The relationship between the use of ICT for instruction and learning and the availability of ICT resources

by

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ABSTRACT

South African schools appear to be far from attaining the strategic objectives of the White Paper 7 on e-Education of 2004. The use of ICT for instruction and learning in schools is hampered by contextual factors in South Africa. One factor hampering the use of ICT in South African schools is the availability of ICT resources. Despite a high degree of access to ICT at home, most schools do not have the relevant ICT resources that teachers can use for instruction and learning.

The SITES 2006 technical coordinators dataset was used to determine the statistical significant difference of the joint frequencies of the number of years that schools have been using ICT for instruction and learning as well as the availability of ICT resources. An integrated qualitative-quantitative design was used to transform the dataset for the calculation of a two-way Chi-square. A two-way Chi-square was calculated for the joint frequencies as well as for the odds ratio to determine the effect size of the frequencies.

Activity Theory was used as a "theoretical framework for the analysis and understanding of human interaction through the use of tools and artefacts" (Hashim & Jones, 2007). The extent of the use of ICT resources (tools) by teachers (subject) in instructing learners (object) determines the degree of success in education (outcome). Easy availability of ICT resources for use in instruction and learning should yield a positive, meaningful achievement in education.

Keywords: e-Education, availability of ICT, access to ICT, SITES 2006, integrated qualitative-quantitative design, Chi-square, Activity Theory, use of ICT, instruction and learning, theoretical framework

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LIST OF ACRONYMS

CEA	Centre for Evaluation and Assessment
GoL	Gauteng On-Line
ICT	Information Communication Technology
IEA	International Association of Educational Assessment
IEA DPC	IEA Data Processing Centre
NRC	National Research Coordinator
ODC	Online Data Collection
OR	Odds Ratio
PDA	Personal Digital Assistant
SDA	Secondary Data Analysis
SITES 2006	Second International Technology in Education Study
SPSS	Statistical Program for the Social Science
TLI	Teacher Laptop Initiative

CHAPTER 1
INTRODUCTION

1.1 Introduction

Information and communication technology (ICT) includes the hardware and software that facilitate the provision of information and make it easier for people to communicate. ICTs are globally acknowledged as vital for transformation in the society (Plomp, Pelgrum & Law, 2007). The focus of the importance of ICT has shifted to the integration of ICT in education. While the "problem of integrating ICT effectively in education was identified as insufficient hardware and inappropriate software" (Blignaut, Els, & Howie, , 2010a) in the 1980s, it appears that the problem has not been addressed.

Although the decision makers in education are aware of the benefits of ICT in education, there has been little progress on their provision. The Teacher Laptop Initiative (TLI) seems to be a far-fetched dream of the Department of Education (Department of Education, n.d.). In the Gauteng and Western Cape provinces, the Gauteng Online and the Khanya Project were initiated to meet the strategic goals of the White Paper on e-Education (Bialobrzeska & Cohen, 2005). However, the Gauteng Online (GoL) faced serious challenges that retarded progress in the provision of ICT resources and the connectivity of schools.

1.2 Background

The White Paper on e-Education of 2004 acknowledged the magnitude of the task of providing ICTs together with the necessary infrastructure required in schools (Department of Education, 2004). The provinces in South Africa had to strike a balance between ICT provision in schools and

the training of teachers in the use of ICT. Private corporations such as Sentech, SchoolNet and Telkom also took part in the initiatives to provide training and/or ICT resources to schools in South Africa (Bialobrzeska & Cohen, 2005).

A secondary analysis study was conducted using the SITES 2006 dataset on the technical coordinators. The dataset is relevant because the technical questionnaire contained questions relating to the availability of ICT resource materials (hardware and software) and ICT needs in participating schools.

1.3 Statement of the problem

"Pedagogical integration of ICT is important for bringing changes to classroom teaching and learning so as to foster the development of 21st century skills" (Draper, Howie & Blignaut, 2008). There is an "overwhelming view [that] computers in the teaching and learning context ... bring more advantages than the opposite" (Mofokeng & Mji, 2010).

Mofokeng and Mji (2010) highlighted in their study "that teachers did not use computers in their mathematics and science classrooms" (Mofokeng & Mji, 2010). Teachers need to be competent to use computers in an educational context. Their competency in using computers may be hampered by "lack of training and limited or no access to computer technology" (Mofokeng & Mji, 2010). "Very little empirical research has been carried out or published on teachers' ownership of and usage of technology..." (Mofokeng & Mji, 2010). ICT integration in South Africa focuses on the "lack of resources and a lack of teacher capacity" (Draper et al., 2008).

Information relating to the use of ICT in South African schools is inconclusive. However, the following three scenarios can describe the current situation at schools:

- The ICT situation in schools as well as the availability of necessary ICT-related resources is known.
- The ICT situation in schools as well as the availability of necessary ICT-related resources is unknown.
- The ICT situation in schools is known and the availability of necessary ICT-related resources is unknown.

1.4 Rationale for the study

If one of the three scenarios in connection with ICT use in schools and the availability of the necessary ICT-related resources is known, a tailor-made solution can be provided for stakeholders in education. This will address the current situation and improve the implementation of ICT and relevant resources in South African schools.

1.5 Purpose of the study

The purpose of the study is to explore possible differences between the joint frequencies in a cross tabulation relating to the use of ICT for instruction and learning in the South African schools and the availability of ICT resources.

1.6 Significance of the study

The significance of this study lies in adding to the body of knowledge on the use of ICT for instruction and learning and the availability of ICT resources. The stakeholders in education, both in public and private institutions, will benefit from the findings of this study so that they can

develop informative policies and proper guidelines for the integration of ICT in instruction and learning.

Policy makers in the education sector can make vital decisions that are informed and realistic based on the findings of this study. It is common knowledge that policy implementers emphasise the procurement of textbooks more than resources in digital format. The various formats available could be converted electronically and thus be easily available and usable to most schools.

1.7 Research questions

Based on question 1 and 4 in the technical coordinators' questionnaire, the following research question has been formulated:

- What is the difference between the joint frequencies in a contingency table based on the "*number of years schools [have] been using ICT for [instruction] and learning"* (Pelgrum, 2008) and:

a) *the availability of equipment and hands-on materials (e.g. laboratory equipment, musical instruments, art materials, overhead projectors, slide projectors, electronic calculators)?*
b) *the availability of tutorial/exercise software?*
c) *the availability of a general office suite (e.g. word-processing, database, spread sheet and presentation software?)*
d) *the availability of multimedia production tools (e.g. media capture and editing equipment, drawing programs, webpage/multimedia production tools)?*
e) *the availability of data logging tools?*
f) *the availability of simulations/modelling software/digital learning games?*

g) *the availability of communication software (e.g. e-mail, chat and discussion forum)?*
h) *the availability of digital resources (e.g. portals, dictionaries, and encyclopaedias)?*
i) *the availability of mobile devices (e.g. Personal Digital Assistants (PDAs) or Smartphones)?*
j) *the availability of a smart board/ interactive whiteboard*?
k) *the availability of a learning management system* (e.g. web-based learning environment)?
l) *the availability of mail accounts for teachers*?
m) and *the availability of mail accounts for learners*?

1.8 Assumptions

The technical coordinators' questionnaire was administered to 410 schools in South Africa. The assumption is that the number of schools that participated is representative of the different categories of schools located within the various demographics of South Africa during 2006, namely, in rural and urban schools, in poor and affluent schools.

1.9 Limitations and delimitations

A number of caveats regarding this study need to be noted. As a secondary data analysis, the researcher cannot draw final conclusions from the results of the analysis. The sample size of this study, 349 technical coordinators in the South Africa schools that offered grade eight, is too small to make conclusive findings. The initial SITES 2006 STUDY was done eight years ago. Also, there is no comparative study in South Africa on the availability of ICT resources for instruction and learning.

1.10 Outline of the dissertation

The dissertation is structured as per Table 1.1 that outlines the number of chapters and the description of each chapter.

Table 1.1: Structure of the dissertation

Chapter	Name	Description
1	Introduction	Introduces the study, highlights the background, rationale, problem statement, purpose of the study, the significant of the study, research questions, assumptions, limitations and delimitations.
2	Literature and theoretical framework	Gives an overview of the literature consulted and the theoretical framework.
3	Research design and methods	Indicates SITES 2006 research design, population, sample, instrumentation, data collection, data preparation as well as the envisaged study's population, sample, design data collection and data preparation.
4	Data analysis and interpretation	Presents data analysis and interpretation.
5	Summary, conclusion and recommendations	Summarises the results from Chapter 4, concludes and recommends based on the findings.

CHAPTER 2
LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

Information and Communication Technology (ICT) refers to the "diverse set of technological tools and resources used to communicate, and to create, disseminate, store and manage information" (Wikibooks: Open books for an open world, n.d.). These resources are gadgets and devices such as computers and other technical devices as well as application software. According to Hsu and Kuan (2013), the use of ICT resources has become part of the school milieu (Hsu & Kuan, 2013).

Teachers should, therefore integrate ICT in their instruction and learning (Hsu & Kuan, 2013). Hsu and Kuan (2013) also indicates that recently "computers, printers, scanners, digital cameras and the Internet are considered parts of basic school infrastructure" (Hsu & Kuan, 2013). The focus of the review is on the use and availability of ICT resources in schools, the barriers to ICT integration, training in using ICT resources, the integration of ICT resources in South Africa as well as the SITES 2006 study.

2.2 The use of ICT resources for instruction and learning

The research study by Kolikant (2010) indicates that there is minimal utilisation of computers at school, and that there are issues and fears on possible bad consequence of ICT use (Kolikant, 2010). Even though ICT

provides numerous benefits in academic training, teachers appear to be hesitant in utilising information technology (Van Acker, Van Buuren, Kreijns & Vermeulen, 2011).The current generation of learners is actually very adept at making use of ICT; therefore the curriculum offering needs modification in order to accommodate their requirements (Jordan, 2011).

2.2.1 The benefits of using ICT resources

The integration of ICT in education is useful in instruction and learning and it is becoming more prominent in education (Bhausiri, Xaymoungkhoun, Zo, Rho & Ciganek, 2011). When making use of ICT resources in education, teachers tend to be exposed to countless techniques and strategies for boosting learning objectives (Jordan, 2011).

Besides promoting a learner-centred approach, the integration of ICT also promotes problem-solving skills, inquiry skills, constructivist and social constructivist approaches to instruction and learning (Kolikant, 2010; Barak, 2013; Kafyulilo & Keengwe, 2013; Hsu & Kuan, 2013). These types of approach enhance learning while making instruction and learning efficient (Klieger, Ben-Hur, & Bar-Yossef, 2009).

Klieger et al. (2009) and Kolikant (2010) point out that the integration of ICT enhances the motivation of learners, allows exposure to a wider curriculum by teachers, encourages higher order intellectual skills and improves teaching techniques (Klieger et al., 2009; Kolikant, 2010). Subsequently ICT integration exposes teachers and learners to meaningful as well as deep information attributes through their interaction and collaboration with fellow teachers and learners (Nelson, Christopher & Mims, 2009; Salleh & Laxman, 2013).

