internet and principals who used a computer for school related activities.
- Statistical Interaction – Gender, frequency of computer use, years of experience as principal at any school, years of experience as principal at the current school and years of experience in any professional capacity at the current school.

Table 4.12: Promoting the integration of ICT in the teaching and learning of traditional subjects and to increase the number of teachers using ICT for teaching and learning purposes/Control variables

Promoting the integration of ICT in traditional subjects/To increase the number of teacher using ICT for teaching and learning purposes	Principal personal characteristics	Categories	Number of participants	P-value	Significance	Multivariate relationship	Kendall's Tau-B/C or Cramer's V	Strength of association
	Gender	Female	54	.003*	Yes	$r^{\dagger}(n = 54) = .474, p \leq .05, FET^{\dagger}$	.474	Strong
		Male	295	.000*	Yes	$r(n = 295) = .279, p \leq .05, FET$	.279	Moderate
	Age	45 years or less	101	.001*	Yes	$r(n = 101) = .312, p \leq .05, FET$	.312	Strong
		46 years or more	249	.000*	Yes	$r(n = 249) = .240, p \leq .05, FET$	.240	Moderate
	How often does the principal personally use a computer?	Never	15	.182	No	$r(n = 15) = .120, p = .182, FET$	.120	Weak
		Few times yearly to almost monthly	87	.025*	Yes	$r(n = 87) = .195, p \leq .05, FET$	.195	Moderate
		Weekly to daily	212	.000*	Yes	$r(n = 212) = .335, p \leq .05, FET$	.335	Strong
	Does the principal use a computer to connect to the Internet?	No	186	.000*	Yes	$r(n = 186) = .276, p \leq .05, FET$	.276	Moderate
		Yes	120	.000*	Yes	$r(n = 120) = .330, p \leq .05, FET$	.330	Strong
	Does the principal use a computer for school related activities?	No	60	.056	No	$r(n = 60) = .298, p = .056, FET$	.298	Moderate
		Yes	248	.000*	Yes	$r(n = 248) = .295, p \leq .05, FET$	.295	Moderate

Table 4.12: Promoting the integration of ICT in the teaching and learning of traditional subjects and to increase the number of teachers using ICT for teaching and learning purposes/Control variables (continued)

Promoting the integration of ICT in traditional subjects/To increase the number of teachers using ICT for teaching and learning purposes	Principal personal characteristics	Categories	Number of participants	P-value	Significance	Relationship	Kendall's Tau-B/C or Cramer's V	Strength of association
	Years of experience as principal at any school	5 years or less	86	.000*	Yes	$r(n = 86) = .184, p \leq .05, \text{FET}$	.184	Weak
		6 to 20 years	223	.000*	Yes	$r(n = 223) = .266, p \leq .05, \text{FET}$	.266	Moderate
		21 years or more	26	.045*	Yes	$r(n = 26) = .346, p \leq .05, \text{FET}$	.346	Strong
	Years of experience as principal at this school	5 years or less	111	.000*	Yes	$r(n = 111) = .236, p \leq .05, \text{FET}$	.236	Moderate
		6 to 20 years	223	.000*	Yes	$r(n = 223) = .283, p \leq .05, \text{FET}$	.283	Moderate
		21 years or more	7	1.000	No	$r(n = 7) = .490, p = 1.000, \text{FET}$	.490	Strong
	Years of experience in any professional capacity at this school	5 years or less	32	.054	No	$r(n = 32) = .290, p = .054, \text{FET}$	.290	Moderate
		6 to 20 years	178	.000*	Yes	$r(n = 178) = .350, p \leq .05, \text{FET}$	.350	Strong
		21 years or more	103	.182	No	$r(n = 103) = .086, p = .182, \text{FET}$	.086	Very Weak

*The association is significant at $\leq .05$ (2-sided).

†r: Relationship

‡FET: Fisher's Exact Test

Table 4.13: Promoting the integration of ICT in the teaching and learning of traditional subjects/Control variables

Promoting the integration of ICT in the teaching and learning of traditional subjects	Principal personal characteristics	Number of participants	P-value	Significance	Relationship	Kendall's Tau-B/C or Cramer's V	Strength of association
	Gender	373	.042*	Yes	$r^{\dagger} (n = 373) = .130, p \leq .05$	.130	Weak
	Age	374	.580	No	$r (n = 374) = .049, p = .580$	.049	Very weak
	How often does the principal personally use a computer?	333	.754	No	$r (n = 333) = -.050, p = .754, \text{FET}^{\ddagger}$	-.050	Very weak
	Does the principal use a computer to connect to the Internet?	326	.003*	Yes	$r (n = 326) = .188, p \leq .05$	.188	Weak
	Does the principal use a computer for school related activities?	328	.028*	Yes	$r (n = 328) = .148, p \leq .05$	.148	Weak
	Years of experience as principal at any school	355	.359	No	$r (n = 355) = -.082, p = .359, \text{FET}$	-.082	Very weak
	Years of experience as principal at this school	363	.234	No	$r (n = 363) = -.091, p = .234, \text{FET}$	-.091	Very weak
	Years of experience in any professional capacity at this school	334	.598	No	$r (n = 334) = .059, p = .598, \text{FET}$	.059	Very weak

*The association is significant at $\leq .05$ (2-sided).

$\dagger r$: Relationship

$\ddagger \text{FET}$: Fisher's Exact Test

Table 4.14: Multivariate table elaboration summary

Promoting the integration of ICT in the teaching and learning of traditional subjects/To increase the number of teachers using ICT for teaching and learning purposes	Relationship	Explanation	Control variables							
			Gender	Age	How often does principal use a computer	Use computer to connect to Internet	Use computer for school related activities	Experience as principal at any school	Experience as principal at this school	Experience in any professional capacity at this school
	Direct	$[2] = [3(a)] = [3(b)] = [3(c)]$	No	Yes	No	Yes	Yes	No	No	No
	Extraneous	$[2] = [3(a)] = [3(b)] = [3(c)]$ and [5] is small	No	Yes	No	No	No	No	No	No
	Joint	[6] and [7] = significant	Yes	No	No	Yes	Yes	No	No	No
	Statistical Interaction	$[3(a)] \leftrightarrow [3(b)] \leftrightarrow [3(c)]$	Yes	No	Yes	No	No	Yes	Yes	Yes
	Intervening/Spurious	$[3(a)] < [2]$ and $[3(b)] < [2]$ and $[3(c)] < [2]$	-	No	-	No	No	-	-	-
	Suppressed	$[3(a)] > [2]$ and $[3(b)] > [2]$ and $[3(c)] > [2]$	-	No	-	No	No	-	-	-

[2] Original bivariate cross-tabulation (Dependent and Independent variables) Kendall's Tau-B/C or Cramer's V value (See Addendum F5).

[3(a)] Multivariate cross-tabulation (Dependent and Independent and Control variables) Kendall's Tau-B/C or Cramer's V category (a) value (See Addendum G2 (a) – G2 (h)).

[3(b)] Multivariate cross-tabulation (Dependent and Independent and Control variables) Kendall's Tau-B/C or Cramer's V category (b) value (See Addendum G2 (a) – G2 (h)).

[3(c)] Multivariate cross-tabulation (Dependent and Independent and Control variables) Kendall's Tau-B/C or Cramer's V category (c) value (See Addendum G2 (a) – G2 (h)).

[5] Bivariate cross-tabulation (Dependent and Control variables) Kendall's Tau-B/C or Cramer's V value (See Addendum H1 – H8).

[6] Original bivariate cross-tabulation (Dependent and Independent variables) Chi²/Fisher's Exact significance (See Addendum F5).

[7] Bivariate cross-tabulation (Dependent and Control variables) Chi²/Fisher's Exact significance (See Addendum H1 – H8)).

4.3.6 Promoting the integration of ICT in the teaching and learning of traditional subjects and to improve students' ICT skills

4.3.6.1 First phase of analysis

During the first phase of the analysis the Fisher's Exact Test of significance was used as two cells had an expected count of less than five. The relationship between the two variables "promoting the integration of ICT in the teaching and learning of traditional subjects" and "to improve students' ICT skills" is illustrated in Table 4.15. This relationship proved to be statistically significant ($p \leq .05$, Fisher's Exact Test) (See Addendum F.6). The Kendall's Tau-C measure of association was used in the original bivariate table between the dependent variable and independent variable. The association is moderate, measuring .217.

Table 4.15: Promoting the integration of ICT in the teaching and learning of traditional subjects and to improve students' ICT skills

Improve Students' ICT skills Promoting the integration of ICT in traditional subjects	Not a priority	Low priority	Medium priority	High priority	Total
Low priority %	11 25	7 15.9	11 25	15 34.1	44 100
Medium priority %	10 7.1	11 7.9	34 24.3	85 60.7	140 100
High priority %	14 8.3	5 3	19 11.2	131 77.5	169 100
Total %	35 10	23 6.5	64 18.1	231 65.4	353 100

Chi-square/Fisher's Exact Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	40.608 ^a	6	.000
Fisher's Exact Test	38.754	-	.000
No of valid cases	353		
a. 2 of the cells (16.7%) have expected counts of less than 5. The minimum expected count is 2.87.			
Symmetric Measures			
	Value		
Kendall's Tau-C	.217		
No of valid cases	353		

Table 4.15 reveals that 77.5% ($n = 131$) of principals indicated that “promoting the integration of ICT in the teaching and learning of traditional subjects” was a “high priority” while they also regarded “improving students’ ICT skills as a high priority”.

The bivariate relationship was significant and the association was moderate; therefore further exploration was required.

4.3.6.2 Second phase of analysis

If the relationship between the original dependent and independent variable in Phase 1 was statistically significant and was at least of moderate strength, control variables were introduced to determine the possible causal nature of the association. A detailed summary of all the personal background characteristics of the principal, introduced as control variables to the bivariate cross-tabulations during the second phase, is illustrated in Table 4.16 (See Addendum G.3 (a) – G.3 (h)).

4.3.6.3 Third phase of analysis

For the third phase of the analysis the control variables (personal background characteristics) were cross-tabled with the dependent variable, as illustrated in Table 4.17, to examine if the relationship differs from the multivariate relationship (See Addendum H.1).

All the data of the control variables showed no statistical significance with the exception of the following three control variables:

- Gender indicating a weak association ($r(373) = .130, p < .05$).
- Principals who used a computer to connect to the Internet indicating a weak association ($r(326) = .188, p < .05$).
- Principals who used a computer for school related activities indicating a weak association ($r(328) = .148, p < .05$).

4.3.6.4 Fourth phase of analysis

The possible algorithm for exploration during the fourth phase of analysis could be whether the multivariate relationship is a direct, extraneous, joint, interactive, intervening or suppressed relationship (in the precise order of exploration). The

“eyeball” rule (no formal test of statistical inference) was used to compare the association between the relevant values of the multivariate tables. These values had to remain within $|\pm 0.10|$ (the rule of thumb) of one another. The following changes emerged across the multivariate cross-tabulations (See Table 4.18 and Addendum I):

- Direct Relationship – Gender, age, principals who used a computer to connect to the Internet and years of experience as principal at the current school
- Extraneous Relationship – Gender, age and years of experience as principal at the current school.
- Joint Relationship – Gender, principals who used a computer to connect to the Internet and principals who used a computer for school related activities.
- Statistical Interaction – Frequency of computer use and years of experience as principal at any school.