Hennessy, Harrison and Wamakote (2010), and Carrasco and Torrecilla (2012) are of the opinion that the utilisation of ICT for instruction and learning is actually closely associated with school accomplishment and student attainment (Hennessy et al., 2010; Carrasco & Torrecilla, 2012). Gioko (2012) and Salleh and Laxman (2013) point out that teachers make use of ICT resources to strengthen their work in several ways; namely classroom delivery, creating resources for teaching and assisting with administration (Gioko, 2012; Salleh & Laxman, 2013). The benefits of ICT integration in education are many.

Collaboration in ICT integration is significant among teachers who learn various integration attributes from one another (Hsu & Kuan, 2013). Teachers are required to use ICT resources daily inside classes (Hsu & Kuan, 2013). Learners that are subjected to ICT resources tend to be susceptible to learning new attributes that are challenging and also better their learning (Chudgar, 2013).

In a study by Carrasco and Torrecilla (2012), findings show that the regular use of ICT resources by learners has the tendency to improve their achievements. Additionally, the use of ICT resources by learners encourages them to become lifelong learners, i.e. they will stay learning beyond prescribed periods of exposure to academic endeavour (Jordan, 2011).

2.2.2 Support for integrating ICT in education

Hennessy et al. (2010) postulate that teachers want to be supported in integrating ICT resources in their instruction (Hennessy et al., 2010). Insufficient support of teachers is the reason for the low measure of ICT integration in schools (Tezci, 2011). In a small school it is easier to communicate and embrace the latest innovation of ICT while in large

schools, communication and supporting one another may be lacking (Hsu & Kuan, 2013).

Teachers ought to be afforded the opportunity to attend ICT-related training in order to enhance their competency in using ICT resources (Salleh & Laxman, 2013). They should also be supplied with ICT devices such as projectors, wireless Internet, computers, etc. (Salleh & Laxman, 2013). In the event the administrators think that ICT integration helps to enhance the quality of education, they have a tendency to aid teachers in their ICT integration endeavours and also formulate guidelines as well as to maintain a technology-based school tradition (Tezci, 2011).

Furthermore, many teachers are working in conditions that are not conducive to supporting ICT use (Hennessy et al. 2010). The prosperity of ICT integration in instruction and learning depends, primarily on human resources, technological resources and also on the social support for the integration (Donnelly, McGarr & O'Reilly, 2011).

2.3 The availability of ICT resources for instruction and learning

Tezci (2011) as well as Szeto and Cheng (2013) underscore the fact that the availability of ICT resources is important to generate situations in which teachers can make use of ICT in their classrooms with certainty and correctly (Tezci, 2011; Szeto & Cheng, 2013). The availability of ICT resources in schools depends on whether the school has procured the resources or the Department of Education has provided the resources.

2.3.1 Provision of ICT resources at schools

The provision of ICT resources at schools means that schools should develop effective strategies for using ICT resources for enhancing instruction (Kolikant, 2010; Kafyulilo & Keengwe, 2013). Schools provided with ICT resources should make it possible for teachers and learners to access those resources and use them.

The non-provisioning of resources includes, among others, the non-access to electricity and ICT resources, non-availability of software in language instruction, geographical factors and communication (Hennessy, et al., 2010; Kafyulilo & Keengwe, 2013). It is essential that all schools should be provided with the basic school ICT infrastructure. The resources provided should be kept in proper storage to minimise abuse and loss through theft. Generally there have been on-going initiatives in many countries to supply schools with equipment and application software and to inspire teachers to utilise ICT in the classroom based on to their nationwide ICT guidelines (Tezci, 2011).

Teachers, according to the study conducted by Jordan (2011), should use ICT to improve their instruction and learning tactics for learners to obtain ICT skills necessary in the labour force (Jordan, 2011). There is a sturdy correlation between classroom computer accessibility and ICT use in teaching (Kale & Goh, 2012). In spite of a great deal of current progress and the expectation that many more learners can easily gain from access to ICT, the facilities necessary for implementing technical resources are inadequate in minimal income nations (Hennessy et al., 2010).

2.4 Barriers to ICT integration

There are a number of barriers that hinder the integration of ICT in education. Researchers have among others, indicated the following as some of the barriers to ICT integration:

a) low self-efficacy
b) limited encounter with Internet and Web 2.0
c) lack of suitable and relevant content
d) absence of professional development
e) standardised course of study and review not encouraging cooperative learning, and
f) infrastructural challenges including a deficit of appropriate bandwidth, not enough computer access, and not enough technical assistance and limited self-confidence in using ICT resources (Chitiyo & Harmon, 2009; Hennessy et al., 2010; Donnelly et al., 2011; Van Acker et al., 2011; Kale & Goh, 2012).

The obstacles to ICT integration can be split into two groups, namely those that relate to the non-provisioning of ICT resources, and teachers' fundamental philosophy and unwillingness to improve (Donnelly et al., 2011). Many teachers are afraid of integrating ICT in their instruction and learning.

The aspects that affect the utilisation of ICT in schools tend to be, among others, access to resources, the school policy/plan, school tradition and assistance for teachers utilising ICT; for teachers these aspects relate to their mind-set, philosophy, history, gender, encounter with ICT as well as training (Tezci, 2011; Van Acker et al., 2011; Gioko, 2012; Hsu & Kuan, 2013).

The rate of ICT resources supply is an additional component that impedes ICT incorporation (Jordan, 2011). When teachers are not supplied with current ICT resources, they have a tendency to quit attempting to integrate ICT in instruction and learning (Jordan, 2011; Gioko, 2012). Even though the rate on delivering resources is sluggish computer-integrated instruction is progressively improving (Hennessy et al., 2010). The enhancement is a result of the awareness of the advantages of ICT integration; hence the supply of computers and online connection (Hennessy et al., 2010).

The integration of ICT in schools is actually a change that calls for almost all staff members to be involved and to embrace changes to be put in place (Jordan, 2011; Hsu & Kuan, 2013). At times teachers fail to integrate ICT in instruction and learning mainly because of restricted time available for lesson planning making use of ICT, inadequate professional development and little support from the seniors at school (Kale & Goh, 2012).

For most teachers unfamiliarity with modern teaching techniques and the time required for efficiently integrating technology in the curriculum tend to be a few of the hurdles to the integration of ICT (Barak, 2013). This particular position has been confirmed to be a result of teachers' insufficient confidence in using ICT resources in instruction and learning and their hesitancy to change their conventional teaching techniques (Barak, 2013).

Numerous studies suggest that it is teachers' mind-set, expertise, lack of independence and lack of understanding to assess the use and role of ICT in teaching that are the most common aspects hindering teachers' ability and confidence in utilising ICT support (Hennessy et al., 2010). Quite a few teachers have identified ICT resources issues, such as the insufficient

number of working computers, untrustworthy electricity and inaccessibility to the Internet connection as hampering the use of ICT in instruction and learning (Hennessy et al., 2010).

Access to equipment, software packages and network technologies giving support to the use of ICT resources remain problematic because some teachers may notice slight connections between ICT resources and their pedagogical utilisation (Kale & Goh, 2012). Many software packages are open source (free) but because of the limitations initiated by the Department, they cannot be accessed for pedagogical use (Nelson et al., 2009). Effective integration of ICT in instruction and learning is actually dependent on the accessibility of ICT resources at schools (Chudgar, 2013).

2.4.1 Limitations of ICT integration

Kafyulilo and Keengwe (2013) report that although most schools may be provided with ICT resources, their use is not guaranteed (Kafyulilo & Keengwe, 2013). Teachers have little time available to integrate ICT resources for pedagogical use (Hsu & Kuan, 2013). They also maintain that the use of ICT resources for instruction and learning entails additional work since they have to do lesson preparation (Hennessy, et al., 2010).

As a result some researchers feel that the utilisation of ICT resources for instruction and learning is not influenced by their availability (Donnelly et al., 2011; Tezci, 2011; Kale & Goh, 2012). Additionally, there is some opposition to ICT integration among teachers, mainly because of the anxiety that the private relationship between a teacher and learners will be adversely impacted by continuous accessibility to computers during lesson presentations (Hogenbirk & Van de Braak, 2012).

Moreover, teachers find it tough to create a technology-enhanced lesson as they presume that it requires time away from real lesson learning (Kafyulilo & Keengwe, 2013). These teachers acknowledge the prospects of integrating ICT in instruction and learning; however, they are concerned about the implications of their utilisation and abuse (Kolikant, 2010). Users of ICT resources tend to be less likely to use books and other publications compared to earlier generations (Kolikant, 2010).

2.5 Training in using ICT for instruction and learning

A research study (Hennessey et al., 2010) indicates that, until recently, training options for the utilisation of ICT resources in instruction and learning have remained limited, unavailable and inconsistent in quality. Recently, some schools have been advantaged to be offered teacher training on ICT integration and access to ICT resources, thus improving the results of ICT integration practices (Kafyulilo & Keengwe, 2013).

Pertaining to dedication to professional learning, Van Acker et al. (2011) recognise that teachers' low measure of confidence regarding the utilisation of ICT may be a result of inadequate training (Van Acker et al., 2011). To develop positive attitudes towards ICT resources, teachers should be provided with opportunities to attend ICT training courses (Salleh & Laxman, 2013). After training, ICT resources such as personal computers and projectors as well as the installation of wireless connectivity in schools should be provided to access the web easily (Salleh & Laxman, 2013).

2.6 ICT integration in South Africa

Research studies have revealed that South Africa faces education challenges regarding the integration of ICT in schools with 38% access to computers; the teachers' preference for traditional learning impedes learners' acquisition of 21st century skills (Blignaut, Els & Howie, 2010).

Howie and Blignaut (2009) have found that in South Africa the majority of schools do not have the essential conditions to implement ICT; according to them there is no ICT integration in "Mathematics and Science Grade 8 classrooms" (Howie & Blignaut, 2009). Lastly, ICT implementation is one of a "long list of priorities in education" (Howie & Blignaut, 2009).

Indications are that teachers do not use computers in instruction and learning activities; the majority of teachers do not have access to computers at home and teachers are eager to attend training in aspects of computing related to Mathematics and Science teaching (Mofokeng & Mji, 2010).

Studies have also found that compared to Chile, South Africa lacks ICT equipment and applications and there is low technical support in South African schools (Blignaut et al., 2010). There is also little ICT pedagogical support in South Africa (Blignaut et al., 2010). Most South African principals cannot outline the importance of ICT in instruction and learning (Blignaut et al., 2010).

2.7 SITES 2006 study

The Second International Technology in Education Study (SITES 2006) is an international survey that was conducted by the International Association for the Evaluation of Educational Achievement (IEA) (Blignaut et al., 2010). The IEA coordinated the SITES 2006 study from the

University of Twente, the Hong Kong University and the IEA Data Processing Centre in Hamburg, Germany (Blignaut et al., 2010).

2.7.1 Purpose of the SITES 2006 study

The purpose of the SITES study was mainly to "uncover how ICTs influence teaching and learning processes in schools" (Blignaut et al., 2010a). Three SITES studies have been conducted since 1990:

1. Module 1 – an initial school-based survey.
2. Module 2 - investigated how teachers use ICTs.
3. Module 3 - "investigated how school and system level factors influence teachers' pedagogical adoption of ICTs" (Blignaut et al., 2010a).

The SITES 2006 survey administered three questionnaires to the following participants:

1. Principals
2. Technology coordinators
3. Mathematics and Science teachers (Blignaut et al., 2010a).

The sample design of the SITES 2006 was a stratified two-stage sample on school level and teachers' level (Blignaut et al., 2010a).
At the teachers' level, Grade 8 learners studying Mathematics were targeted while the school level targeted school principals (Blignaut et al., 2010). The SITES 2006 study was conducted in 22 countries; the emphasis was on the comparative study of education systems rather than the countries themselves (Blignaut et al., 2010).

2.7.2 National Research Coordinators (NRC)

In South Africa a coordinating team was established by IEA, namely the National Research Coordinators. The coordinators were Sarah Howie from

the Centre for Evaluation and Assessment (CEA), University of Pretoria and Seugnet Blignaut, formerly from the Tshwane University of Technology (Blignaut et al., 2010a). The National Research Coordinators, as with all studies that involve schools, teachers and students, duly obtained permission from both the national and the provincial departments before the questionnaires could be administered to the participants.

2.7.3 SITES 2006 Data Collection

The data collection method was online (ODC), face-to-face and the hybrid of both ODC and face-to-face (Blignaut et al., 2010a). South Africa was the only country that did a face-to-face data collection method due to the anticipated lack of ICT in some of the sampled schools (Blignaut et al. 2010). Despite having done a face-to-face data collection, South Africa received more than a 90% return rate, while the IEA anticipation was 85%. Although IEA had recommended a sample of 400 schools, South Africa, due to adaptability factors, had a final sample of ”666 Mathematics teachers and 622 Science teachers” (Blignaut et al., 2010a).

The data collection was done by the field workers who were learners from the Tshwane University of Technology (Blignaut et al., 2010a). The field workers were thoroughly trained by the National Research Coordinators (Blignaut et al., 2010a). Data capturing was done at the University of Pretoria while the data cleaning and processing was done at the IEA Data Processing Centre (Blignaut et al., 2010a).

2.8 Theoretical framework

For the secondary data analysis of SITES 2006 this study implemented Activity Theory framework. “Activity theory is a theoretical framework for the analysis and understanding of human interaction through the use of

tools and artefacts" (Hashim & Jones, 2007, p. 2). Activity theory "… offers a set of conceptual tools that is applicable to various situations to understand the coupling of cognition and activity" (Lim, 2002, p. 413).

Activity theory was developed by the Russian psychologist, L.S. Vygostky. The model was modified by his student Leont'ev (Verenika, 2001 cited in Hashim & Jones, 2007). Vygostky's Activity Theory model is divided into three analytical components, namely *subject*, *tools* and *object* as depicted in Figure 2.1 (Hashim & Jones, 2007).

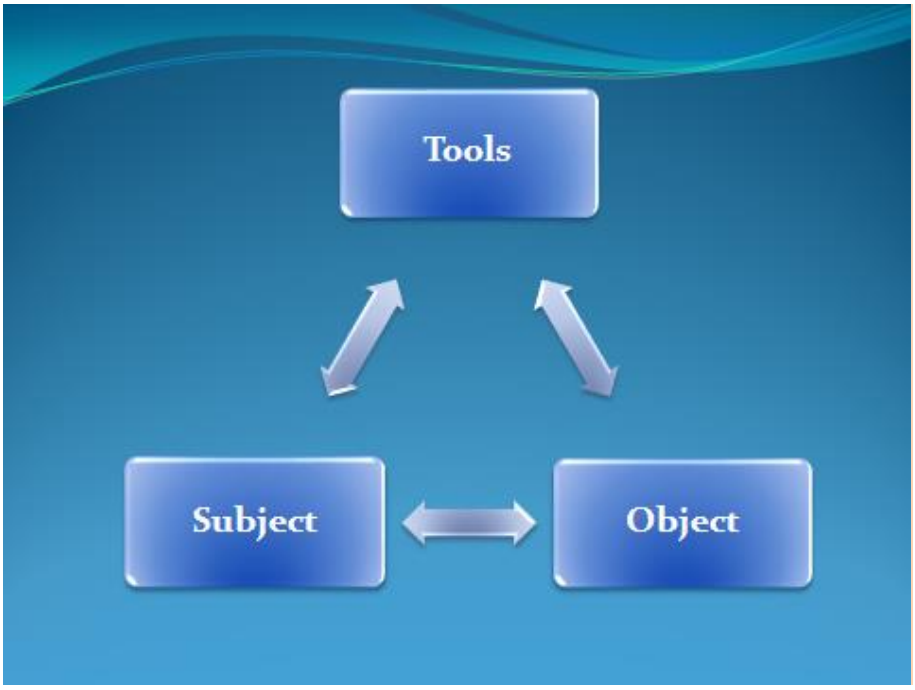


Figure 2.1: Vygotsky's Activity Theory model

The third generation of the model was expanded by Yrjö Engeström. In the expansion of Vygostky's model, rules, community and the division of labour were added (Hashim & Jones, 2007, p. 4). Engeström's Expanded Activity Theory model is depicted as a unit system that has a unit of analysis.

The model depicted in Figure 2.2 is a triangle with the additions to Vygostky's model. The model has *rules* that represent the "set of conditions that help to determine how and why an individual may act" (Hashim & Jones, 2007). The *community* represents "the collective of individuals and groups whose activity is oriented to the shared object" (Guy, 2005). The *division of labour* is "the horizontal division of activities and vertical division of power and responsibility; who performs what actions in relation to the shared object" (Guy, 2005). In addition the model includes the *outcome* of the activity system.

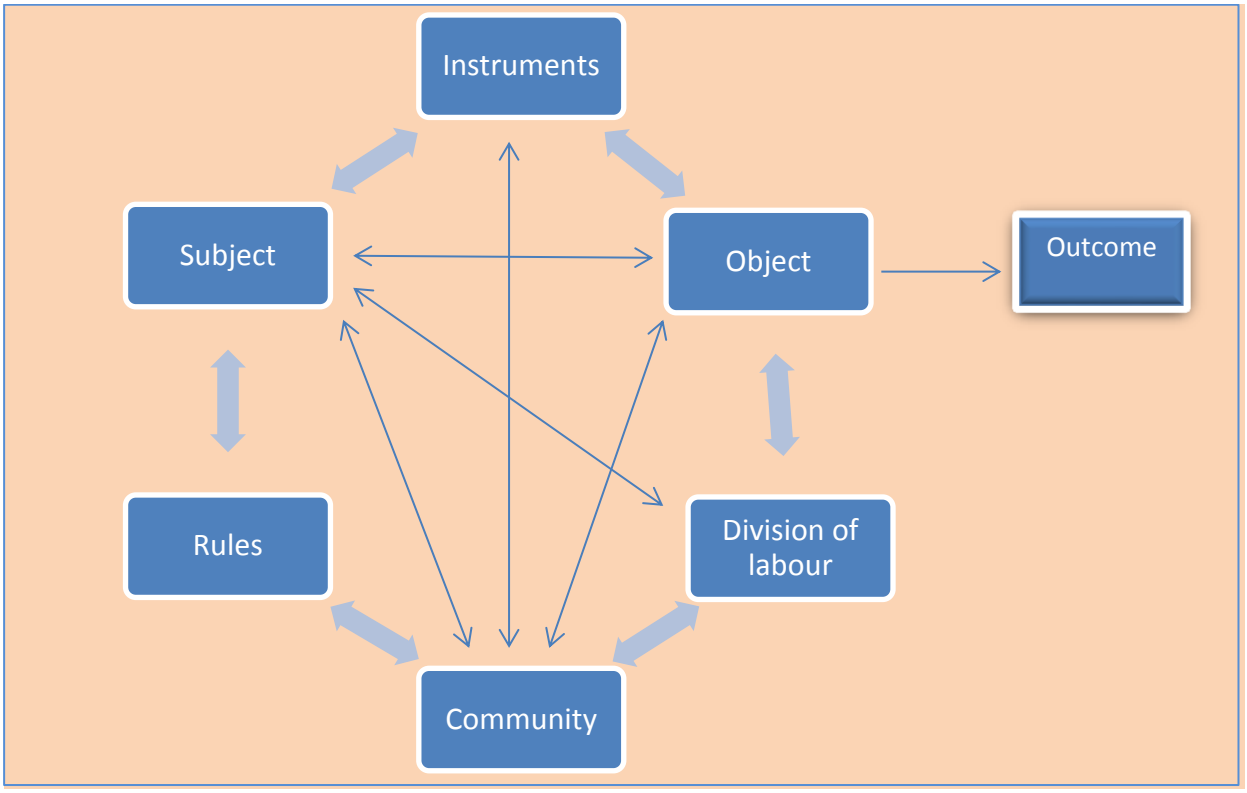


Figure 2.2: Engeström's Activity System model

Activity Theory was suitable for the intended study because it relates to the purpose statement. The theory provides a suitable theoretical lens for the study on the use of ICT in instruction and learning. Engeström's Activity System model relates to the current study in the following manner:

a) Instruments – are represented by the ICTs.
b) Subject – are represented by the teachers who participated in the South African SITES 2006 study.
c) Object – is represented by instruction and learning.
d) Rules – are represented by policies on ICT in education.
e) Community – is represented by the education system.
f) Division of labour – the use of ICT by certain individuals at school.
g) Outcome – is represented by the impact of the use of ICT in education.

2.9 Conclusion

This chapter presents the reviews on the studies relating to the use of ICT resources for instruction and learning, the background to the SITES 2006 study as well as the theoretical framework. ICT resources are becoming readily available and thus their popularity in education is gradually increasing. Although ICT resources can be provided to schools, their use cannot be ascertained.

CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter outlines the research design and methodology used in the SITES 2006 study. The items outlined, relating to the research design and methodology, are research design, population of the study, sampling procedure, the sample, instrumentation, data collection, ethical considerations, data preparation, operational definition of research variables and answering research questions.

The research and methodology for this study are also outlined. The technical coordinators' dataset was used for this study.

3.2 Research design

The International Association for the Evaluation of Educational Achievement (IEA) conducted the SITES 2006 study in 22 education systems. In each country National Research Coordinators (NRCs) were identified to administer and facilitate the SITES 2006 study. They were also responsible for contextualising the survey instruments such as language translations, cultural adaptions and exclusions. In the case of South Africa, two National Research Coordinators were appointed. One was based at the University of Pretoria and the other at Tshwane University of Technology.