Table 4.16: Promoting the integration of ICT in the teaching and learning of traditional subjects and to improve students' ICT skills/Control variables

Promoting the integration of ICT in traditional subjects/To improve students' ICT skills	Principal personal characteristics	Categories	Number of participants	P-value	Significance	Multivariate relationship	Kendall's Tau-B/C or Cramer's V	Strength of association
	Gender	Female	52	.127	No	$r^{\dagger}(n = 52) = .274, p = .127, \text{FET}^{\S}$	.274	Moderate
		Male	296	.000*	Yes	$r(n = 296) = .243, p \leq .05, \text{FET}$	.243	Moderate
	Age	45 years or less	101	.017*	Yes	$r(n = 101) = .249, p \leq .05, \text{FET}$	.249	Moderate
		46 years or more	248	.000*	Yes	$r(n = 248) = .205, p \leq .05, \text{FET}$	.205	Moderate
	How often does the principal personally use a computer?	Never	15	.171	No	$r(n = 15) = .120, p = .171, \text{FET}$	.120	Weak
		Few times yearly to almost monthly	87	.032*	Yes	$r(n = 87) = .229, p \leq .05, \text{FET}$	.229	Moderate
		Weekly to daily	211	.000*	Yes	$r(n = 211) = .245, p \leq .05, \text{FET}$	.245	Moderate
	Does the principal use a computer to connect to the Internet?	No	187	.003*	Yes	$r(n = 187) = .246, p \leq .05, \text{FET}$	.246	Moderate
		Yes	118	.001*	Yes	$r(n = 118) = .298, p \leq .05, \text{FET}$	.298	Moderate
	Does the principal use a computer for school related activities?	No	61	.042*	Yes	$r(n = 61) = .321, p \leq .05, \text{FET}$	.321	Strong
		Yes	246	.000*	Yes	$r(n = 246) = .275, p \leq .05, \text{FET}$	.275	Moderate

Table 4.16: Promoting the integration of ICT in the teaching and learning of traditional subjects and to improve students' ICT skills/Control variables (continued)

Promoting the integration of ICT in traditional subjects/ To improve students' ICT skills	Principal personal characteristics	Categories	Number of participants	P-value	Significance	Relationship	Kendall's Tau-B/C or Cramer's V	Strength of association
	Years of experience as principal at any school	5 years or less	86	.098	No	$r(n = 86) = .057, p = .098, \text{FET}$	.057	Very weak
		6 to 20 years	222	.000*	Yes	$r(n = 222) = .228, p \leq .05, \text{FET}$	.228	Moderate
		21 years or more	26	.070	No	$r(n = 26) = .346, p = .070, \text{FET}$	.346	Strong
	Years of experience as principal at this school	5 years or less	111	.003*	Yes	$r(n = 111) = .167, p \leq .05, \text{FET}$	.167	Moderate
		6 to 20 years	222	.000*	Yes	$r(n = 222) = .246, p \leq .05, \text{FET}$	.246	Moderate
		21 years or more	7	0 [‡]	0	$r(n = 7) = .245, p = 0, \text{FET}$	.245	Moderate
	Years of experience in any professional capacity at this school	5 years or less	31	.471	No	$r(n = 31) = .019, p = .471, \text{FET}$	.019	Very Weak
		6 to 20 years	179	.000*	Yes	$r(n = 179) = .341, p \leq .05, \text{FET}$	.341	Strong
		21 years or more	101	.274	No	$r(n = 101) = .049, p = .274, \text{FET}$	.049	Very Weak

*The association is significant at $\leq .05$ (2-sided).

†r: Relationship

‡4 of the cells (100%) have expected counts of less than 5. The minimum expected count is .43.

§FET: Fisher's Exact Test

Table 4.17: Promoting the integration of ICT in the teaching and learning of traditional subjects/Control variables

Promoting the integration of ICT in the teaching and learning of traditional subjects	Principal personal characteristics	Number of participants	P-value	Significance	Relationship	Kendall's Tau-B/C or Cramer's V	Strength of association
	Gender	373	.042*	Yes	$r^{\dagger} (n = 373) = .130, p \leq .05$	.130	Weak
	Age	374	.580	No	$r (n = 374) = .049, p = .580$	.049	Very weak
	How often does the principal personally use a computer?	333	.754	No	$r (n = 333) = -.050, p = .754, \text{FET}^{\ddagger}$	-.050	Very weak
	Does the principal use a computer to connect to the Internet?	326	.003*	Yes	$r (n = 326) = .188, p \leq .05$	.188	Weak
	Does the principal use a computer for school related activities?	328	.028*	Yes	$r (n = 328) = .148, p \leq .05$	.148	Weak
	Years of experience as principal at any school	355	.359	No	$r (n = 355) = -.082, p = .359, \text{FET}$	-.082	Very weak
	Years of experience as principal at this school	363	.234	No	$r (n = 363) = -.091, p = .234, \text{FET}$	-.091	Very weak
	Years of experience in any professional capacity at this school	334	.598	No	$r (n = 334) = .059, p = .598, \text{FET}$	.059	Very weak

*The association is significant at $\leq .05$ (2-sided).

$\dagger r$: Relationship

$\ddagger \text{FET}$: Fisher's Exact Test

Table 4.18: Multivariate table elaboration summary

Promoting the integration of ICT in the teaching and learning of traditional subjects/To improve students' ICT skills	Relationship	Explanation	Control variables							
			Gender	Age	How often does principal use a computer	Use computer to connect to Internet	Use computer for school related activities	Experience as principal at any school	Experience as principal at this school	Experience in any professional capacity at this school
	Direct	[2] = [3(a)] = [3(b)] = [3(c)]	Yes	Yes	No	Yes	No	No	Yes	No
	Extraneous	[2] = [3(a)] = [3(b)] = [3(c)] and [5] is small	Yes	Yes	No	No	No	No	Yes	No
	Joint	[6] and [7] = significant	Yes	No	No	Yes	Yes	No	No	No
	Statistical Interaction	[3(a)] <> [3(b)] <> [3(c)]	No	No	Yes	No	No	Yes	No	Yes
	Intervening/Spurious	[3(a)] < [2] and [3(b)] < [2] and [3(c)] < [2]	No	No	-	No	No	-	No	-
	Suppressed	[3(a)] > [2] and [3(b)] > [2] and [3(c)] > [2]	No	No	-	No	No	-	No	-

[2] Original bivariate cross-tabulation (Dependent and Independent variables) Kendall's Tau-B/C or Cramer's V value (See Addendum F6).

[3(a)] Multivariate cross-tabulation (Dependent and Independent and Control variables) Kendall's Tau-B/C or Cramer's V category (a) value (See Addendum G3 (a) – G3 (h)).

[3(b)] Multivariate cross-tabulation (Dependent and Independent and Control variables) Kendall's Tau-B/C or Cramer's V category (b) value (See Addendum G3 (a) – G3 (h)).

[3(c)] Multivariate cross-tabulation (Dependent and Independent and Control variables) Kendall's Tau-B/C or Cramer's V category (c) value (See Addendum G3 (a) – G3 (h)).

[5] Bivariate cross-tabulation (Dependent and Control variables) Kendall's Tau-B/C or Cramer's V value (See Addendum H1 – H8).

[6] Original bivariate cross-tabulation (Dependent and Independent variables) Chi²/Fisher's Exact significance (See Addendum F6).

[7] Bivariate cross-tabulation (Dependent and Control variables) Chi²/Fisher's Exact significance (See Addendum H1 – H8).

4.3.7 Teachers' lack of ICT skills and promoting the collaboration between teachers of different subjects

4.3.7.1 First phase of analysis

During the first phase of the analysis, the Fisher's Exact Test of significance was used as three cells had an expected count of less than five. The relationship between the two variables "teachers' lack of ICT skills" as obstacle and "promoting the collaboration between teachers of different subjects" is illustrated in Table 4.19. This relationship was not statistically significant ($p = .369$, Fisher's Exact Test) (See Addendum F.7). The Kendall's Tau-C measure of association was used in the bivariate table between the dependent variable and independent variable. The association was very weak measuring .059.

Table 4.19: Teachers' lack of ICT skills and promoting the collaboration between teachers of different subjects

Promoting collaboration between teachers Teachers' lack of ICT skills	Low priority	Medium priority	High priority	Total
Not at all %	2 6.2	10 31.3	20 62.5	32 100
A little %	4 7.8	13 25.5	34 66.7	51 100
Somewhat %	7 7.1	30 30.3	62 62.6	99 100
A lot %	5 2.6	52 26.7	138 70.7	195 100
Total %	18 4.8	105 27.8	254 67.4	377 100

Chi-square/Fisher's Exact Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.569 ^a	6	.473
Fisher's Exact Test	6.364	-	.369
No of valid cases	377		
a. 3 of the cells (16.7%) have expected counts of less than 5. The minimum expected count is 1.53.			
Symmetric Measures			
	Value		
Kendall's Tau-C	.059		
No of valid cases	377		

Table 4.19 reveals that 70.7% (n = 138) of principals indicated that the obstacle “teachers’ lack of ICT skills”, hinder the school’s capacity to realise its’ pedagogical goals “a lot”. The same group of principals regarded “promoting the collaboration between teachers of different subjects”, as a “high priority” to address the obstacle, “teachers’ lack of ICT skills”.

The bivariate relationship was not statistically significant and the association was very weak; therefore no further exploration was required.

4.3.8 Teachers’ lack of ICT skills and to improve the technical skills of teachers

4.3.8.1 First phase of analysis

During the first phase of the analysis, the Fisher’s Exact Test of significance was used as four cells had an expected count of less than five. The relationship between the two variables “teachers’ lack of ICT skills” as obstacle and “to improve the technical skills of teachers” is illustrated in Table 4.20. This relationship was not statistically significant ($p = .072$, Fisher’s Exact Test) (See Addendum F.8). The Kendall’s Tau-B measure of association was used in the original bivariate table between the dependent variable and independent variable. The association was very weak measuring $-.011$.

Table 4.20 reveals that 64% (n = 119) of principals indicated that the obstacle, “teachers’ lack of ICT skills” hindered the school’s capacity to realise its’ pedagogical goals “a lot”. The same group of principals also regarded “improving the technical skills of teachers”, as a “high priority” to address the obstacle, “teachers’ lack of ICT skills”.

The bivariate relationship was not statistically significant and the association was of very weak; therefore no further exploration was required.

Table 4.20: Teachers' lack of ICT skills and to improve the technical skills of teachers

To improve the technical skills of teachers Teachers' lack of ICT skills	Not a priority	Low priority	Medium priority	High priority	Total
Not at all %	3 10	3 10	4 13	20 67	30 100
A little %	4 8.5	4 8.5	14 30	25 53	47 100
Somewhat %	2 2.1	8 8.3	16 16.7	70 72.9	96 100
A lot %	22 11.8	13 7	32 17.2	119 64	186 100
Total %	31 8.6	28 7.8	66 18.4	234 65.2	359 100

Chi-square/Fisher's Exact Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.447 ^a	9	.143
Fisher's Exact Test	14.489	-	.072
No of valid cases	359		
a. 4 of the cells (25%) have expected counts of less than 5. The minimum expected count is 2.34.			
Symmetric Measures			
	Value		
Kendall's Tau-B	-.011		
No of valid cases	359		

4.3.9 Teachers' lack of ICT skills and to improve the ability of teachers to make good pedagogical use of ICT

4.3.9.1 First phase of analysis

During the first phase of the analysis, the Fisher's Exact Test of significance was used as four cells had an expected count of less than five. The relationship between the two variables "teachers' lack of ICT skills" as obstacle and "to improve the ability of teachers to make good pedagogical use of ICT" is illustrated in Table 4.21. This relationship was not statistically significant ($p = .125$, Fisher's Exact Test) (See Addendum F.9). The Kendall's Tau-B measure of association was used in the bivariate table between the dependent variable and independent variable. The association was very weak measuring $-.020$.

Table 4.21 reveals that 62.9% (n = 117) of principals indicated that the obstacle, “teachers’ lack of ICT skills” hindered the school’s capacity to realise its’ pedagogical goals “a lot”. The same group of principals also regarded “improving the ability of teachers to make good pedagogical use of ICT”, as a “high priority” to address the obstacle, “teachers’ lack of ICT skills”.

The bivariate relationship was not statistically significant and the association was very weak; therefore no further exploration was required.

Table 4.21: Teachers’ lack of ICT skills and to improve the ability of teachers to make good pedagogical use of ICT

Improve teachers’ pedagogical use of ICT	Teachers’ lack of ICT skills					Chi-square/Fisher’s Exact Tests			
	Not a priority	Low priority	Medium priority	High priority	Total		Value	Df	Asymp. Sig. (2-sided)
Not at all	3	3	3	21	30	Pearson Chi-Square	13.649 ^a	9	.135
%	10	10	10	70	100	Fisher’s Exact Test	14.442	-	.125
A little	5	2	15	27	49	No of valid cases	361		
%	10.2	4.1	30.6	55.1	100	a. 4 of the cells (25%) have expected counts of less than 5. The minimum expected count is 1.75.			
Somewhat	3	5	24	64	96	Symmetric Measures			
%	3.1	5.2	25	66.7	100		Value		
A lot	24	11	34	117	186	Kendall’s Tau-B	-.020		
%	12.9	5.9	18.3	62.9	100	No of valid cases	361		
Total	35	21	76	229	361				
%	9.7	5.8	21.1	63.4	100				

4.3.10 Teachers’ lack of ICT skills and managing the adoption of ICT-supported methods for assessing student progress

4.3.10.1 First phase of analysis

During the first phase of the analysis, the Pearson Chi-square was used as zero cells had an expected count of less than five. The relationship between the two

variables “teachers’ lack of ICT skills” as obstacle and “managing the adoption of ICT-supported methods for assessing student progress” is illustrated in Table 4.22. This relationship was not statistically significant ($p = .465$) (See Addendum F.10). The Kendall’s Tau-C measure of association was used in the bivariate table between the dependent variable and independent variable. The association was very weak measuring .061.