The SITES 2006 study guidelines on sampling explicitly outlined how sampling should be done. Following those guidelines, the SITES 2006 study was bound to exclude some of the schools that did not meet the conditions set out by the IEA. There were national coverage, school and

within-school exclusions. For national coverage, factors and reasons resulting in exclusions were political, organisational and operational.

These factors made it difficult for the National Research Coordinators based in each participating country to determine the target population as espoused by the IEA. School exclusions were a result of schools being inaccessible due to geographic factors, schools catering only for disabled learners, schools extremely small in size, etc. The within-school exclusions were caused by teachers - for example those teaching only learners with disabilities.

3.3 Population of the study

The population of the SITES 2006 study was defined as "all the schools with students enrolled in the target grade" (Carstens & Pelgrum, 2009). The target grade in most of the "education systems participating in the SITES 2006" (Carstens & Pelgrum, 2009) study was Grade 8. The target grade in South Africa was also Grade 8.

The SITES 2006 target population consisted of two levels, namely school level and teacher level. The school level of the population included learners in the eighth year of schooling. The teacher level of the population included teachers teaching Mathematics and those teaching Science at the targeted grade (Carstens & Pelgrum, 2009).

3.4 Sampling procedure

To avoid the conflict brought about by probability proportional to size (PPS), stratification or grouping of schools was done. The sample design used by the SITES 2006 researchers involved the following stratifications:

- Explicit stratification
- Size stratification

- Implicit stratification

The explicit stratification variables in the SITES 2006 study included, among others, the following variables: school size; regions; urbanisation; socio-economic status; school type and school programmes (Carstens & Pelgrum, 2009).

The size stratification allowed the SITES 2006 researchers a more reliable estimate and "better control [of] the variability of [the] school and teacher weights" (Carstens & Pelgrum, 2009). Implicit stratification entailed sorting schools according to the known variables such as provinces in the case of South Africa.

The National Research Coordinators in South Africa developed five strata for the sampling of schools. These strata included the following:

- Secondary schools with a high ICT usage in the case of seven provinces.
- Secondary schools with a low ICT usage in the case of seven provinces.
- Secondary schools with no computers in the case of seven provinces.
- Secondary schools whose ICT status is unknown in the case of seven provinces.
- Gauteng and Western Cape secondary schools.

Two provinces, Gauteng and the Western Cape, were represented by one stratum because "ICTs are significantly used" in these provinces only (Blignaut et al., 2010a).

3.5 The sample

The IEA, in their guidelines to the participating countries, recommended a minimum sample of 400 schools in the SITES 2006 study (Blignaut et al., 2010a). Due to contextual considerations, South Africa ended up with a sample of 410 schools.

3.6 Instrumentation

The SITES 2006 study included the following four questionnaires:

- National context questionnaire
- Principal questionnaire
- Technical questionnaire
- Teacher questionnaire

"The National context questionnaire (NCQ) was designed and administered to all the national research coordinators (NRCs)" (Carstens & Pelgrum, 2009). The principal questionnaire was earmarked for the principals of the schools sampled. The technical questionnaire was administered to the technical coordinators at the sampled schools while the teacher questionnaire was earmarked for the teachers teaching either Mathematics or Science at the targeted Grade 8 class (Carstens & Pelgrum, 2009).

The questionnaires were to be contextualised in terms of the language(s) used in the different countries and the cultural environment (Carstens & Pelgrum, 2009). In South Africa all four questionnaires were used in English (Blignaut et al., 2010a).

3.7 Data collection

The SITES 2006 study utilised three data collection methods. Data was collected either online (ODC), or face-to-face or by a hybrid of both ODC and face-to-face (Blignaut et al., 2010a). The survey instruments were used in the English version and did not require to be translated.

Students from the Tshwane University of Technology were used as field workers in administering the three questionnaires to all the schools sampled.

3.8 Ethical considerations

The IEA, through the NRCs, obtained permission from the departments of education in the participating countries to conduct the survey. The NRCs were responsible for administering the questionnaire in the participating countries.

3.9 Data preparation

Upon receiving the survey from the school, the NRCs were tasked to do the following as part of data preparation:

- Check "that the complete and appropriate questionnaires were received" (Carstens & Pelgrum, 2009).
- Verify "that all identification numbers on all paper instruments were accurate and legible" (Carstens & Pelgrum, 2009).
- Follow-up "on schools that had not returned all the survey materials or for which forms were missing, incomplete or otherwise inconsistent" (Carstens & Pelgrum, 2009).

Data preparation required close cooperation between the NRCs and the IEA Data Processing Centre (DPC). The IEA DPC provided each national

research centre "with the Windows Data Entry Manager software" for capturing and processing data (Carstens & Pelgrum, 2009). Responses "were entered into data files created by the IEA DPC" (Carstens & Pelgrum, 2009).

A codebook was provided at the national centres "which contained information about the names, the lengths, the locations, the labels, the valid ranges or valid values and the missing codes for each variable in each of the three questionnaire types" (Carstens & Pelgrum, 2009).

After data entry, using the software by the national research centres, the data was forwarded to the IEA DPC for data cleaning. This was done to ensure that data was of "high quality and internationally comparable" (Carstens & Pelgrum, 2009). WinW3S software was used to do data cleaning. Data "cleaning was organized according to strict rules applied to all national data sets so that deviations in the cleaning sequence were impossible" (Carstens & Pelgrum, 2009).

Once data cleaning had been done, a re-check was done to ensure that there were no omissions or errors during data entry. The codebooks and data were then imported into an SAS database. The software used for cleaning was able to identify and, in some instances, rectify inconsistencies in the data (Carstens & Pelgrum, 2009).

Missing data was categorised by IEA into the following: (Carstens & Pelgrum, 2009).

- Omitted/ invalid (9): respondent did not respond or provided an invalid response.
- "Not administered (8): respondent was not administered the actual question, item or option because it was removed from the national version"

- "Not reached (7): Not reached by the respondent at the end of a questionnaire, usually due to a lack of time (dropped)"
- "Logically not applicable (6): The respondent answered a preceding filter question in a way that made the following dependent questions not applicable"

The "IEA DPC ensured that information coded in each variable was, in fact, internationally comparable, that national adaptations were reflected that questions not internationally comparable were removed from the database" (Carstens & Pelgrum, 2009). The international database (IDB) was then made available in SAS and SPSS format.

3.10 Operational definition of research variables

There were two types of coding relating to the variables in the SITES 2006 study, namely survey and questionnaire coding. Survey coding was further categorised into the following:

a) Identification coding:
   - IDSCHOOL – the code identifies a school.
   - IDTECH – the code identifies an ICT coordinator.
   - IDTEACH – the code identifies teachers within the schools and is used with the school ID.
   - IDPOP – the code identifies the population.

b) Tracking coding:
   The tracking variables are used in the database to "provide information about the survey administration, participation and some basic characteristics of respondents" (Carstens & Pelgrum, 2009).

c) Sampling and weighting coding:
   These variables are used in the database to indicate how the sampling and weighting of schools was used. For example, the code

SCHWGT indicates that the school weight was used (Brese & Carstens, 2009).

Questionnaire coding is the code given to the three questionnaires administered at school. The following codes were used:

- BCP – code used for the data from the principal questionnaire.
- BCT – code used for the data from the Technical questionnaire.
- BTG – code used for the data from the Teacher questionnaire (Brese and Carstens, 2009).

3.11 Answering research questions

The following are the SITES 2006 study research questions: (Plomp et al., 2007)

- What are the pedagogical practices applied in schools and how is ICT used in them?
- What are the pedagogical visions of schools and teachers?

  Sub-questions:

  - What ICT is available in the schools and how is it used in instruction and learning?
  - What are the pedagogical visions of schools and teachers?
  - In what pedagogical practices are ICT used and in what way?
- To what extent are factors associated with the use of ICT and the nature of pedagogical practices found in schools and among teachers?

3.12 The envisaged Secondary Data Analysis (SDA) study

Perspectives on the use of ICT for instruction and learning as well as the current trends on the provision of resources for instruction and learning in

South Africa influenced this study. Also, the various ICT workshops attended influenced this study.

Secondary Data Analysis was identified as the suitable strategy to address the envisaged research question. The dataset on the technical coordinators was used to determine the relationship between the use of ICT for instruction and learning and the availability of ICT resources.

3.12.1 Population and sample

The population for this study consisted of all teachers that offered lessons to Grade 8 learners in the South African schools that formed part of the SITES 2006. On the SITES 2006 dataset only 349 cases were valid for further analysis from a South African sample of 410 technical coordinators.

3.12.2 Research design

The research design used in this study is an integrated qualitative-quantitative design. In an integrated qualitative-quantitative design qualitative data is transformed into quantitative data for analysis. The SITES 2006 dataset has a qualitative data that have, for this study, been converted to quantitative data.

3.12.3 Data collection and preparation

Prior to accessing the dataset permission to access and use the SITES 2006 dataset was sought from the National Research Coordinator at the University of Pretoria. Permission was granted and the technical coordinator dataset was downloaded. The technical coordinators dataset is accessible from the IEA website following the SITES 2006 link. The dataset was then saved for further analysis. The Statistical Package for the Social Sciences (SPSS) was used to analyse the dataset.

In the SPSS window the variable on the "number of years school has been using ICT for teaching and learning" was recoded from five categories to two categories, namely "0 – 5 years" and "More than 5 years". The category "0 – 5 years" was labelled 1 and the "More than 5 years" category was labelled 2. In calculating the data set, categories seven and nine were omitted from the calculation as they represented "Not reached" and "Omitted" respectively.

In the variable "Resource materials" there are 13 types of resource materials (A – M) that have been analysed in relation to their use by the schools. In the SPSS window the dataset was selected to exclude those that indicated "not needed and not available". For this variable the analysis was thus on the data that shows "Available" and "Needed and not available".

3.12.4 Data analysis

Descriptive and inferential statistics were used for the data analysis of this study. A Chi-square was calculated to determine the possible significant difference of the variables on the number of years schools have been using ICT and the availability of ICT resources (software and hardware). In the conclusion the Odds ratio was calculated to determine the effect size.

3.12.5 Ethical considerations – Secondary study

South Africa, just like all the participating countries, gave IEA permission to conduct the SITES 2006 survey in the sampled schools in the nine provinces. The NRC at the University of Pretoria gave permission to the researcher to use the SITES 2006 data set for the further study. The data set on technical coordinators was thus acquired to conduct a secondary

data analysis as provincial departments of education gave IEA permission to administer the battery of survey instruments.

Table 3.1 summaries the research question, research design, research methods and the sample of the envisaged study.

Table 3.1: Research design and methods

Research question	Research design	Research methods		Sample
		Data gathering	Data analysis	
1. What is the difference between the joint frequencies in a contingency table based on the number of years schools had been using ICT and the availability of resource materials?	Integrated qualitative-quantitative	Secondary Data Analysis (SDA)	Descriptive and inferential statistics (Pearson Chi-square)	**SITES 2006** 1. A stratified two-stage sample of Grade 8 schools: • School level – school principal and technology coordinator. • Teacher level – Mathematics and Science teachers. 2. Schools were further subdivided into four categories: a) high ICT usage expected, b) low ICT usage expected, c) no computers available and d) unknown. 3. The South African sample size was 410 although the SITES prescripts were 400 (Blignaut et al., 2010). **Envisaged study** 1. From the dataset – 349 technical coordinators were valid to do the envisaged study.

CHAPTER 4
DATA ANALYSIS AND INTERPRETATION OF RESULTS

4.1 Introduction

This chapter deals with data analysis and the interpretation of results obtained from the technical questionnaire SITES 2006 dataset. The dataset was analysed by using descriptive and inferential statistics. Regarding descriptive statistics, the number of schools, number of technical coordinators as well as the number of years schools have been using ICT for instruction and learning are presented. The inferential statistics were done by calculating the Chi-square value and presenting the interpretation of the findings.

4.2 Descriptive analysis

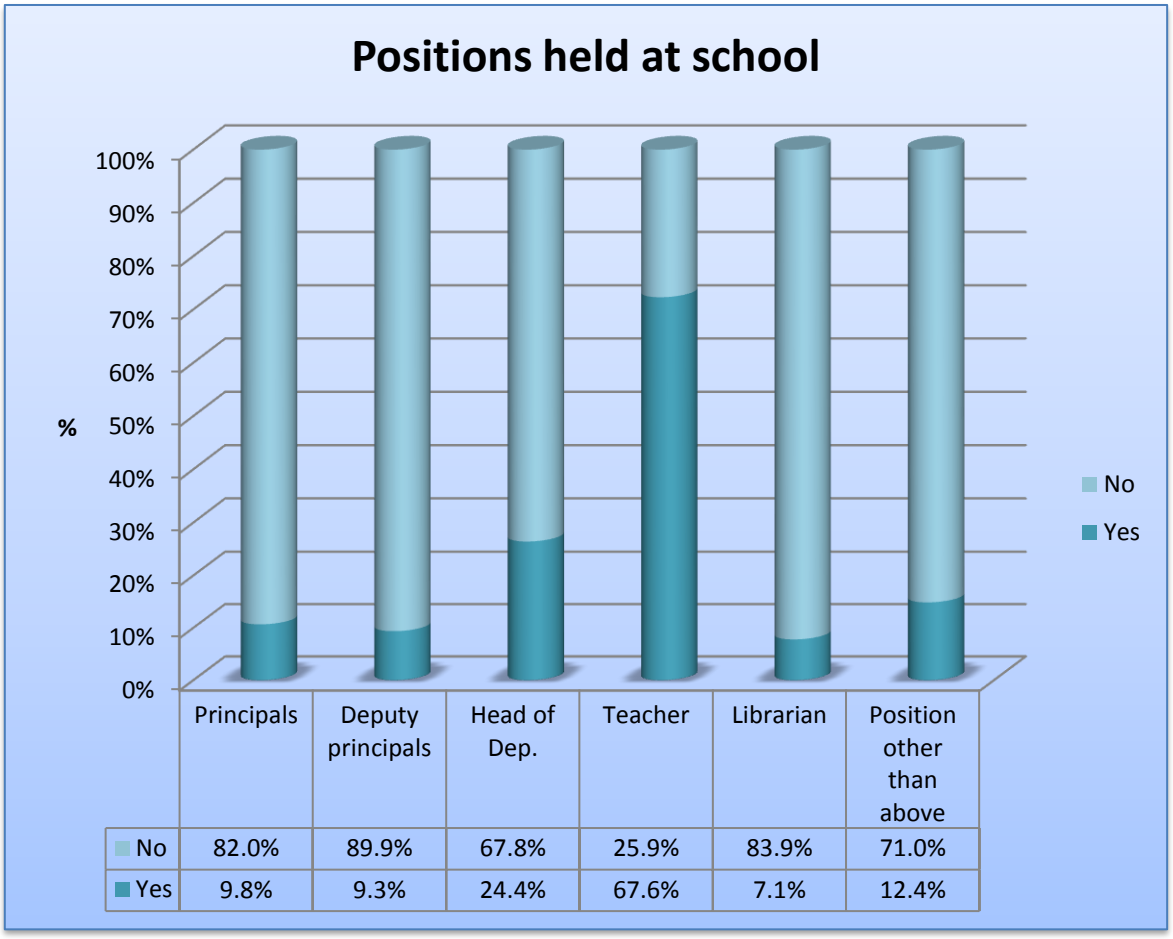
The SITES 2006 study originally aimed at exploring the status of pedagogy and ICT-use in Mathematics and Science classrooms. In addition other contextual factors that contribute to the use of ICT by teachers were considered. As a result the principals' and the technical coordinators' questionnaires were developed. This study focuses on the use of ICT by Grade 8 teachers and the availability of ICT resources from the viewpoint of the technical coordinators.

The number of technical coordinators involved in the project was 410. The same number of technical coordinators participated in the project. Only 349 (85%) of the 410 technical coordinators indicated the number of years that ICT had been used.

4.2.1 Positions held at school

The questionnaire required technical coordinators to indicate the positions that they held at their schools. The technical coordinators were to indicate whether they were principals, deputy principals, heads of department, teachers, librarians and other positions at their schools.

As shown in Figure 4.1, from the total of 410 technical coordinators, the majority were teachers (67.6%) while the least indicated that they were librarians (7.1%).



	Principals	Deputy principals	Head of Dep.	Teacher	Librarian	Position other than above
No	82.0%	89.9%	67.8%	25.9%	83.9%	71.0%
Yes	9.8%	9.3%	24.4%	67.6%	7.1%	12.4%

Figure 4.1: Positions held at school

4.2.2 Duties done at school

The 410 technical coordinators were also to indicate the type of duty they performed at their schools. Figure 4.2 shows that technical coordinators were to indicate whether they informally or formally served as technical coordinators, taught other subjects, taught mathematics and/or Science, taught ICT courses to teachers and other staff or taught ICT courses to students.

Figure 4.2 on the duties done at their schools also shows that a large number of technical coordinators taught other subjects (66.1%) and the smallest number taught ICT courses to teachers and other staff (15.1%).

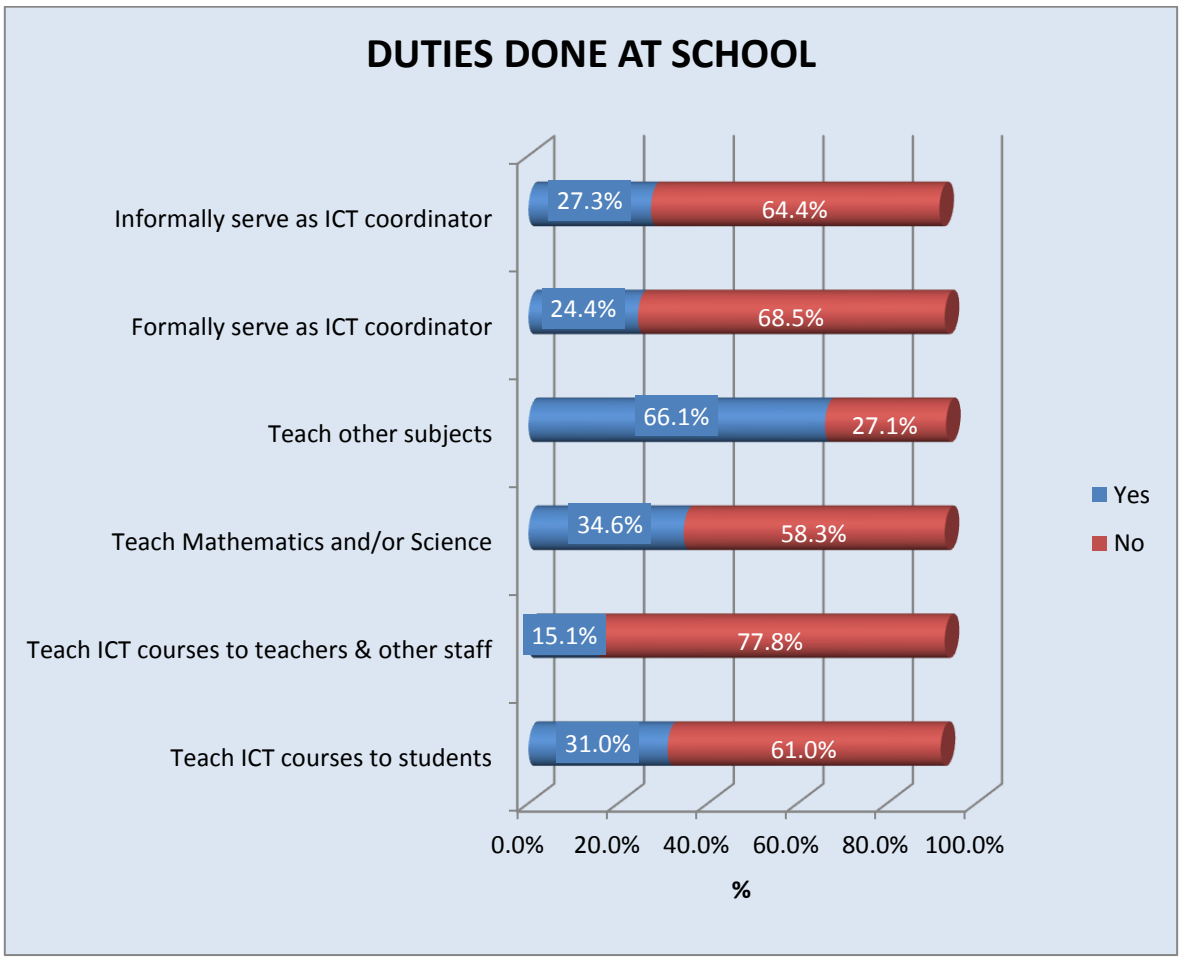


Figure 4.2: Duties done at school

4.2.3 Access to a computer at home

The 410 technical coordinators were also required to indicate whether they accessed a computer at their homes. In Figure 4.3, it clearly shows that a high number of technical coordinators (81.0%) have access to a computer at home.