Table 4.22: Teachers’ lack of ICT skills and managing the adoption of ICT-supported methods for assessing student progress

ICT-supported methods for assessing student progress \ Teachers’ lack of ICT skills	Low priority	Medium priority	High priority	Total
Not at all %	8 25.8	10 32.3	13 41.9	31 100
A little %	6 12.5	17 35.4	25 52.1	48 100
Somewhat %	15 15.6	35 36.5	46 47.9	96 100
A lot %	28 16.3	47 27.3	97 56.4	172 100
Total %	57 16.4	109 31.4	181 52.2	347 100

Chi-square/Fisher’s Exact Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.640 ^a	6	.465
No of valid cases	347		
a. No cells (0.0%) have expected counts of less than 5. The minimum expected count is 5.09.			
Symmetric Measures			
	Value		
Kendall’s Tau-C	.061		
No of valid cases	347		

Table 4.22 reveals that 56.4% ($n = 97$) of principals indicated that the obstacle “teachers’ lack of ICT skills” hindered the school’s capacity to realise its’ pedagogical goals “a lot”. The same group of principals regarded “managing the adoption of ICT-supported methods for assessing student progress” as a “high priority” to address the obstacle “teachers’ lack of ICT skills”.

The bivariate relationship was not statistically significant and the association was very weak; therefore no further exploration was required.

4.3.11 Insufficient qualified technical personnel to support ICT-use and to establish/enhance an online learning support platform and its management so that teaching and learning can take place anytime, anywhere

4.3.11.1 First phase of analysis

During the first phase of the analysis, the Pearson Chi-square was used as zero cells had an expected count of less than five. The relationship between the two variables “insufficient qualified technical personnel to support ICT-use” as obstacle and “to establish/enhance an online learning support platform and its management so that teaching and learning can take place anytime, anywhere” is illustrated in Table 4.23. This relationship proved to be statistically significant ($p \leq 0.05$) (See Addendum F.11). The Kendall’s Tau-B measure of association was used in the

Table 4.23: Insufficient qualified technical personnel and to establish/enhance an online learning support platform and its management

To establish an online learning support platform In-sufficient qualified technical personnel	Not a priority	Low priority	Medium priority	High priority	Total	Chi-square/Fisher’s Exact Tests			
							Value	Df	Asymp. Sig. (2-sided)
Not at all %	5 14.3	9 25.7	10 28.6	11 31.4	35 100	Pearson Chi-Square	24.852 ^a	9	.003
A little %	6 12.2	9 18.4	13 26.5	21 42.9	49 100	No of valid cases	361		
Somewhat %	3 4.6	11 16.9	30 46.2	21 32.3	65 100	a. No cells (0.0%) have expected counts of less than 5. The minimum expected count is 5.72.			
A lot %	47 22.2	30 14.1	47 22.2	88 41.5	212 100				
Total %	61 16.9	59 16.3	100 27.7	141 39.1	361 100	Symmetric Measures			
							Value		
						Kendall’s Tau-B	-.014		
						No of valid cases	361		

bivariate table between the dependent variable and independent variable. The association was very weak measuring $-.014$.

Table 4.23 reveals that 41.5% ($n = 88$) of principals indicated that the obstacle “insufficient qualified technical personnel” hindered the school’s capacity to realise its’ pedagogical goals “a lot”. The same group of principals regarded “to establish/enhance an online learning support platform and its management” as a “high priority” to address the obstacle “insufficient qualified technical personnel”.

Although the bivariate relationship was statistically significant, the association was very weak; therefore no further exploration was required.

4.3.12 Insufficient qualified technical personnel to support ICT-use and organising cooperation with other schools regarding the development of ICT-based teaching and learning

4.3.12.1 First phase of analysis

During the first phase of the analysis, the Pearson Chi-square was used as zero cells had an expected count of less than five. The relationship between the two variables “insufficient qualified technical personnel to support ICT-use” as obstacle and “organising cooperation with other schools regarding the development of ICT-based teaching and learning” is illustrated in Table 4.24. This relationship was not statistically significant ($p = .573$) (See Addendum F.12). The Kendall’s Tau-C measure of association was used in the bivariate table between the dependent variable and independent variable. The association was very weak measuring $.070$.

Table 4.24 reveals that 50.2% ($n = 101$) of principals indicated that the obstacle “insufficient qualified technical personnel” hindered the school’s capacity to realise its’ pedagogical goals “a lot”. The same group of principals also regarded “organising cooperation with other schools regarding the development of ICT-based teaching and learning” as a “high priority” to address the obstacle “insufficient qualified technical personnel”.

Table 4.24: Insufficient qualified technical personnel and organising cooperation with other schools regarding the development of ICT-based teaching and learning

Organising co- operation with other schools In- suffi- cient qualified technical personnel	Low priority	Medium priority	High priority	Total
Not at all %	10 29.4	11 32.4	13 28.2	34 100
A little %	11 23.4	16 34	20 42.6	47 100
Somewhat %	9 15	23 38.3	28 46.7	60 100
A lot %	36 18	64 31.8	101 50.2	201 100
Total %	66 19.3	114 33.3	162 47.4	342 100

Chi-square/Fisher's Exact Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.776 ^a	6	.573
No of valid cases	342		
a. No cells (0.0%) have expected counts of less than 5. The minimum expected count is 6.56.			
Symmetric Measures			
	Value		
Kendall's Tau-C	.070		
No of valid cases	342		

The bivariate relationship was not statistically significant and the association was very weak; therefore no further exploration was required.

4.3.13 Insufficient qualified technical personnel to support ICT-use and to develop a strategic plan for integrating ICT-use in teaching and learning

4.3.13.1 First phase of analysis

During the first phase of the analysis the Pearson Chi-square was used as zero cells had an expected count of less than five. The relationship between the two variables “insufficient qualified technical personnel to support ICT-use” as obstacle and “to develop a strategic plan for integrating ICT-use in teaching and learning” is illustrated in Table 4.25. This relationship was not statistically significant ($p = .195$) (See Addendum F.13). The Kendall's Tau-C measure of association was used in the

bivariate table between the dependent variable and independent variable. The association was very weak measuring .064.

Table 4.25 reveals that 57.7% (n = 116) of principals indicated that the obstacle “insufficient qualified technical personnel” hindered the school’s capacity to realise its’ pedagogical goals “a lot”. The same group of principals also regarded “to develop a strategic plan for integrating ICT-use in teaching and learning” as a “high priority” to address the obstacle “insufficient qualified technical personnel”.

Table 4.25: Insufficient qualified technical personnel and to develop a strategic plan for integrating ICT-use in teaching and learning

Developing a strategic plan to integrate ICT-use In-sufficient qualified technical personnel	Low priority	Medium priority	High priority	Total
Not at all %	10 27	8 21.6	19 51.4	37 100
A little %	9 20	11 24.4	25 55.6	45 100
Somewhat %	9 13.8	25 38.5	31 47.7	65 100
A lot %	26 12.9	59 29.4	116 57.7	201 100
Total %	54 15.5	103 29.6	191 54.9	348 100

Chi-square/Fisher’s Exact Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.644 ^a	6	.195
No of valid cases	348		
a. No cells (0.0%) have expected counts of less than 5. The minimum expected count is 5.74.			
Symmetric Measures			
	Value		
Kendall’s Tau-C	.064		
No of valid cases	348		

The bivariate relationship was not statistically significant and the association was very weak; therefore no further exploration was required.

4.4 Presentation of hypotheses and interpretation of results

The sub-research questions and the hypotheses, grouped according to the two components of the human factors “vision” and “expertise” as illustrated in the

adapted Four-in-Balance-Model (See Figure 2.4), are discussed in this section. Table 4.24 illustrates the sub-research questions grouped under the human factor “vision” and Table 4.25 the sub-research questions grouped under the human factor “expertise”.

4.4.1 Vision

4.4.1.1 Principals’ priorities to develop a common pedagogical vision among the teaching staff in the school

The results show that there are statistically significant weak relationships ($p \leq .05$) (See Table 4.26) between the dependent variable principals’ priorities “to develop a common pedagogical vision among the teaching staff in the school” and the three independent variables, “to broaden their pedagogical repertoire and to widen their pedagogical competence”, “to provide teachers with incentives to integrate ICT in their instruction and learning” as well as “to improve the technical skills of teachers”. The null hypothesis is therefore rejected for all three relationships.

4.4.1.2 Principals’ priorities to promote the integration of ICT in traditional subjects

4.4.1.2.1 Principals’ priorities to promote the integration of ICT in traditional subjects and to improve the technical skills of teachers

The results indicate a statistically significant moderate relationship ($p \leq .05$) between the two variables relating to principals’ priorities “to promote the integration of ICT in traditional subjects” and “to improve the technical skills of teachers” (See Table 4.26). The null hypothesis is rejected.

Furthermore, when this relationship was controlled with other variables in the second phase of analysis (See Table 4.8) female principals, as well as principals using a computer to connect to the Internet show strong statistically significant associations. Additionally, moderate statistically significant associations (See Table 4.8) are revealed for male principals, principals of the age of 46 years or older, principals with

a personal computer use of weekly or daily, principals not using a computer to connect to the Internet, those who use a computer for school activities, principals with five years or less experience at any or their current school as well as those principals with five years or less and six to twenty years of experience in any professional capacity at their current school.

During the third phase of the analysis, when the dependent variable was cross-tabled with the control variables (See Table 4.9), only the data of gender, principals who use a computer to connect to the Internet and principals who use a computer for school related activities showed weak statistical significance.

This multivariate analysis illustrates the following relationships during the fourth phase (See Table 4.10):

- Direct relationship: Age and whether the principal uses a computer for school related activities.
- Extraneous relationship: Age.
- Joint relationship: Gender - whether the principal uses a computer to connect to the Internet and whether he or she uses a computer for school related activities.
- Statistical interaction: How often does the principal use a computer, years of experience as principal at any school, years of experience as principal at the current school and years of experience in any professional capacity at the current school.

Table 4.26: Sub-research questions grouped under the human factor, “vision”

No	Research question	Research hypotheses	Statistical hypotheses	Decision rule	Accepted/ Rejected
1.	What is the relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to broaden their pedagogical repertoire and to widen their pedagogical competence?	H ₀ : There is no relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to broaden their pedagogical repertoire and to widen their pedagogical competence.	H ₀ : $p = 0$		Rejected
		H _a : There is a relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to broaden their pedagogical repertoire and to widen their pedagogical competence.	H _a : $p \neq 0$	$P \leq .05$, Fisher's Exact Test	Accepted
2.	What is the relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to provide teachers with incentives to integrate ICT in their instruction and learning?	H ₀ : There is no relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to provide teachers with incentives to integrate ICT in their instruction and learning.	H ₀ : $p = 0$		Rejected
		H _a : There is a relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to provide teachers with incentives to integrate ICT in their instruction and learning.	H _a : $p \neq 0$	$P \leq .05$, Fisher's Exact Test	Accepted
3.	What is the relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to improve the technical skills of teachers?	H ₀ : There is no relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to improve the technical skills of teachers.	H ₀ : $p = 0$		Rejected
		H _a : There is a relationship between principals' priorities to develop a common pedagogical vision among the teaching staff in the school and to improve the technical skills of teachers.	H _a : $p \neq 0$	$P \leq .05$, Fisher's Exact Test	Accepted
4.	What is the relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving the technical skills of teachers?	H ₀ : There is no relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving the technical skills of teachers.	H ₀ : $p = 0$		Rejected
		H _a : There is a relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving the technical skills of teachers.	H _a : $p \neq 0$	$\chi^2 (6, n = 351) = 44.203, p \leq .05$	Accepted

Table 4.26: Sub-research questions grouped under the human factor, “vision” (continued)

No	Research question	Research hypotheses	Statistical hypotheses	Decision rule	Accepted/Rejected
5.	What is the relationship between principals' priorities to promote the integration of ICT in traditional subjects and increasing the number of teachers using ICT for teaching and learning purposes?	H ₀ : There is no relationship between principals' priorities to promote the integration of ICT in traditional subjects and increasing the number of teachers using ICT for teaching and learning purposes?	H ₀ : $p = 0$		Rejected
		H _a : There is a relationship between principals' priorities to promote the integration of ICT in traditional subjects and increasing the number of teachers using ICT for teaching and learning purposes?	H _a : $p \neq 0$	$\chi^2 (6, n = 354) = 61.410, p \leq .05$	Accepted
6.	What is the relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving student's ICT skills?	H ₀ : There is no relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving student's ICT skills?	H ₀ : $p = 0$		Rejected
		H _a : There is a relationship between principals' priorities to promote the integration of ICT in traditional subjects and improving student's ICT skills?	H _a : $p \neq 0$	$\chi^2 (6, n = 353) = 40.608, p \leq .05$	Accepted

4.4.1.2.2 Principals' priorities to promote the integration of ICT in traditional subjects and to increase the number of teachers using ICT for teaching and learning purposes

The results show that there is a statistically significant moderate relationship ($p \leq .05$) between the two variables relating to principals' priorities "to promote the integration of ICT in traditional subjects" and "to increase the number of teachers using ICT for teaching and learning purposes" (See Table 4.26). The null hypothesis is therefore rejected.