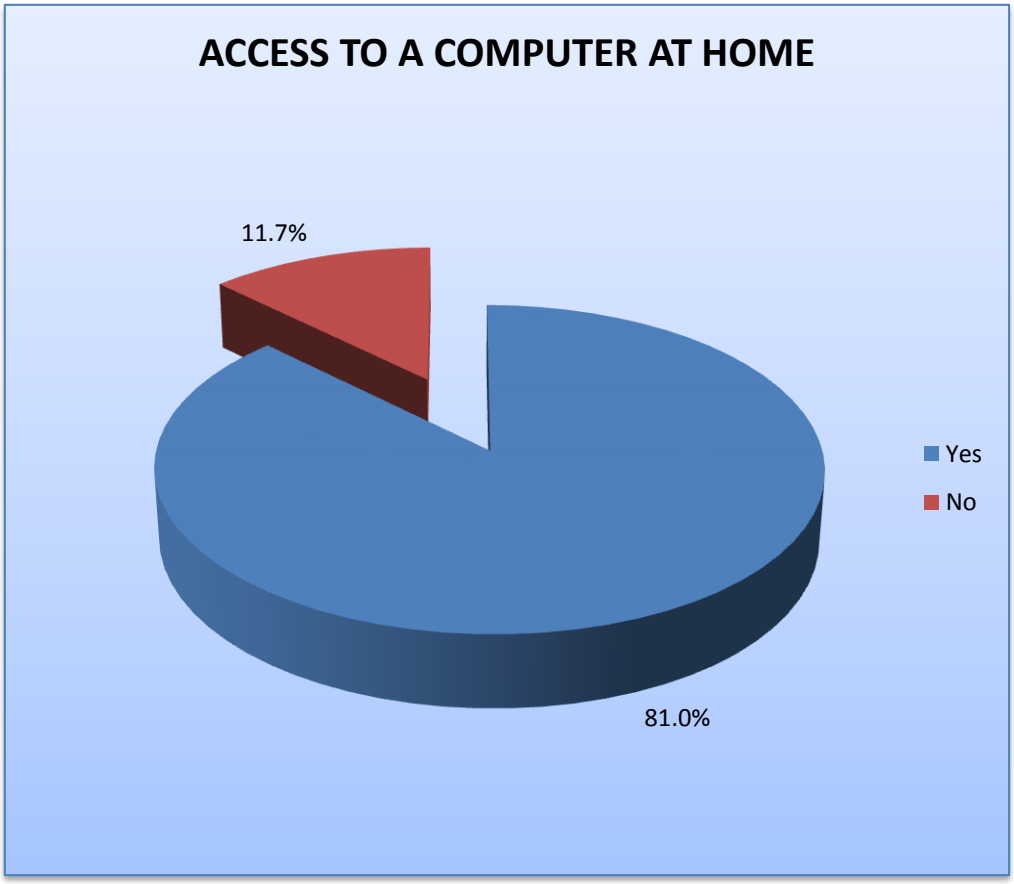


Figure 4.3: Access to a computer at home

4.3 Inferential analysis

Inferential data analysis was done in this study using a two-way Chi-square technique. The Chi-square technique was used to determine if there is a statistical significant association in frequencies in a cross tabulation. The cross tabulation is a 2 x 2 table analysis of the following two variables:

- Availability of ICT resources
- The number of years the participating schools have used ICT

The analysis focused on the following hypotheses:

- H_o: No association exists between the availability of ICT resources and the use of ICT
- H_A: An association exists between the availability of ICT resources and the use of ICT

To get a 2 by 2 table the following was done to the variables:

- The numbers of years the participating schools have used ICT: In SPSS, data on variable BCT01A1 was recoded from 1 – 5 categories to 1 – 2 categories. Category 1 was named "0 - 5 years" and category 2 "More than 5 years".
- Availability of ICT resources: In SPSS, the data on "resource materials" BCT04A1 – BCT04M1 from the questionnaire were selected one at the time to calculate data "available" represented by (1) and those "needed but not available represented by (2).

The outcomes of these actions were 13 cross tabulations, one for each of the resources indicated in question 4. The 13 cross tabulations are presented in Table 4.1 to Table 4.13 based on the following types of ICT resource (Pelgrum, 2008):

a) Equipment and hands-on materials
b) Tutorial/exercise software
c) General office suite
d) Multimedia production tools
e) Data-logging tools
f) Simulations/modelling software
g) Communication software

h) Digital resources
i) Mobile devices
j) Smart board/interactive whiteboard
k) Learning management system
l) Mail accounts for teachers
m) Mail accounts for students

The Asymptotic Significance (Asymp. Sig.) value in the output table for the Chi-square calculation (13) is the p-value in each of the 13 cases that will be used to determine the significance of the difference between the numbers in the cross tabulation.

The p-value generated in each case was interpreted based on the following principle:

- if the p-value is greater than .05, then there is no significant difference between the numbers in the cross tabulation.
- if the p-value is less than or equal to .05, then there is a significant difference between the numbers in the cross tabulation.

The tables on 13 types of ICT resource, together with a brief description of each table are presented in paragraphs 4.3.1 – 4.3.13.

4.3.1 Equipment and hands-on materials

A two-way Chi-square was done between the "number of years schools had been using ICT for [instruction] and learning" (Pelgrum, 2008) and the availability of equipment and hands-on materials. The results are presented in Table 4.1.

In the cross tabulation it is evident that 15.6% of the technical coordinators in the category "0 – 5 years" believed that equipment and

hands-on materials were available. However, 84.4% of the technical coordinators in the same category indicated that the necessary equipment and hands-on materials were needed but were not available (χ^2 (1, 343) = 53.125, p < .05).

Table 4.1: Equipment and hands-on materials

Number of years schools had been using ICT \ Availability of equipment and hands-on materials		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	42	227	269
	Expected Count	65.9	203.1	269.0
	%	15.6%	84.4%	100.0%
MORE THAN 5 YEARS	Count	42	32	74
	Expected Count	18.1	55.9	74.0
	%	56.8%	43.2%	100.0%
TOTAL	Count	84	259	343
	Expected Count	84.0	259.0	343.0
	%	24.5%	75.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	53.125[a]	1	.000
Continuity Correction[b]	50.923	1	.000
Likelihood Ratio	47.575	1	.000
Linear-by-Linear Association	52.970	1	.000
N of Valid Cases	343		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.12.

b. Computed only for a 2x2 table

The same cross tabulation revealed that 56.8% of the technical coordinators in the category "more than 5 years" were of the opinion that equipment and hands-on materials were available. In contrast 43.2% of the technical coordinators in the same category indicated that the necessary equipment and hands-on materials were needed but not available (χ^2 (1, 343) = 53.125, p<.05).

The same number of technical coordinators in the categories "0 - 5 years" and "more than 5 years" pointed out that the equipment and hands-on materials were available. In the category "0 - 5 years" more technical coordinators indicated that the equipment and hands-on materials were needed but not available than in the category "more than 5 years"

(χ^2 (1, 343) = 53.125, p < .05).

4.3.2 Tutorial/ exercise software

Table 4.2 presents results on the two-way Chi-square calculation between the "number of years schools had been using ICT for [instruction] and learning" (Pelgrum, 2008) and the availability of tutorial/exercise software.

Table 4.2: Tutorial/ exercise software

Number of years schools had been using ICT \ Availability tutorial/ exercise software		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	25	237	262
	Expected Count	37.2	224.8	262.0
	%	9.5%	90.5%	100.0%
MORE THAN 5 YEARS	Count	22	47	69
	Expected Count	9.8	59.2	69.0
	%	31.9%	68.1%	100.0%
TOTAL	Count	47	284	331
	Expected Count	47.0	284.0	331.0
	%	14.2%	85.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.377[a]	1	.000
Continuity Correction[b]	20.581	1	.000
Likelihood Ratio	19.076	1	.000
Linear-by-Linear Association	22.310	1	.000
N of Valid Cases	331		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.80.

b. Computed only for a 2x2 table

The results reveal that 9.5% of the technical coordinators in the category "0 – 5 years" believed that tutorial/exercise software was available. In the same category of "0 – 5 years" 90.5% of the technical coordinators indicated that the basic tutorial/exercise software was needed but was not available (χ^2 (1, 331) = 22.377, p < .05).

The results also show that 31.9% of the technical coordinators in the category "more than 5 years" held the view that tutorial/exercise software was available. On the contrary it is apparent that 68.1% of the technical

coordinators in the same category indicated that the necessary tutorial/exercise software was needed but it was not available (χ^2 (1, 331) = 22.377, p < .05).

More technical coordinators in the category "0 - 5 years" indicated that tutorial/exercise software was available and needed but not available than in the category "more than 5 years" (χ^2 (1, 331) = 22.377, p < .05).

4.3.3 General office suite

The results on the two-way Chi-square calculation shown in Table 4.3 relate to the "number of years schools had been using ICT for [instruction] and learning" (Pelgrum, 2008) and the availability of a general office suite.

In this table 39.3% of the technical coordinators in the category "0 – 5 years" were of the opinion that a general office suite was available (χ^2 (1, 340) = 32.141, p < .05). However, 60.7% of the technical coordinators in the same category point out that a general office suite was needed but was not available (χ^2 (1, 340) = 32.141, p < .05).

The table also shows that 76.7% of the technical coordinators in the category "more than 5 years" were of the opinion that a general office suite was available. However, 23.3% of the technical coordinators in the same category indicated that the required general office suite was needed but was not available (χ^2 (1, 340) = 32.141, p < .05).

In categories "0 – 5 years" and "more than 5 years", more technical coordinators were of the opinion that a general office suite is available and needed but not available than those in the category "more than 5 years" (χ^2 (1, 340) = 32.141, p < .05).

Table 4.3: General office suite

Number of years schools had been using ICT / Availability of general office suite		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	105	162	267
	Expected Count	126.4	140.6	267.0
	%	39.3%	60.7%	100.0%
MORE THAN 5 YEARS	Count	56	17	73
	Expected Count	34.6	38.4	73.0
	%	76.7%	23.3%	100.0%
TOTAL	Count	161	179	340
	Expected Count	161.0	179.0	340.0
	%	47.4%	52.6%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	32.141 [a]	1	.000
Continuity Correction[b]	30.659	1	.000
Likelihood Ratio	33.270	1	.000
Linear-by-Linear Association	32.047	1	.000
N of Valid Cases	340		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 34.57.

b. Computed only for a 2x2 table

4.3.4 Multimedia production tools

The results on the two-way Chi-square calculation between the "number of years schools had been using ICT for [instruction] and learning" (Pelgrum, 2008) and the availability of multimedia production tools are presented in Table 4.4.

In this table it is clear that 5% of the technical coordinators in the category "0 – 5 years" postulate that multimedia production tools were available. However, 95% of the technical coordinators in the same category mentioned that the necessary multimedia production tools were needed but were not available (χ^2 (1, 334) = 46.152, p < .05).

In the "more than 5 years" category, 33.3% of the technical coordinators held the view that multimedia production tools were available. In the same category 66.7% of the technical coordinators mentioned that the essential multimedia production tools were needed but not available (χ^2 (1, 334) = 46.152, p < .05).