Furthermore, taking into account other variables in this multivariate relationship during the second phase of the analysis (See Table 4.12), strong statistically significant relationships were identified for female principals, principals of the age of 45 years or younger, principals with a personal computer use of weekly to daily, principals using a computer to connect to the Internet, principals with 21 or more years of experience as principal at any school as well as those principals with six to twenty years of experience in any professional capacity at their current school. Moreover, statistically significant and moderate associations (See Table 4.12) were revealed for male principals, principals of the age of 46 years or older, principals with a personal computer use of a few times yearly to almost monthly, principals not using a computer to connect to the Internet, those using a computer for school related activities, principals with six to twenty years of experience as principal at any school as well as principals with five years or less, or six to twenty years of experience at their current school.

In the third phase of the analysis, when the dependent variable was cross-tabled with the control variables (See Table 4.13), only the data of gender, principals using a computer to connect to the Internet along with principals using a computer for school related activities showed weak statistical significance.

This multivariate analysis illustrates the following relationships during the fourth phase (See Table 4.14):

- Direct relationship: Age, whether the principal uses a computer to connect to the Internet as well as whether the principal uses a computer for school related activities.
- Extraneous relationship: Age.
- Joint relationship: Gender - whether the principal uses a computer to connect to the Internet along with whether the principal uses a computer for school related activities.
- Statistical interaction: Gender, how often the principal uses a computer, years of experience as principal at any school, years of experience as principal at the current school over and above years of experience in any professional capacity at the current school.

4.4.1.2.3 Principals' priorities to promote the integration of ICT in traditional subjects and to improve students' ICT skills

The data reveals a statistically significant moderate ($p \leq .05$) relationship between the two variables relating to principals' priorities "to promote the integration of ICT in traditional subjects" and "to improve students' ICT skills" (See Table 4.26). The null hypothesis is rejected.

When this relationship was controlled with other variables during the second phase of the analysis (See Table 4.16) only principals using a computer for school related activities and principals with six to twenty years of experience in any professional capacity at the current school showed strong statistically significant associations. Moderate statistically significant associations (See Table 4.16) were revealed for male principals, principals of the age of 45 years or less along with 46 years or older, principals with a personal computer use of a few times yearly to almost monthly as well as weekly to daily, principals using, or not using a computer to connect to the Internet, those who use a computer for school related activities, principals with six to twenty years of experience at any or their current school as well as those principals with five or less years of experience as principal at their current school.

During the third phase of the analysis, when the dependent variable was cross-tabled with the control variables (See Table 4.17), only the data of gender, principals who

used a computer to connect to the Internet and principals who used a computer for school related activities showed weak statistical significance.

This multivariate analysis illustrates the following relationships during the fourth phase (See Table 4.18):

- Direct relationship: Gender, age, whether the principal use a computer to connect to the Internet and years of experience as principal at the current school.
- Extraneous relationship: Gender, age as well as years of experience as principal at the current school.
- Joint relationship: Gender, whether the principal uses a computer to connect to the Internet and whether the principal uses a computer for school related activities.
- Statistical interaction: How often the principal uses a computer, years of experience as principal at any school and years of experience in any professional capacity at the current school.

4.4.2 Expertise

4.4.2.1 Teachers' lack of ICT skills

Unexpectedly the results revealed that there are no relationships between the dependent variable, “teachers’ lack of ICT skills” and the independent variables “promoting the collaboration between teachers of different subjects”, “improving the technical skills of teachers” as well as “improving the ability of teachers to make good pedagogical use of ICT” (See Table 4.27). The null hypothesis is therefore accepted for the aforementioned relationships. A statistically significant relationship ($p \leq .05$) (See Table 4.27) does exist between the dependent variable, “teachers’ lack of ICT skills” and the independent variable “managing the adoption of ICT-supported methods for assessing student progress”. Consequently, the null hypothesis is rejected; however, this relationship measured very weak at .061 (Kendall’s Tau-C). Due to the very weak relationship between the aforementioned two variables, no further exploration was computed with predictor (control) variables.

4.4.2.2 Insufficient qualified technical personnel

As the results show, there is no relationship between the dependent variable, “insufficient qualified technical personnel to support ICT-use” and the independent variables, “organising cooperation with other schools regarding the development of ICT-based teaching and learning” and “to develop a strategic plan for integrating ICT-use in teaching and learning”. The null hypothesis is therefore accepted for these relationships. A statistically significant relationship ($p \leq .05$) (See Table 4.26) does exist between the dependent variable, “insufficient qualified technical personnel to support ICT-use” and the independent variable “to establish/enhance an online learning support platform and its management so that teaching and learning can take place anytime, anywhere”. Therefore the null hypothesis is rejected, however, this relationship measured very weak at $-.014$ (Kendall’s Tau-B). Due to the very weak association of the aforementioned relationship, no further exploration was computed with predictor (control) variables.

Table 4.27: Sub-research questions grouped under the human factor, “expertise”

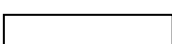
No	Research question	Research hypotheses	Statistical hypotheses	Decision rule	Accepted/ Rejected
1.	What is the relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and promoting the collaboration between teachers of different subjects?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and promoting the collaboration between teachers of different subjects.	H ₀ : $p = 0$	$P = .362$, Fisher's Exact Test	Accepted
		H _a : There is a relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and promoting the collaboration between teachers of different subjects.	H _a : $p \neq 0$		Rejected
2.	What is the relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and improving the technical skills of teachers?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and improving the technical skills of teachers.	H ₀ : $p = 0$	$P = .09$, Fisher's Exact Test	Accepted
		H _a : There is a relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and improving the technical skills of teachers.	H _a : $p \neq 0$		Rejected
3.	What is the relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and to improve the ability of teachers to make good pedagogical use of ICT?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and to improve the ability of teachers to make good pedagogical use of ICT.	H ₀ : $p = 0$	$P = .125$, Fisher's Exact Test	Accepted
		H _a : There is a relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and to improve the ability of teachers to make good pedagogical use of ICT.	H _a : $p \neq 0$		Rejected
4.	What is the relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and managing the adoption of ICT-supported methods for assessing student progress?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and managing the adoption of ICT-supported methods for assessing student progress.	H ₀ : $p = 0$		Rejected
		H _a : There is a relationship between the obstacles in instruction and learning caused by teachers' lack of ICT skills and managing the adoption of ICT-supported methods for assessing student progress.	H _a : $p \neq 0$	$\chi^2 (6, n = 347) = 5.640, p \leq .05$	Accepted

Table 4.27: Sub-research questions grouped under the human factor, “expertise” (continued)

No	Research question	Research hypotheses	Statistical hypotheses	Decision rule	Accepted/ Rejected
5.	What is the relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and establishing/enhancing an online learning support platform and its management?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and establishing/enhancing an online learning support platform and its management.	H ₀ : $p = 0$		Rejected
		H _a : There is a relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and establishing/enhancing an online learning support platform and its management.	H _a : $p \neq 0$	$X^2(9, n = 361) = 24.852, p \leq .05$	Accepted
6.	What is the relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and organising cooperation with other schools regarding the development of ICT-based teaching and learning?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and organising cooperation with other schools regarding the development of ICT-based teaching and learning.	H ₀ : $p = 0$	$X^2(6, n = 242) = 4.776, p = .573$	Accepted
		H _a : There is a relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and organising cooperation with other schools regarding the development of ICT-based teaching and learning.	H _a : $p \neq 0$		Rejected
7.	What is the relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and developing a strategic plan for integrating ICT use in teaching and learning?	H ₀ : There is no relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and developing a strategic plan for integrating ICT use in teaching and learning.	H ₀ : $p = 0$	$X^2(6, n = 348) = 8.644, p = .195$	Accepted
		H _a : There is a relationship between the obstacles in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and developing a strategic plan for integrating ICT use in teaching and learning.	H _a : $p \neq 0$		Rejected

4.5 Review of the results

The results reported in this chapter is summarised according to the two components of the human factors “vision” and “expertise” as illustrated in the adapted Four-in-Balance-Model (See Figure 2.4). Table 4.28 illustrates the data of the sub-research questions grouped under the human factor, “vision” during the first phase of the analysis. Three of the bivariate relationships of the human factor “vision” show statistical significance of moderate strength and therefore required further exploration into Phase 2, Phase 3 and Phase 4. Table 29 illustrates the multivariate analyses (Phase 2) of the dependent variable “promoting the integration of ICT in the teaching and learning of traditional subjects” cross-tabled with the three independent variables “to improve the technical skills of teachers”, “to increase the number of teachers using ICT for teaching and learning purposes” and “to improve students’ ICT skills” jointly with the principal personal characteristics as control variables. The following key is relevant for Table 4.29:

	Significant with strong association
	Significant with moderate association
	Significant with weak association
	Significant with very weak association
	Not significant

The third phase of the analysis, where the dependent variable, “promoting the integration of ICT in the teaching and learning of traditional subjects” are cross-tabled with the principal personal characteristics as control variables, are illustrated in Table 4.30. The fourth and final phase of analysis is summarised in Table 4.31. This multivariate table elaboration summary indicates the type of relationship identified between the original bivariate table and the different categories of each control or predictor variable.

Table 4.28: Bivariate cross-tabulation results of the human factor, “vision” (First phase)

Factors	Component	Dependant variable	Independent variable	Chi square/Fisher's Exact	Kendall's Tau-B/C	Strength of association	Significant association
Human Factors	Vision	Developing a common pedagogical vision among teaching staff in the school (BCP13A1)	To broaden teachers' pedagogical repertoire and to widen their pedagogical competence to engage in new methods of teaching and learning (BCP06H1)	FET (n = 404) = 36.632, $p \leq .05$	.182	Weak association	Yes
		Developing a common pedagogical vision among teaching staff in the school (BCP13A1)	To provide teachers with incentives (including salary adjustment, promotion) to integrate ICT use in their teaching and learning (BCP06J1)	FET (n = 401) = 20.347, $p \leq .05$	.135	Weak association	Yes
		Developing a common pedagogical vision among teaching staff in the school (BCP13A1)	To improve the technical skills of teachers (BCP06F1)	FET (n = 401) = 33.902, $p \leq .05$	.171	Weak association	Yes
		Promoting the integration of ICT in the teaching and learning of traditional subjects (BCP13I1)	To improve the technical skills of teachers (BCP06F1)	FET (n = 351) = 41.937, $p \leq .05$	.199	Moderate association	Yes
		Promoting the integration of ICT in the teaching and learning of traditional subjects (BCP13I1)	To increase the number of teachers using ICT for teaching and learning purposes (BCP06K1)	FET (n = 354) = 57.847, $p \leq .05$	.258	Moderate association	Yes
		Promoting the integration of ICT in the teaching and learning of traditional subjects (BCP13I1)	To improve student's ICT skills (BCP06I1)	FET (n = 353) = 38.754, $p \leq .05$	.217	Moderate association	Yes

Table 4.29: Multivariate cross-tabulation results of the human factor, “vision” (Second phase)

Promoting the integration of ICT in the teaching and learning of traditional subjects	Principal personal characteristics		To improve the technical skills of teachers	To increase the number of teachers using ICT for teaching and learning purposes	To improve student's ICT skills
	Gender	Female	$r^{\dagger}(n = 52) = .351, p \leq .05, FET^{\S}$	$r^{\dagger}(n = 54) = .474, p \leq .05, FET^{\S}$	$r^{\dagger}(n = 52) = .274, p = .127, FET^{\S}$
		Male	$r(n = 294) = .254, p \leq .05, FET$	$r(n = 295) = .279, p \leq .05, FET$	$r(n = 296) = .243, p \leq .05, FET$
	Age	45 years or less	$r(n = 102) = .185, p \leq .05, FET$	$r(n = 101) = .312, p \leq .05, FET$	$r(n = 101) = .249, p \leq .05, FET$
		46 years or more	$r(n = 245) = .204, p \leq .05, FET$	$r(n = 249) = .240, p \leq .05, FET$	$r(n = 248) = .205, p \leq .05, FET$
	How often does the principal personally use a computer?	Never	$r(n = 15) = .133, p = .273, FET$	$r(n = 15) = .120, p = .182, FET$	$r(n = 15) = .120, p = .171, FET$
		Few times yearly to almost monthly	$r(n = 85) = .171, p = .159, FET$	$r(n = 87) = .195, p \leq .05, FET$	$r(n = 87) = .229, p \leq .05, FET$
		Weekly to daily	$r(n = 211) = .249, p \leq .05, FET$	$r(n = 212) = .335, p \leq .05, FET$	$r(n = 211) = .245, p \leq .05, FET$
	Does the principal use a computer to connect to the Internet?	No	$r(n = 184) = .231, p \leq .05, FET$	$r(n = 186) = .276, p \leq .05, FET$	$r(n = 187) = .246, p \leq .05, FET$
		Yes	$r(n = 119) = .314, p \leq .05, FET$	$r(n = 120) = .330, p \leq .05, FET$	$r(n = 118) = .298, p \leq .05, FET$
	Does the principal use a computer for school related activities?	No	$r(n = 61) = .257, p = .056, FET$	$r(n = 60) = .298, p = .056, FET$	$r(n = 61) = .321, p \leq .05, FET$
		Yes	$r(n = 244) = .275, p \leq .05, FET$	$r(n = 248) = .295, p \leq .05, FET$	$r(n = 246) = .275, p \leq .05, FET$
	Years of experience as principal at any school	5 years or less	$r(n = 86) = .251, p \leq .05, FET$	$r(n = 86) = .184, p \leq .05, FET$	$r(n = 86) = .057, p = .098, FET$
		6 to 20 years	$r(n = 221) = .187, p \leq .05, FET$	$r(n = 223) = .266, p \leq .05, FET$	$r(n = 222) = .228, p \leq .05, FET$
		21 years or more	$r(n = 22) = .111, p = .446, FET$	$r(n = 26) = .346, p \leq .05, FET$	$r(n = 26) = .346, p = .070, FET$