Table 4.4: Multimedia production tools

Number of years schools had been using ICT \ Availability of multimedia production tools		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	13	249	262
	Expected Count	29.0	233.0	262.0
	%	5.0%	95.0%	100.0%
MORE THAN 5 YEARS	Count	24	48	72
	Expected Count	8.0	64.0	72.0
	%	33.3%	66.7%	100.0%
TOTAL	Count	37	297	334
	Expected Count	37.0	297.0	334.0
	%	11.1%	88.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	46.152[a]	1	.000
Continuity Correction[b]	43.316	1	.000
Likelihood Ratio	37.467	1	.000
Linear-by-Linear Association	46.013	1	.000
N of Valid Cases	334		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.98.

b. Computed only for a 2x2 table

As shown in the table, more technical in the category "more than 5 years" indicated that the ICT resource is available than those in the category "0 – 5 years". The same ICT resource is needed but not available to more technical coordinators in the category "0 – 5 years" than those in the category "more than 5 years" (χ^2 (1, 334) = 46.152, p < .05).

4.3.5 Data-logging tools

The calculation of a two-way Chi-square between the "number of years schools had been using ICT for [instruction] and learning" (Pelgrum, 2008) and the availability of data-logging tools was done and the results are shown in Table 4.5. In this table 9.9% of the technical coordinators in the category "0 – 5 years" thought that data-logging tools were available whereas 90.1% of the technical coordinators in the same category revealed that the crucial data-logging tools were needed but were not available (χ^2 (1, 318) = 31.877, p < .05).

In the category "more than 5 years" 38.5% of the technical coordinators believed that data-logging tools were available. In the same category 61.5% of the technical coordinators mentioned that the crucial data-logging tools were needed but not available
(χ^2 (1, 318) = 31.877, p < .05).

The same number of technical coordinators in the categories "0 - 5 years" and "more than 5 years" indicated that data-logging tools were available. More technical coordinators in the category "0 – 5 years" indicated that the data-logging tools were needed but not available than in the category "more than 5 years" (χ^2 (1, 318) = 31.877, p < .05).

Table 4.5: Data-logging tools

Number of years schools had been using ICT \ Availability of data-logging tools		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	25	228	253
	Expected Count	39.8	213.2	253.0
	%	9.9%	90.1%	100.0%
MORE THAN 5 YEARS	Count	25	40	65
	Expected Count	10.2	54.8	65.0
	%	38.5%	61.5%	100.0%
TOTAL	Count	50	268	318
	Expected Count	50.0	268.0	318.0
	%	15.7%	84.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	31.877[a]	1	.000
Continuity Correction[b]	29.757	1	.000
Likelihood Ratio	26.907	1	.000
Linear-by-Linear Association	31.777	1	.000
N of Valid Cases	318		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.22.

b. Computed only for a 2x2 table

4.3.6 Simulations/ modelling software

The results of the calculation of a two-way Chi-square between the "number of years schools had been using ICT for [instruction] and learning" (Pelgrum, 2008) and the availability of simulations/modelling software are tabulated in Table 4.6.

The results exhibit that simulations/modelling software was available to 3.1% of technical coordinators and was needed but was not available to 96.9% of technical coordinators in the category "0 – 5 years". In the category "more than 5 years", 22.1% of technical coordinators indicated that simulations/modelling software was available and 77.9% felt that it was needed but was not available (χ^2 (1, 330) = 30.075, p < .05).

Table 4.6: Simulations/modelling software

Number of years schools had been using ICT	Availability of Simulations/ modelling software	AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	8	254	262
	Expected Count	18.3	243.7	262.0
	%	3.1%	96.9%	100.0%
MORE THAN 5 YEARS	Count	15	53	68
	Expected Count	4.7	63.3	68.0
	%	22.1%	77.9%	100.0%
TOTAL	Count	23	307	330
	Expected Count	23.0	307.0	330.0
	%	7.0%	93.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.075[a]	1	.000
Continuity Correction[b]	27.216	1	.000
Likelihood Ratio	23.548	1	.000
Linear-by-Linear Association	29.984	1	.000
N of Valid Cases	330		

a. 1 cell (25.0%) has expected a count less than 5. The minimum expected count is 4.74.

Between the categories, it is evident that more technical coordinators in the category "0 – 5 years" were in need of the simulations/modelling software but it was not available. However, more technical coordinators in the category "more than 5 years" indicated that simulations/modelling software is available (χ^2 (1, 330) = 30.075, p < .05).

4.3.7 Communication software

A calculation of a two-way Chi-square was done between the "number of years schools had been using ICT for [instruction] and learning" (Pelgrum, 2008) and the availability of communication software. The results are presented in Table 4.7.

In the cross tabulation 15.2% of the technical coordinators in the category "0 – 5 years" believed that communication software was available. In contrast, 84.8% of the technical coordinators in the same category indicated that the necessary communication software was needed but was not available (χ^2 (1, 334) = 37.305, p < .05).

Table 4.7: Communication software

Number of years schools had been using ICT	Availability of Communication software	AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	40	223	263
	Expected Count	59.1	203.9	263.0
	%	15.2%	84.8%	100.0%
MORE THAN 5 YEARS	Count	35	36	71
	Expected Count	15.9	55.1	71.0
	%	49.3%	50.7%	100.0%
TOTAL	Count	75	259	334
	Expected Count	75.0	259.0	334.0
	%	22.5%	77.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	37.305[a]	1	.000
Continuity Correction[b]	35.373	1	.000
Likelihood Ratio	33.125	1	.000
Linear-by-Linear Association	37.193	1	.000
N of Valid Cases	334		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.94.

b. Computed only for a 2x2 table

The table also revealed that 49.3% of the technical coordinators in the category "more than 5 years" felt that communication software was available. In contrast 50.7% of the technical coordinators in the same category indicated that the communication software was needed but not available (χ^2 (1, 334) = 37.305, p < .05).

More technical coordinators in the category "0 - 5 years" indicated that communication software was available than in the category "More than 5 years". Also, more technical coordinators in the category "0 – 5 years" indicated that the communication software was needed but not available (χ^2 (1, 334) = 37.305, p < .05).

4.3.8 Digital resources

Table 4.8 displays the results of the calculation of a two-way Chi-square between the "number of years schools had been using ICT for [instruction] and learning" (Pelgrum, 2008) and the availability of digital resources.

Table 4.8: Digital resources

Number of years schools had been using ICT \ Availability of digital resources		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	48	220	268
	Expected Count	69.2	198.8	268.0
	%	17.9%	82.1%	100.0%
MORE THAN 5 YEARS	Count	40	33	73
	Expected Count	18.8	54.2	73.0
	%	54.8%	45.2%	100.0%
TOTAL	Count	88	253	341
	Expected Count	88.0	253.0	341.0
	%	25.8%	74.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	40.765[a]	1	.000
Continuity Correction[b]	38.861	1	.000
Likelihood Ratio	36.973	1	.000
Linear-by-Linear Association	40.645	1	.000
N of Valid Cases	341		

a. 0 cells (0.0%) had expected count less than 5. The minimum expected count is 18.84.

b. Computed only for a 2x2 table

In Table 4.8, 17.9% of the technical coordinators in the category "0 – 5 years" were of the opinion that digital resources were available. However, 82.1% of the technical coordinators in the same category indicated that the necessary digital resources were needed but were not available (χ^2 (1, 341) = 40.765, p < .05).

The table also presents that 54.8% of the technical coordinators in the category "more than 5 years" observed that digital resources were available while 45.2% of the technical coordinators in the same category indicated that the necessary digital resources were needed but were not available (χ^2 (1, 341) = 40.765, p < .05).

In the category "0 - 5 years" more technical coordinators indicated that digital resources were available as well as needed but not available than in the category "more than 5 years" (χ^2 (1, 341) = 40.765, p < .05).

4.3.9 Mobile devices

The results of the calculation of a two-way Chi-square between the number of years schools had been using ICT for instruction and learning and the availability of mobile devices are presented in Table 4.9.

The results demonstrate that 13.8% of the technical coordinators in the category "0 – 5 years" were convinced that mobile devices were available. However, 86.2% of the technical coordinators in the same category indicated that the necessary mobile devices were needed but were not available (χ^2 (1, 298) = 8.100, p < .05).

The results also denote that 29.3% of the technical coordinators in the category "more than 5 years" held the view that mobile devices were available. In contrast 70.7% of the technical coordinators in the same category indicated that mobile devices were needed but were not available (χ^2 (1, 298) = 8.100, p < .05). technical coordinators indicated that mobile devices were available and needed but not available than in the category "more than 5 years" (χ^2 (1, 298) = 8.100, p < .05).

Table 4.9: Mobile devices

Availability of mobile devices / Number of years schools had been using ICT		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	33	207	240
	Expected Count	40.3	199.7	240.0
	%	13.8%	86.2%	100.0%
MORE THAN 5 YEARS	Count	17	41	58
	Expected Count	9.7	48.3	58.0
	%	29.3%	70.7%	100.0%
TOTAL	Count	50	248	298
	Expected Count	50.0	248.0	298.0
	%	16.8%	83.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.100[a]	1	.004
Continuity Correction[b]	7.024	1	.008
Likelihood Ratio	7.244	1	.007
Linear-by-Linear Association	8.073	1	.004
N of Valid Cases	298		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.73.

b. Computed only for a 2x2 table

4.3.10 Smart board/ Interactive whiteboard

Table 4.10 presents the results of the calculation of a two-way Chi-square done between the number of years schools that had been using ICT for instruction and learning and the availability of a smart board/ interactive whiteboard.

In Table 4.10, results show that only 8% of the technical coordinators in the category "0 – 5 years" were of the view that a smart board/interactive whiteboard were available. However, 92% of the technical coordinators in the same category were of the view that a smart board/interactive whiteboard were needed but were not available
(χ^2 (1, 332) = 21.565, p < .05).

In the same table, results also show that 28.6% of the technical coordinators in the category "more than 5 years" were of the opinion that a smart board/interactive whiteboard were available.

Table 4.10: Smart board/ Interactive whiteboard

Number of years schools had been using ICT \ Availability of smart board/ interactive whiteboard		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	21	241	262
	Expected Count	32.4	229.6	262.0
	%	8.0%	92.0%	100.0%
MORE THAN 5 YEARS	Count	20	50	70
	Expected Count	8.6	61.4	70.0
	%	28.6%	71.4%	100.0%
TOTAL	Count	41	291	332
	Expected Count	41.0	291.0	332.0
	%	12.3%	87.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.565[a]	1	.000
Continuity Correction[b]	19.707	1	.000
Likelihood Ratio	18.194	1	.000
Linear-by-Linear Association	21.500	1	.000
N of Valid Cases	332		

a. 0 cells (0.0%) had expected count less than 5. The minimum expected count is 8.64.

b. Computed only for a 2x2 table

However, 71.4% of the technical coordinators in the same category indicated that the smart board/interactive whiteboard was needed but was not available (χ^2 (1, 332) = 21.565, p < .05).

More technical coordinators in the category "0 – 5 years" indicated that the smart board/interactive whiteboard was available and also needed but not available (χ^2 (1, 332) = 21.565, p < .05).

4.3.11 Learning management system

In the calculation of a two-way Chi-square between the number of years schools had been using ICT for instruction and learning and the availability of the learning management system, the results are tabulated in Table 4.11.