Table 4.29: Multivariate cross-tabulation results of the human factor, “vision” (Second phase) (continued)

Promoting the integration of ICT in the teaching and learning of traditional subjects	Principal personal characteristics	To improve the technical skills of teachers	To improve the technical skills of teachers	To increase the number of teachers using ICT for teaching and learning purposes	To improve student's ICT skills
	Years of experience as principal at this school	5 years or less	$r(n = 110) = .287, p \leq .05, \text{FET}$	$r(n = 111) = .236, p \leq .05, \text{FET}$	$r(n = 111) = .167, p \leq .05, \text{FET}$
		6 to 20 years	$r(n = 221) = .168, p \leq .05, \text{FET}$	$r(n = 223) = .283, p \leq .05, \text{FET}$	$r(n = 222) = .246, p \leq .05, \text{FET}$
		21 years or more	$r(n = 7) = .245, p = 0^\ddagger, \text{FET}$	$r(n = 7) = .490, p = 1.000, \text{FET}$	$r(n = 7) = .245, p = 0^\ddagger, \text{FET}$
	Years of experience in any professional capacity at this school	5 years or less	$r(n = 32) = .272, p \leq .05, \text{FET}$	$r(n = 32) = .290, p = .054, \text{FET}$	$r(n = 31) = .019, p = .471, \text{FET}$
		6 to 20 years	$r(n = 177) = .265, p \leq .05, \text{FET}$	$r(n = 178) = .350, p \leq .05, \text{FET}$	$r(n = 179) = .341, p \leq .05, \text{FET}$
		21 years or more	$r(n = 181) = .083, p = .060, \text{FET}$	$r(n = 103) = .086, p = .182, \text{FET}$	$r(n = 101) = .049, p = .274, \text{FET}$

*The association is significant at $\leq .05$ (2-sided).

[†]r: Relationship

[‡]4 cells (100%) have expected counts of less than 5. The minimum expected count is .43.

[§]FET: Fisher's Exact Test

Table 4.30: Bivariate cross-tabulation results of the dependent variable and control variables of the human factor, “vision” (Third phase)

Promoting the integration of ICT in the teaching and learning of traditional subjects	Principal personal characteristics	Relationship
	Gender	$r^{\dagger} (n = 373) = .130, p \leq .05$
	Age	$r (n = 374) = .049, p = .580$
	How often does the principal personally use a computer?	$r (n = 333) = -.050, p = .754, \text{FET}^{\ddagger}$
	Does the principal use a computer to connect to the Internet?	$r (n = 326) = .188, p \leq .05$
	Does the principal use a computer for school related activities?	$r (n = 328) = .148, p \leq .05$
	Years of experience as principal at any school	$r (n = 355) = -.082, p = .359, \text{FET}$
	Years of experience as principal at this school	$r (n = 363) = -.091, p = .234, \text{FET}$
	Years of experience in any professional capacity at this school	$r (n = 334) = .059, p = .598, \text{FET}$

*The association is significant at $\leq .05$ (2-sided).

$^{\dagger}r$: Relationship

$^{\ddagger}\text{FET}$: Fisher’s Exact Test

Table 4.31: Multivariate table elaboration summary of the human factor, “vision” (Fourth phase)

Bivariate relationship before controls	Type of multivariate relationship after controls	Control variables							
		Gender	Age	How often does principal use a computer	Use a computer to connect to Internet	Use a computer for school related activities	Experience as principal at any school	Experience as principal at this school	Experience in any professional capacity at this school
Promoting the integration of ICT in the teaching and learning of traditional subjects/To improve the technical skills of teachers	Direct	No	Yes	No	No	Yes	No	No	No
	Extraneous	No	Yes	No	No	No	No	No	No
	Joint	Yes	No	No	Yes	Yes	No	No	No
	Statistical Interaction	No	No	Yes	No	No	Yes	Yes	Yes
	Intervening/Spurious	No	No	-	No	No	-	-	-
	Suppressed	No	No	-	No	No	-	-	-
Promoting the integration of ICT in traditional subjects/To increase the number of teacher using ICT for teaching and learning purposes	Direct	No	Yes	No	Yes	Yes	No	No	No
	Extraneous	No	Yes	No	No	No	No	No	No
	Joint	Yes	No	No	Yes	Yes	No	No	No
	Statistical Interaction	Yes	No	Yes	No	No	Yes	Yes	Yes
	Intervening/Spurious	No	No	-	No	No	-	-	-
	Suppressed	No	No	-	No	No	-	-	-

Table 4.31: Multivariate table elaboration summary of the human factor, “vision” (Fourth phase) (continued)

Bivariate relationship before controls	Type of multivariate relationship after controls	Control variables							
		Gender	Age	How often does principal use a computer	Use a computer to connect to Internet	Use a computer for school related activities	Experience as principal at any school	Experience as principal at this school	Experience in any professional capacity at this school
Promoting the integration of ICT in the teaching and learning of traditional subjects/To improve students' ICT skills	Direct	Yes	Yes	No	Yes	No	No	Yes	No
	Extraneous	Yes	Yes	No	No	No	No	Yes	No
	Joint	Yes	No	No	Yes	Yes	No	No	No
	Statistical Interaction	No	No	Yes	No	No	Yes	No	Yes
	Intervening/Spurious	No	No	-	No	No	-	-	-
	Suppressed	No	No	-	No	No	-	-	-

Table 4.32 illustrates the results of the data analysis during the first phase of all the sub-research questions grouped under the human factor, “expertise”. The only statistically significant association identified was for the bivariate cross-tabulation of the dependent variable, “insufficient technical personnel to support ICT-use” and the independent variable “to establish/enhance an online learning support platform and its management so that teaching and learning can take place anytime, anywhere”. However, this association measured very weak at -0.014 (Kendall’s Tau-B). Consequently, no further exploration was required for any of the bivariate cross-tabulations grouped under the human factor “expertise”.

Table 4.32: Results of the bivariate cross-tabulations grouped under the human factor, “expertise” (First phase)

Factors	Component	Dependant variable	Independent variable	Chi square/Fisher's Exact	Kendall's Tau-B/C	Strength of association	Significant association
Human Factors	Expertise	Teachers' lack of ICT skills (BCP16I1)	Promoting the collaboration between teachers of different subjects (BCP13E1)	FET (n = 377) = 6.364, p = .362	.059	Very weak association	No
		Teachers' lack of ICT skills (BCP16I1)	To improve the technical skills of teachers (BCP06F1)	FET (n = 359) = 14.489, p = .090	-.110	Very weak association	No
		Teachers' lack of ICT skills (BCP16I1)	To improve the ability of teachers to make good pedagogical use of ICT (BCP06G1)	FET (n = 361) = 14.442, p = .125	-.120	Very weak association	No
		Teachers' lack of ICT skills (BCP16I1)	Managing the adoption of ICT-supported methods for assessing student progress (BCP13F1)	X ² (6, n = 347) = 5.640, p = .465	.061	Very weak association	No
		Insufficient technical personnel to support ICT-use (BCP16A1)	To establish/enhance an online learning support platform and its management so that teaching and learning can take place anytime, anywhere (BCP06E1)	X ² (9, n = 361) = 24.852, p ≤ .05	-.014	Very weak association	Yes
		Insufficient technical personnel to support ICT-use (BCP16A1)	Organising cooperation with other schools regarding the development of ICT-based teaching and learning (BCP13H1)	X ² (6, n = 342) = 4.776, p = .573	.07	Very weak association	No
		Insufficient technical personnel to support ICT-use (BCP16A1)	To develop a strategic plan for integrating ICT use in teaching and learning (BCP13J1)	X ² (6, n = 348) = 8.644, p = .195	.064	Very weak association	No

Chapter Five

Discussion, Conclusions and Recommendations

5.1 Introduction

Chapter 5 begins with a discussion of the main ideas gathered from research findings and the literature review of this study through the lens of the research and sub-research questions. The human factors, “vision” and “expertise”, as components of the adapted Four-in-Balance-Model were used in an attempt to understand the findings as presented by the data from the principals’ questionnaire of the SITES 2006 project. These are followed by conclusions with reference to the critical function of the school principal as facilitator and administrator of the ICT integration process in South African schools, as inferred from the data. Recommendations relating to the role of the stakeholders in this integration process will follow and suggestions for further studies conclude this chapter.

5.2 Discussion of findings

The focal point of this research is twofold: firstly, to examine the priorities school principals’ give to the attainment of leadership competencies as a vehicle to enhance ICT integration, and secondly to examine the obstacles hindering the schools’ capacity to realise its’ pedagogical goals through the integration of ICT in instruction and learning. The priorities school principals give to the attainment of leadership competencies form part of the “vision” component, while the obstacles hindering the schools’ capacity to realise its’ pedagogical goals form part of the “expertise” component of the Four-in-Balance-Model.

“Vision” and “expertise”, the two components representing the human factors of the Four-in-Balance-Model, should be driven by school leadership and supported by collaboration between internal and external professionals in order to improve sustainable ICT integration in instruction and learning (Kennisset Foundation, 2011).

Paragraphs 5.2.1 – 5.2.2.2 provide a detailed summary of the sub-research questions grouped into the human factors, “vision” and “expertise”

5.2.1 Vision

“Vision” is described by the Kennisnet Foundation (2011) as the pedagogical objectives of teachers, management and the school as well as the methodology they plan on using in order to achieve their pedagogical objectives.

Developing a common pedagogical vision among the teaching staff in the school (dependent variable) as well as promoting the integration of ICT in traditional subjects in the school (dependent variable) were recognised as two of the fundamental competencies that could and should be prioritised by a school principal for the purpose of facilitating sustainable ICT integration in instruction and learning.

The summarised results of the data analysis relating to the aforementioned two dependent variables follow in the next section.

5.2.1.1 Developing a common pedagogical vision among the teaching staff of the school

The following are the sub-research questions, relating to the priorities school principals’ give to “developing a common pedagogical vision among the teaching staff of the school” as leadership competency to facilitate ICT integration in instruction and learning:

- *What is the relationship between a principals’ priority to develop a common pedagogical vision among the teaching staff in the school and to broaden their pedagogical repertoire and to widen their pedagogical competence?*
- *What is the relationship between a principals’ priority to develop a common pedagogical vision among the teaching staff in the school and to provide teachers with incentives to integrate ICT-use in their teaching and learning?*
- *What is the relationship between a principals’ priority to develop a common pedagogical vision among the teaching staff in the school and to improve the technical skills of teachers?*

These sub-research questions are discussed in the subsequent paragraphs.

The data analysis revealed that statistically significant but weak relationships do exist between the principals’ priority to develop a common pedagogical vision among the

teaching staff in the school (dependent variable) and all three above-mentioned independent variables (See Table 4.26). Due to the weak nature of these relationships, no further analysis with control variables was carried out.

It is also clear that in all three relationships between the dependent and each of the independent variables the highest number of school principals considered it a high priority to develop a common pedagogical vision among the teaching staff in the school (See Table 4.4, 4.5 and 4.6). The same principals also considered it a high priority to:

- broaden teachers' pedagogical repertoire and to widen their pedagogical competence;
- provide teachers with incentives to integrate ICT-use in their teaching and learning;
- improve the technical skills of teachers.

The role of the principal in building a common pedagogical vision among the teaching staff in a school is acknowledged by the literature reviewed in this study. Van der Linde et al. (2010) perceive vision building as one of the critical components of a school-based ICT policy. A principals' ability to establish shared visions among the teaching staff in a school is also regarded by Wong et al. (2008) as a determining factor in leading transformation through ICT integration. Vision building together with teachers' professional development and technological and pedagogical support is identified by Blignaut et al. (2010b) as key elements to guide the transformation process into innovative instruction and learning through the use of ICT.

5.2.1.2 Promoting the integration of ICT in the teaching and learning of traditional subjects

The three sub-research questions, relating to the priorities school principals' give to promoting the integration of ICT in the teaching and learning of traditional subjects as leadership competency (dependent variable), are discussed in paragraphs 5.2.1.2.1 - 5.2.1.2.3.

How each of the three independent variables, (1) to improve the technical skills of teachers, (2) to increase the number of teachers using ICT for teaching and learning

purposes, (3) to improve students' ICT skills as well as the personal principal characteristics (control variables) relates to promoting the integration of ICT in the teaching and learning of traditional subjects, will be summarised individually for each sub-research question.

5.2.1.2.1 What is the relationship between the principals' priorities to promote the integration of ICT in the teaching and learning of traditional subjects and to improve the technical skills of teachers?

5.2.1.2.1 (a) Phase 1 (Table 4.7)

The results generated in phase 1 shows a moderate statistically significant relationship between promoting the integration of ICT in the teaching and learning of traditional subjects and the independent variable, to improve the technical skills of teachers. Moreover, 78.7% (133) principals indicated that promoting the integration of ICT in the teaching and learning of traditional subjects is a "high priority" for them, while the same group of principals also considers it a "high priority" to improve the technical skills of teachers.

5.2.1.2.1 (b) Phase 2 (Table 4.8)

The number of school principals representing the sample of the aforementioned relationship cross-tabled with gender is 294 males (85%) in relation to 52 (15%) female principals. The results for this phase of analysis confirm that both male and female principals are expected to promote the integration of ICT in traditional subjects by means of prioritising the improvement of teachers' technical skills. However, the female principals of this sample are more inclined to promote ICT integration in traditional subjects through improving the technical skills of teachers than their male counterparts.

Principals who are 46 years of age and older are also more inclined to improve the technical skills of teachers as a way to promote the integration of ICT in the teaching and learning of traditional subjects than the principals who are 45 years of age or younger. Most principals in this sub-sample are 46 years of age or older (71%), while only 29% are 45 years or younger.

With regard to the frequency of computer use, only those school principals who use a computer on a daily or weekly basis are likely to promote the integration of ICT in the teaching and learning of traditional subjects by means of improving teachers' technical skills. This implies that principals who never use a computer or only use it once or a few times yearly, do not identify the link between improving teachers' technical skills and promoting the integration of ICT in the teaching and learning of traditional subjects. According to the data of this sample 4.7% of principals never make use of a computer.

Whether principals use a computer to connect to the Internet or not, are both significant relationships. However, the number of principals who make use of a computer to connect to the Internet shows statistical significance with a strong association. In terms of using a computer for school related activities, only the principals who do make use of a computer for school related activities are inclined to improve the technical skills of teachers as a means to promote the integration of ICT in the teaching and learning of traditional subjects. It is interesting to note that 80% of the school principals from this sample do use a computer for school related activities.

The number of years of experience as principal at their current, or at any school, or in any professional capacity at their current school, affects a school principals' understanding of the relationship between improving the technical skills of teachers and promoting the integrating of ICT in the teaching and learning of traditional subjects. Interestingly in all three categories school principals with six to 20 years of experience, and even more so, the principals with five years or less experience, are inclined to prioritise improving the technical skills of teachers as a vehicle to promote cross-curricular ICT integration.

5.2.1.2.1 (c) Phase 3 (Table 4.9)

The only personal characteristics that show significance in this phase are gender, using a computer to connect to the Internet as well as for school related activities. Each of the aforementioned principal characteristics as well as improving the technical skills of teachers jointly correlates with promoting the integration of ICT in traditional subjects.

5.2.1.2.1 (d) Phase 4 (Table 4.10)

Direct relationships after cross-tabling with control variables, were age and using a computer for school related activities. Moreover, the age of the principal was also extraneous, meaning the association was so weak, that it did not really count. The age of principals, or the fact that principals use a computer for school related activities did not really have any effect on the original relationship between promoting ICT in the teaching and learning of traditional subjects through improving the technical skills of teachers.

Joint relationships were gender, using a computer to connect to the Internet and using a computer for school related activities. Each of these three personal characteristics of the principal and improving the technical skills of teachers (independent variable) jointly influence promoting the integration of ICT in the teaching and learning of traditional subjects.

The personal principal characteristics showing statistical interaction are frequency of computer use, the years of experience as principal at the current or any school as well as the years of experience in any professional capacity at the current school. The association between the dependent and independent variables changed across the sub-groups of the aforementioned four control variables. Therefore the frequency at which a school principal used a computer, as well as the principals' years of experience in any professional capacity, or the years of experience as principal at the current or any school are the personal factors influencing the tendency of a principal to improve the technical skills of teachers as a vehicle to promote the integration of ICT in the teaching and learning of traditional subjects.

5.2.1.2.2 What is the relationship between principals' priorities to promote the integration of ICT in the teaching and learning of traditional subjects and to increase the number of teachers using ICT for teaching and learning purposes?

5.2.1.2.2 (a) Phase 1 (Table 4.11)

The results from the data of the principal questionnaire illustrate a moderate statistically significant relationship between promoting the integration of ICT in the teaching and learning of traditional subjects and to increase the number of teachers using ICT for teaching and learning purposes. Furthermore, 130 (76%) principals indicated that promoting the integration of ICT in the teaching and learning of traditional subjects is a high priority for them, while they also regard it a high priority to increase the number teachers using ICT for teaching and learning purposes.

5.2.1.2.2 (b) Phase 2 (Table 4.12)

The number of male school principals of the sample representing the above mentioned two variables, is 295 (84.5%) in comparison to 54 (15.5%) females. The results confirm that both male and female principals are likely to increase the number of teachers using ICT for teaching and learning purposes in order to promote the integration of ICT in the teaching and learning of traditional subjects, but female principals more so than their male counterparts.

Principals of both age groups, although those aged 45 years and younger more strongly so, recognise the importance of increasing the number of teachers using ICT for teaching and learning purposes as a means to promote the integration of ICT in the teaching and learning of traditional subjects. The South African principal data from the SITES 2006 project indicates that this sample consists of 249 (71.1%) principals of 46 years or older, while only 101 (28.9%) principals are 45 years or younger.

Regarding principals' frequency of computer use, the data reveals that when the frequency of computer use increases, so does the inclination to promote ICT integration in the instruction and learning of traditional subjects through increasing the number of ICT-using teachers. The data for this sample shows that 4.7% of principals never use a computer.

In terms of using a computer to connect to the Internet or for school related activities, there is a strong indication that principals who do use a computer to connect to the Internet and moderately so for school related activities, regard increasing the number

of teachers using ICT for teaching and learning purposes as a vehicle to promote the integrating of ICT in the teaching and learning of traditional subjects.

The data shows an escalating pattern regarding the years of experience as principal at any school; when the principals' experience in years increases, so does the school principals' perception that increasing the number of teachers using ICT for teaching and learning purposes will promote the integration of ICT in the teaching and learning of the traditional subjects of the school. If this experience is limited to their current school, only principals in the two categories which represent less than 20 years of experience can identify with the perception that the promotion of ICT integration in the traditional subjects of a school can be enhanced by increasing the number of ICT using teachers. Finally, principals who have six to 20 years of experience in any professional capacity at their current school, strongly believes that increasing the number of ICT using teachers will promote the integration of ICT in the traditional subjects of the school.

5.2.1.2.2 (c) Phase 3 (Table 4.13)

The only personal characteristics showing significance in this phase are gender, using a computer to connect to the Internet as well as for school related activities. Each of these personal principal characteristics as well as increasing the number of teachers using ICT in their teaching and learning jointly affects promoting the integration of ICT in traditional subjects.

5.2.1.2.2 (d) Phase 4 (Table 4.14)

Direct relationships after controlling with the personal principal characteristics (control variables), are age, using a computer for school related activities and using a computer to connect to the Internet. Moreover, the age of the principal is also extraneous, meaning the association is so weak that it does not really make any difference. The age of principals, or the fact that principals use a computer for school related activities or connect to the Internet, does not really have any significant effect on the original relationship between promoting the integration of ICT in the teaching and learning of traditional subjects by means of increasing the number of teachers using ICT for teaching and learning purposes.

Joint relationships are gender, using a computer to connect to the Internet and using a computer for school related activities. Individually these three personal characteristics of the principal as well as increasing the number of teachers using ICT for teaching and learning purposes (independent variable), jointly have an effect on promoting the integration of ICT in the teaching and learning of traditional subjects.

The principals' personal characteristics that show statistical interaction are gender, frequency of computer use and the years of experience as principal at the current, or any school as well as the years of experience in any professional capacity at the current school. Thus, the association between the dependent and independent variables changes across the sub-groups of the aforementioned five control variables. The school principals gender, frequency of computer use, as well as the years of experience as principal at the current or any school, as well as the years of experience in any professional capacity at the current school, are the factors influencing the perception of a principal to increase the number of teachers using ICT in their teaching and learning as a way to promote the integration of ICT in the teaching and learning of traditional subjects.

5.2.1.2.3 What is the relationship between principals' priorities to promote the integration of ICT in the teaching and learning of traditional subjects and to improve students' ICT skills?

5.2.1.2.3 (a) Phase 1 (Table 4.15)

The results demonstrate a moderate statistically significant relationship between promoting the integration of ICT in the teaching and learning of traditional subjects and to improve students' ICT skills. Furthermore, 131 (77.5%) principals indicated that promoting the integration of ICT in the teaching and learning of traditional subjects is a high priority for them, as much as improving students' ICT skills is.

5.2.1.2.3 (b) Phase 2 (Table 4.16)

The number of school principals of this sample is 296 male (85.1%) in relation to 52 (14.9%) female principals. According to the results of the analysis, only male principals are inclined to improve the ICT skills of students as a means to promote the integration of ICT in the teaching and learning of traditional subjects.

All principals, irrespective of their age group, recognise the importance of promoting the integration of ICT in the teaching and learning of traditional subjects through improving the ICT skills of students in their school. Again, this sample illustrates a large difference in the number of principals falling in the category 46 years or older (71%) compared to only 29% in the category of 45 years or younger.

The importance of a principal's own computer use is repeatedly illustrated in the analysis. School principals using a computer at least a few times a year to monthly or weekly to daily, link the improvement of their students' ICT skills with promoting the integration of ICT in the teaching and learning of traditional subjects. Surprisingly 5% of the school principals from this sample never used a computer.

According to the data analysis, all principals regard improving the ICT skills of students in their school as an important means to promote ICT integration in traditional subjects, whether the principal uses a computer to connect to the Internet or for school related activities, or not.

Generally school principals with six to 20 years of experience as principal at any or their current school, as well as principals with six to 20 years of experience in any capacity at the current school believe that there is an important relationship between the ICT competence of the students and cross-curricular ICT integration. The only other sub-group that supports this belief is principals with five or less years of experience as principal at their current school.

5.2.1.2.3 (c) Phase 3 (Table 4.17)

The only personal characteristics of the principal showing significance in this phase are gender, using a computer to connect to the Internet as well as for school related activities. Each of these principal characteristics as well as improving the ICT skills of students in the school jointly affects the dependent variable promoting the integration of ICT in the teaching and learning of traditional subjects.

5.2.1.2.3 (d) Phase 4 (Table 4.18)

Direct relationships after controlling with the personal principal characteristics (control variables) are gender, age, using a computer to connect to the Internet as well as years of experience as principal at the current school. Moreover, the age, gender and years of experience at the current school are also extraneous, meaning that even though these principal characteristics change nothing when added to the original bivariate relationship, their individual associations are weak. The fact that principals use a computer to connect to the Internet does also not really have any significant effect on the original relationship between promoting the integration of ICT in the teaching and learning of traditional subjects by means of improving student's ICT skills.

Joint relationships are gender, using a computer to connect to the Internet and using a computer for school related activities. Individually these three characteristics of the principal as well as improving the ICT skills of students (independent variable) jointly have an effect on promoting the integration of ICT in the teaching and learning of traditional subjects.

The principal characteristics that show statistical interaction are the frequency of computer use, the years of experience as principal at any school as well as the years of experience in any professional capacity at the current school. Thus, the association between the dependent and independent variables changes across the sub-groups of the aforementioned three control variables. Frequency of computer use is an important personal characteristic influencing a principal to improve the students' ICT competence as a means to promote cross-curricular ICT integration. The number of years of experience as principal at the current or any school, is also a factor influencing this perception.

5.2.2 Expertise

According to the Kennisnet Foundation (2011), "expertise" can be described as the pedagogical knowledge, the knowledge of subject matter as well as the ICT skills of the teacher with a focus on the skills and ability to combine these qualities in order to achieve the pedagogical goals of the school.

5.2.2.1 Teachers' lack of ICT skills

The four sub-research questions, relating to teachers' lack of ICT skills as obstacle (See Figure 5.1) hindering the schools' capacity to realise its' pedagogical goals, are summarized in the next paragraphs:

- *What is the relationship between the obstacle in instruction and learning caused by teachers' lack of ICT skills and promoting the collaboration between teachers of different subjects?*
- *What is the relationship between the obstacle in instruction and learning caused by teachers' lack of ICT skills and improving the technical skills of teachers?*
- *What is the relationship between the obstacle in instruction and learning caused by teachers' lack of ICT skills and to improve the ability of teachers to make good pedagogical use of ICT?*
- *What is the relationship between the obstacle in instruction and learning caused by teachers' lack of ICT skills and managing the adoption of ICT-supported methods for assessing student progress?*

Unexpectedly, the outcome of the data analysis revealed that there are no statistically significant relationships between the obstacle, teachers' lack of ICT skills (dependent variable) and each of the four independent variables (See Table 4.32). It is also clear that the associations in all four relationships are of a very weak nature. However, in all four relationships the highest number of principals indicated that the schools' capacity to reach its pedagogical goals is hindered by teachers' lack of ICT skills (See Table 4.19, 4.20, 4.21 and 4.22). In addressing teachers' lack of ICT skills as an obstacle, the same group of principals regarded it as a high priority to:

- promote the collaboration between teachers of different subjects;
- improve the technical skills of teachers;
- improve the ability of teachers to make good pedagogical use of ICT;
- manage the adoption of ICT-supported methods for assessing student progress.

The literature review refers to the "will, skill, tool" model developed by Christensen and Knezek (2008). This model is used to predict teachers' adaptability to use ICT in

their classroom practice. Based on this model, “will” is seen as teachers’ attitude towards ICT, “skill” refers to teachers’ ICT competencies and “tool” to their access to ICT. These three aspects of the “will, skill, tool” model necessitate a number of individual but interrelated components of making use of technology in instruction and learning.

The TPCK framework of Harris et al. (2009) demonstrates the interrelatedness of the components (Technological Knowledge, Pedagogical Knowledge and Content Knowledge) of this framework. According to the authors, continuing TPCK-based professional development is needed to enable teachers to acquire such a dynamic type of applied knowledge.

The literature underlines the holistic approach needed when addressing teachers’ professional development. Voogt et al. (2011) argue that teachers’ professional development is essential to address teachers’ lack of ICT skills, but the ability to apply the acquired skills in their curriculum delivery is critical to enhance the adoption of ICT in instruction and learning.

Based on the analysis of the data of the principals’ questionnaire, school principals generally regard teachers’ lack of ICT skills as an obstacle in achieving the pedagogical goals of the school and they do consider it a “high priority” to apply the aforementioned priorities to address this obstacle. The lack in significance of the four analysed relationships could be that one individual priority is not sufficient to address an obstacle of such magnitude. The answer could possibly lie in prioritising all the interrelated factors such as technological, pedagogical and content knowledge in a holistic manner enabling teachers to integrate ICT with confidence in their instruction and learning.

5.2.2.2 Insufficient qualified technical personnel to support ICT-use

The next three sub-research questions, relating to insufficient qualified technical personnel to support ICT-use as obstacle hindering the schools’ capacity to realise its’ pedagogical goals, are summarised in the following section:

- *What is the relationship between the obstacle in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and establishing/enhancing an online learning support platform and its management so that teaching and learning can take place anytime, anywhere?*
- *What is the relationship between the obstacle in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and organising cooperation with other schools regarding the development of ICT-based teaching and learning?*
- *What is the relationship between the obstacle in instruction and learning caused by insufficient qualified technical personnel to support ICT-use and developing a strategic plan for integrating ICT-use in teaching and learning?*

The data revealed that the only statistically significant relationship exists between the obstacle insufficient qualified technical personnel to support ICT-use (dependent variable) and establishing/enhancing an online learning support platform and its management so that teaching and learning can take place anytime, anywhere (See Table 4.32). It is also clear that the associations in all three relationships were of very weak nature. However, Table 4.23, 4.24 and 4.25 illustrate that in all three relationships the largest number of principals indicated that the schools' capacity to reach its pedagogical goals are hindered "a lot" by insufficient qualified technical personnel to support ICT-use. The same group of principals regarded it as a high priority to address this obstacle through:

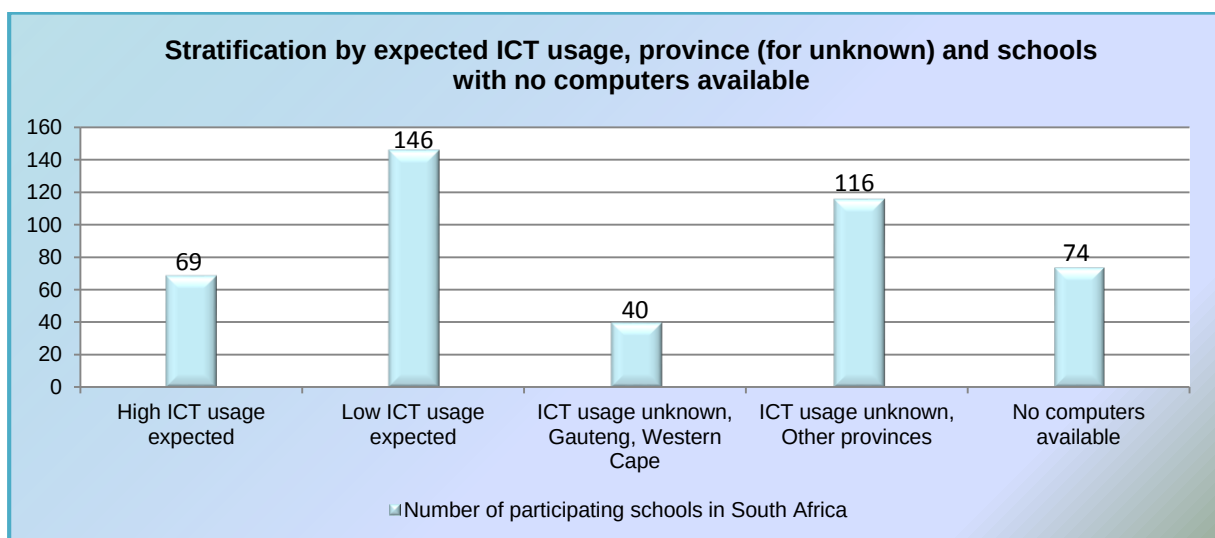
- establishing/enhancing an online learning support platform and its management so that teaching and learning can take place anytime, anywhere;
- organising cooperation with other schools regarding the development of ICT-based teaching and learning;
- developing a strategic plan for integrating ICT-use in teaching and learning.

The literature identified cooperation with external partners and the ability to solve the ICT integration problems internally as two of the commonalities shared by schools with a history of successful and sustainable ICT integration (Eickelman, 2011). It is thus surprising that the SITES 2006 data analysis revealed no relationship between the two independent variables; organising cooperation with other schools regarding

the development of ICT-based teaching and learning and developing a strategic plan for integrating ICT-use in teaching and learning and the dependent variable insufficient qualified technical personnel to support ICT-use. Both of the aforementioned independent variables are important aspects that should be included in a schools' strategic plan or policy for ICT integration. An ICT school policy is an important guideline or "blue-print" in facilitating the change process and supplying the means to realise instructional goals through ICT integration (Tondeur et al., 2010; Van der Linde et al., 2010).

There appears to be a discrepancy between prior research findings (Tondeur et al., 2010; Van der Linde et al., 2010, Eickelman, 2011) and the data analysis results of the principals' questionnaire of the SITES 2006 project. This could be due to the small number of schools with a high ICT usage expected (69) and the large number of schools with low ICT usage expected, unknown ICT usage and no computers available (376) (See Figure 5.1).

Figure 5.1: SITES 2006 – Stratification by expected ICT-use, province (for unknown ICT-use) and schools with no computers available



This fact could lead to the assumption that the aforementioned 376 schools could possibly be managed by principals with either a lack of ICT expertise or a lack of strong leadership skills coupled with a clear understanding of the potential of ICT to enhance instruction and learning, disabling them to convert "expertise" into a support system for ICT integration in their schools. Another possibility could be the lack of

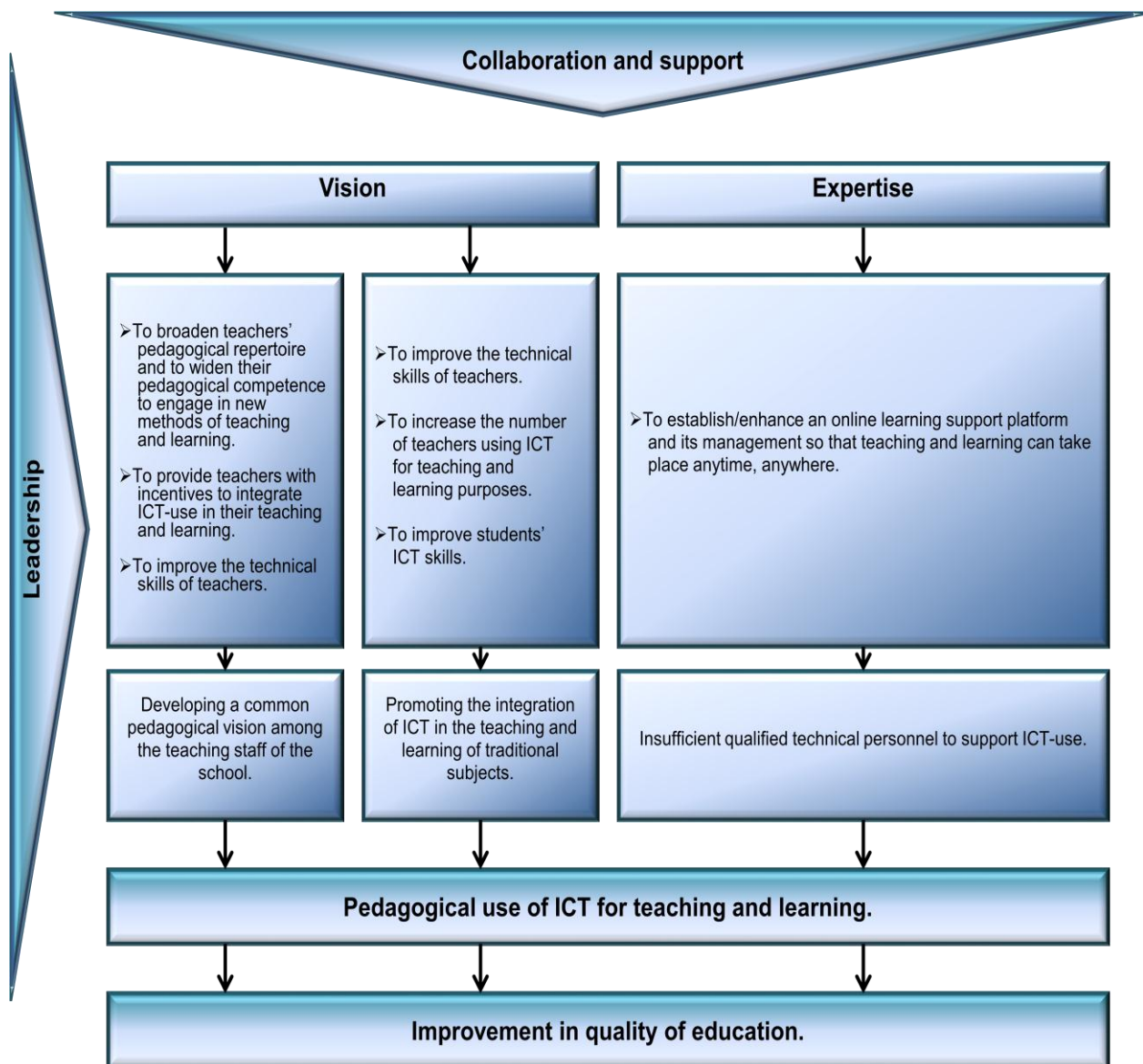
access to technology, bearing in mind that inequalities between wealthy and less resourced provinces in South Africa were given by Howie and Blignaut (2009) as the reasons for South Africa's poor performance in the SITES 2006 project. Several authors label South Africa as an "outlier" compared to other participatory countries of the SITES 2006 project with regard to ICT implementation (Howie & Blignaut, 2009; Law, Lee & Chan, 2010).

5.3 Conclusion

The adapted Four-in-Balance-Model is a valuable conceptual framework to understand the data as presented by the principals' questionnaire of the SITES 2006 project. "Vision" and "expertise" are critical components embedded in the human factors of the Four-in-Balance-Model, facilitating the sustainable and innovative pedagogical use of ICT. Kennisnet Foundation (2011) argues that "vision" and "expertise" should be in place before the need for ICT infrastructure and digital learning material can be addressed. The organisation refers to this specific sequential order of placing "vision" and "expertise" before the material factors "digital learning materials" and "ICT infrastructure", as an "education-driven innovation". The adapted Four-in-Balance-Model is embedded in leadership and collaboration and support (See Figure 5.2), which underlines the important role school leadership as well as collaboration and support have in the improvement of education through ICT integration.

The findings of this study, as presented by the analysis of the data of the principals' questionnaire of the SITES 2006 project, embedded in the adapted Four-in-Balance-Model, are illustrated in Figure 5.2 and Figure 5.3 respectively.

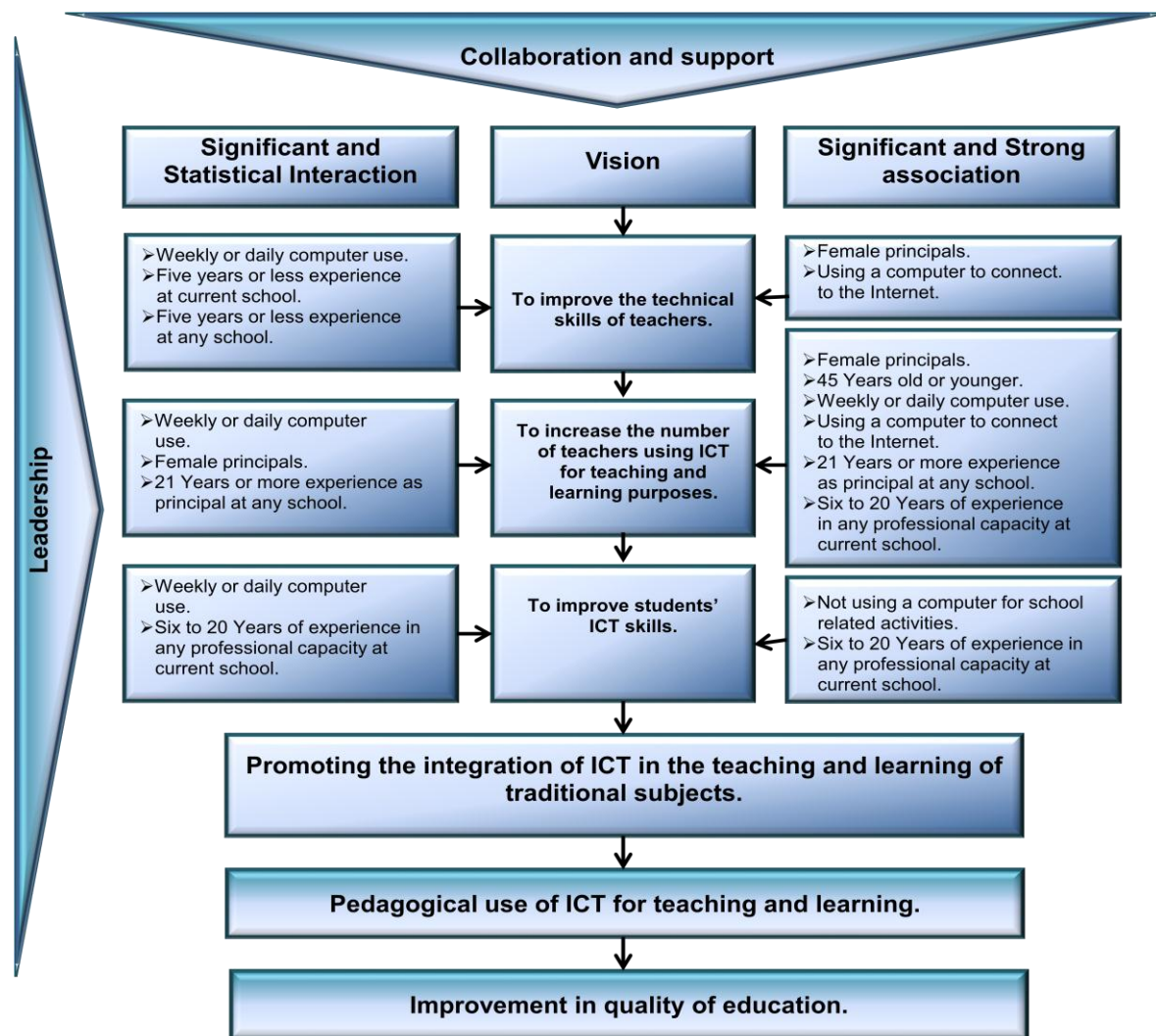
Figure 5.2: Findings of this study (Bivariate cross-tabulations)



5.3.1 Vision

Developing a common pedagogical vision among the teaching staff of the school is generally likely to be achieved by principals through broadening teachers' pedagogical repertoire and widening their pedagogical competence, providing

Figure 5.3: Findings of this study (Multivariate cross-tabulations)



teachers with incentives as well as to improve their technical skills. This, in turn will result in an improvement in the quality of education through ICT integrating (See Figure 5.2). Although the aforementioned three relationships are statistically significant, their individual weak associations did not justify further analysis.

South African school principals who are most likely to promote the integration of ICT in the teaching and learning of traditional subjects by means of improving the technical skills of teachers are principals who use a computer on a weekly to daily basis and principals who have 5 or less years of experience at any or at their current school. The aforementioned personal principal characteristics show statistical significance as well as statistical interaction (See Table 4.8 and 4.10). Furthermore,

strong statistical significant associations are revealed by the data for female principals and principals who use a computer to connect to the Internet.

Female South African school principals, principals who use a computer on a weekly to daily basis as well as principals who have 21 years or more experience as principal at any school, are likely to promote the integration of ICT in the teaching and learning of traditional subjects by means of increasing the number of teachers using ICT for teaching and learning purposes. The aforementioned personal principal characteristics showed statistical significance as well as statistical interaction (See Table 4.12 and 4.14).

Additional personal principal characteristics revealing statistically significant and strong associations are female principals, principals who are 45 years of age or younger, principals who use a computer on a weekly to daily basis, principals who use a computer to connect to the Internet, principals who have 21 years or more experience as principal at any school as well as principals with six to 20 years of experience in any professional capacity at their current school.

The data analysis relating to the principals' questionnaire revealed that principals who use a computer on a weekly to daily basis as well as principals who have six to 20 years of experience in any professional capacity at their current school are most likely to improve students' ICT skills as a vehicle to promote the integration of ICT in the teaching and learning of traditional subjects (See Table 4.16 and 4.18).

Principals who have six to 20 years of experience in any professional capacity at their current school and principals who do not use a computer for school related activities showed statistical significance with strong associations.

5.3.2 Expertise

The results of this study reveal no significant relationship between teachers' lack of ICT skills (dependent variable) as obstacle hindering the schools' capacity to reach its pedagogical goals and any of the four independent variables. The only statistically significant relationship exposed by the data analysis relating to "expertise", is the relationship between the dependent variable, insufficient qualified technical personnel to support the use of ICT and the independent variable, establishing an

online learning support platform and its management so that teaching and learning can take place anytime, anywhere. However, this relationship was of a very weak nature and did not justify further analysis.

5.3.3 Vision and Expertise

In each of the cross-tabled relationships between the dependent and independent variables relating to “vision” and “expertise” of this study, the largest number of school principals “highly prioritised” addressing each obstacle and priority analyzed (See Table 4.4, 4.5, 4.6, 4.7, 4.11, 4.15, 4.19, 4.20, 4.21, 4.22, 4.23, 4.24 and 4.25). It is therefore encouraging to observe that there is a general awareness by South African principals concerning the significance of ICT integration in the pedagogical practice of schools.

Yet, South Africa was regarded an outlier with regard to ICT integration compared to the other participating countries of the SITES 2006 project (Howie & Blignaut, 2009; Law et al., 2010). Howie and Blignaut (2009) blame this on insufficient teacher training as well as a lack of ICT access. Another possible explanation could be a lack of effective ICT leadership.

There seems to be a performance gap between how high school principals’ perceive prioritising the “priorities” and “obstacles” analysed in this study and what happens on ground level in South African schools.

Effective ICT leadership demands a particular level of ICT competence (Stuart et al., 2009). A school principal can understand the added value of ICT in achieving the curriculum goals of a school only if such a principal is a knowledgeable and competent technology user and can link new technology with the school curriculum. School principals that understand the value and possibilities entrenched in ICT as a vehicle to reach the pedagogical goals of a school, can inspire and support the school management as well as the educators to embark on a road of ICT-orientated professional development.

The literature review of this study has revealed that principals themselves need professional development to acquire the necessary skills required to lead staff towards cross-curricular ICT integration (Flanagan & Jacobsen, 2003). The role of

the school principal as the facilitator of human resource development is described by the authors as challenging and unfamiliar. In general, school principals of 46 years and older could find the role of ICT leadership in a school challenging and unfamiliar as they form part of the “baby boomer” generation, born between 1947 and 1965 in a timeframe where ICT-use was non-existent. These principals are therefore not by nature at ease with making ICT an integrated part of their lives and the pedagogical practices of their school. Predictably therefore, based on the evidence of the results, the only strong association relating to age as personal principal characteristic was discovered for principals younger than 45 years of age.

The general profile of the South African school principal, based on the data analysis of the principal questionnaire of the SITES 2006 project, is “male” (84.5%) (See Figure 4.1) and 46 years and older (68.4%) (See Figure 4.2). Howie (2010) appropriately declared that the appointment of a principal in developing countries is frequently solely based on seniority and that this often leads to an autocratic, non-participatory management style, which in turn affects the national leadership and vision in schools. From the research it would appear that in general the “baby boomer” generation described, has some major ICT deficiencies as discussed.

Referring to the main question, this study has revealed an indisputable relationship between the priorities school principals’ give to the attainment of leadership competencies and the integration of ICT in the instruction and learning in South African secondary schools. All the sub-research questions relating to the aforementioned priorities have been found to be significant although some relationships are stronger than others. Furthermore, regarding the relationship between the obstacles hindering the school’s capacity to realise its’ pedagogical goals and the integration of ICT in instruction and learning in South African schools, only one statistically significant relationship although very weak, was discovered between the variables “insufficient qualified technical personnel to support ICT-use” and “to establish/enhance an online learning support platform”.

The role of the school principal as leader of innovative change is of paramount importance. This is revealed in the literature review of this study as well as the data analysis. Eickelmann (2011) identifies the principal’s strong leadership skills with a

clear understanding of the potential ICT has in enhancing instruction and learning as one of the commonalities in schools that have already achieved successful and sustainable ICT integration. Law et al. (2010) view the school principal as the direct link between the government and the school through accountability and policy implementation giving him or her, a strong influence in establishing an innovative instruction and learning culture in a school.

The findings of this study clearly show the complexity of the relationships between the different dependent and independent variables of this study. Principal characteristics such as female principals, the frequency of computer use, using a computer to connect to the Internet and principals younger than 45 years of age are influential in promoting the integration of ICT in the traditional subjects of a school.

Although not the area of research of this study, ICT infra-structure and digital learning materials - the material factors of the Four-in-Balance-Model - need to be addressed when the human factors “vision” and “expertise” are in place. Computer and Internet access, as well as access to digital learning materials are basic necessities in all South African classrooms to facilitate sustainable and effective ICT integration in education. Insufficient access to technology in a classroom will inevitably result in insufficient pedagogical use of ICT that hinders quality education.

5.4 Recommendations

The subsequent paragraphs summarise the recommendations of this study.

The challenging and diverse role of the principal as the leader of technology should evolve into that of a manager of transformation to become “[a] learning leader” (Al Sharija & Watters, 2012). The innovation of technology and the ability to integrate technology sustainably and successfully into the curriculum of the school is a vibrant and continuing process. Special attention should be given to appointing leaders who are willing to immerse themselves in an ongoing process of professional development, irrespective of age and gender.

Based on the results of the data analysis, the frequency of computer use clearly influences the ability of the school principal to understand the possibilities entrenched in ICT as a powerful vehicle to improve the quality of education. So do principals who

use a computer to connect to the Internet. Although various initiatives have been launched by the DoE to equip South African schools as well as school principals with digital devices and Internet connectivity, professional development to encourage principals to become familiar with, and understand the potential of digital devices should be prioritised.

Special consideration should be given to the key role female principals could play in the integration of ICT in the curriculum of South African schools. The data of the principals' questionnaire of SITES 2006 shows only 15.5% of the South African school principals were female.

5.5 Suggestions for further study

The need for further research to understand the relationship between sustainable ICT integration in schools and the changing role and competencies of the school principal as an effective technology leader has been identified by previous research (Al Sharija & Watters, 2012; Wee Leng, 2008; Flanagan & Jacobsen, 2003).

The role of the principal to lead South African schools on the road of successful cross-curricular ICT integration requires further research - specifically how principals can be assisted to use technology and after this has been achieved, to empower them by means of professional development towards facilitating the integration of technology in the curriculum of the school. In the study of Howie (2010) the author reports that it is difficult to find literature on the implementation of ICT in instruction and learning by South African schools.

Important relationships have been revealed by this study relating to personal principal characteristics such as the frequency of computer use as well as the role female principals can play in school leadership. Therefore, further research in finding ways to promote school principals' computer use so that the resulting positive attitude towards ICT can be transferred to the teachers in the school is required.

The role of a female school principal in South African schools seems to be overlooked. This fact also requires further research into finding means to create awareness that female principals are more open to facilitating change towards cross-curricular ICT integration than their male counterparts.

This study is a secondary data analysis of the SITES 2006 project. The data of the SITES 2006 project became available in 2008; as this is a limitation as has been stated, empirical research studies should be conducted to verify the findings of this study.

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