In Table 4.11, the results depict that a mere 7.1% of the technical coordinators in the category "0 – 5 years" believed that a learning management system was available whereas 92.9% of the technical coordinators indicated that the learning management system was needed but was not available (χ^2 (1, 322) = 15.898, p < .05).

In the same table, results also evince that 23.9% of the technical coordinators in the category "more than 5 years" were of the view that a learning management system was available. In contrast 76.1% of the technical coordinators in the same category indicated that the learning management system was needed but was not available (χ^2 (1, 322) = 15.898, p < .05).

In the category "0-5 years" more technical coordinators indicated that a learning management system was available and also needed but not available than in the category "more than 5 years" (χ^2 (1, 322) = 15.898, p < .05).

Table 4.11: Learning management system

Number of years schools had been using ICT \ Availability of learning management system		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	18	237	255
	Expected Count	26.9	228.1	255.0
	%	7.1%	92.9%	100.0%
MORE THAN 5 YEARS	Count	16	51	67
	Expected Count	7.1	59.9	67.0
	%	23.9%	76.1%	100.0%
TOTAL	Count	34	288	322
	Expected Count	34.0	288.0	322.0
	%	10.6%	89.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.898[a]	1	.000
Continuity Correction[b]	14.167	1	.000
Likelihood Ratio	13.363	1	.000
Linear-by-Linear Association	15.849	1	.000
N of Valid Cases	322		

a. 0 cells (0.0%) had expected count less than 5. The minimum expected count is 7.07.

b. Computed only for a 2x2 table

4.3.12 Mail accounts for teachers

A two-way Chi-square was done between the number of years schools had been using ICT for instruction and learning and the availability of mail accounts for teachers. The results are presented in Table 4.12.

The results in the table exhibit that 13.1% of the technical coordinators in the category "0 – 5 years" believed that mail accounts for teachers were available. In contrast, 86.9% of the technical coordinators in the same category indicated that mail accounts for teachers were needed but were not available (χ^2 (1, 321) = 21.826, p < .05).

Table 4.12: Mail accounts for teachers

Number of years schools had been using ICT \ Availability of mail accounts for teachers		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	33	219	252
	Expected Count	46.3	205.7	252.0
	%	13.1%	86.9%	100.0%
MORE THAN 5 YEARS	Count	26	43	69
	Expected Count	12.7	56.3	69.0
	%	37.7%	62.3%	100.0%
TOTAL	Count	59	262	321
	Expected Count	59.0	262.0	321.0
	%	18.4%	81.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.826[a]	1	.000
Continuity Correction[b]	20.218	1	.000
Likelihood Ratio	19.231	1	.000
Linear-by-Linear Association	21.758	1	.000
N of Valid Cases	321		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.68.

b. Computed only for a 2x2 table

The results in the table also reveal that 37.7% of the technical coordinators in the category "more than 5 years" were of the view that mail accounts for teachers were available. However, 62.3% of the

technical coordinators in the same category indicated that the necessary mail accounts for teachers were needed but not available (χ^2 (1, 321) = 21.826, p < .05).

There were more technical coordinators in the category "0-5 years" who indicated that mail accounts for teachers were available and also needed but not available than in the category "more than 5 years" (χ^2 (1, 321) = 21.826, p < .05).

4.3.13 Mail accounts for students

The results of the calculation of a two-way Chi-square between the number of years schools had been using ICT for instruction and learning and the availability of mail accounts for students are displayed in Table 4.13.

Table 4.13: Mail accounts for students

Number of years schools had been using ICT \ Availability of mail accounts for student		AVAILABLE	NEEDED BUT NOT AVAILABLE	TOTAL
0–5 YEARS	Count	24	217	241
	Expected Count	30.2	210.8	241.0
	%	10.0%	90.0%	100.0%
MORE THAN 5 YEARS	Count	14	48	62
	Expected Count	7.8	54.2	62.0
	%	22.6%	77.4%	100.0%
TOTAL	Count	38	265	303
	Expected Count	38.0	265.0	303.0
	%	12.5%	87.5%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.163[a]	1	.007
Continuity Correction[b]	6.058	1	.014
Likelihood Ratio	6.323	1	.012
Linear-by-Linear Association	7.139	1	.008
N of Valid Cases	303		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.78.

b. Computed only for a 2x2 table

The results in the table show 10% of the technical coordinators in the category "0 – 5 years" are of the opinion that mail accounts for students were available while 90% of the technical coordinators in the same category point out that the mail accounts for students were needed but were not available (χ^2 (1, 303) = 7.163, p < .05).

In the same table, the results also signify that 22.6% of the technical coordinators in the category "more than 5 years" were of the view that mail accounts for students were available. However, 77.4% of the technical coordinators in the category "more than 5 years" denoted that mail accounts for students were needed but were not available (χ^2 (1, 303) = 7.163, p < .05).
The greater number of technical coordinators who pointed out that the mail accounts for students was available as well as needed but not available were in the category "0 - 5years" (χ^2 (1, 303) = 7.163, p < .05).

CHAPTER 5
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a brief summary of the two types of variables. The following two variables were analysed:

- the number of years schools that have started to use ICT resources for teaching and learning and
- the availability of ICT resources.

A summary will be done by calculating the effect size which is done by determining the odds ratios on the count values in the 13 tables in Chapter 4. The summaries also include recommendations based on the results of the odds ratios.

5.2 Summary of odds ratios relating to ICT resources

The Odds Ratio (OR) is one of the statistical measures used to measure "one of two possible events or outcomes" (McHugh, 2009). It can be used to measure the outcome of exposure against non-exposure to an event.

The OR is calculated by first identifying the count values as a, b, c and d. The OR can be calculated using any one of the following formulae:

- OR = (a/b)/(c/d)
- OR = (a x d)/(b x c)

(McHugh, 2009).

Table 5.1: Sample data for students' sex and remedial reading classification

	Recommended	**Not recommended**
Boys	35 (a)	65 (b)
Girls	10 (c)	90 (d)
Total	45	155

(Adapted from J.W. Osborne)

For example the Odds Ratio calculated using the second formula on the data in Table 5.1 (using multiplication) will be as follows.

OR = (a x d) / (b x c)
= (35 x 90) / (65 x 10)
= 3150/650
= 4.85

The Odds ratio indicates that the number of boys is 4.85 times more likely to be recommended than the number of girls.

The two variables studied have two categories each. The first variable on the number of years school have been using ICT resources has categories relating to period "0 – 5 years" and "More than 5 years". The second variable on the availability of ICT resources is categorised into "Availability" and "Needed but not available".

The summary, using the Odds ratio, determines in which category do schools need the ICT resources but they are not available. The Odds Ratios will be interpreted in the following manner:

- An OR of 1 means that the two categories on the number of years schools have been using ICT resources are equally affected.

- An OR higher than 1 means that the ICT resources are needed but not available in the category "0 -5 years".
- An OR below 1 is not interpretable. Consider changing the positions of the categories (McHugh, 2009).

5.2.1 Equipment and hands-on materials - summary

The calculation of the OR on the need but unavailability of equipment and hands-on materials was based on the values in Table 5.2.

$$OR = (a \times d)/(b \times c)$$
$$= (227 \times 42)/(42 \times 32)$$
$$= 9534/1344$$
$$= 7.09$$

Table 5.2 Equipment and hands-on materials

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed But Not Available	Available
0 – 5 years	227 $_a$	42 $_b$
More than 5 years	32 $_c$	42 $_d$
Totals	259	84

The results show that technical coordinators in the category "0 - 5 years" need the ICT resource equipment and hands-on materials 7.09 times more than those in the category "more than 5 years".
Therefore, more equipment and hands-on materials should be provided to the technical coordinators in the category "0 – 5 years".

5.2.2 Tutorial/exercise software - summary

Table 5.3 presents the data for the calculation of the OR on the need but unavailability of tutorial/ exercise software.

$$OR = (a \times d)/(c \times d)$$
$$= (237 \times 22)/(25 \times 47)$$
$$= 5214/1175$$
$$= 4.44$$

Table 5.3: Tutorial/ exercise software

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	237 $_a$	25 $_b$
More than 5 years	47 $_c$	22 $_d$
Totals	284	47

The results of the OR calculation show that technical coordinators in the category "0 - 5 years" need ICT resource tutorial/ exercise software 4.44 times more than those in category "more than 5 years".

The technical coordinators in the category "0 – 5 years" should be provided with more tutorial/ exercise software because they have a larger need than those in the category "more than 5 years".

5.2.3 General office suite - summary

The OR calculation of the need but unavailability of general office suite was done using values in Table 5.4.

$$
\begin{aligned}
OR &= (a \times d)/(b \times c) \\
&= (162 \times 56)/(105 \times 17) \\
&= 9072/1785 \\
&= 5.08
\end{aligned}
$$

The results on the calculation of OR show that technical coordinators in the category "0 – 5 years" need the ICT resource general office suite 5.08 times more than the technical coordinators in the category "more than 5 years".

Table 5.4: General office suite

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	162 $_a$	105 $_b$
More than 5 years	17 $_c$	56 $_d$
Totals	179	161

More ICT resource general office suite should be provided to technical coordinators in the category "0 – 5 years" than those in the category "more than 5 years".

5.2.4 Multimedia production tools - summary

The values for the calculation of the OR to determine the need and unavailability of the multimedia tools are presented in Table 5.5.

$$OR = (a \times d)/(b \times c)$$
$$= (249 \times 24)/(13 \times 48)$$
$$= 5976/624$$
$$= 9.58$$

Table 5.5: Multimedia production tools

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	249 $_a$	13 $_b$
More than 5 years	48 $_c$	24 $_d$
Totals	297	37

The results on the calculation of the OR indicate that technical coordinators in the category "0 – 5 years" need ICT resource multimedia production tools 9.58 times more than the technical coordinators in the category "more than 5 years".

As a result, additional multimedia production tools should be provided for technical coordinators in the category "0 – 5 years" than those in the category "more than 5 years".

5.2.5 Data-logging tools - summary

Table 5.6 provides values for the calculation of the OR on the need but unavailability of data-logging tools as ICT resources.

$$OR = (a \times d)/(b \times c)$$
$$= (228 \times 25)/(25 \times 40)$$
$$= 5700/1000$$
$$= 5.7$$

Table 5.6: Data-logging tools

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	228 $_a$	25 $_b$
More than 5 years	40 $_c$	25 $_d$
Totals	268	50

The results of the OR calculation indicates that technical coordinators in the category "0 – 5 years" need data-logging tools 5.7 times more than the technical coordinators in the category "more than 5 years".

The results show that more data logging tools should be made available for the schools that have been using computers for a period less than 5 years.

5.2.6 Simulations/modelling software - summary

The calculation of the OR on the need but unavailability of simulations/ modelling software was done based on the values in Table 5.7.

OR = (a x d)/(b x c)
= (254 x 15)/(8 x 53)
= 3810/424
= 8.99

The results in the calculation of the OR show that technical coordinators in the category "0 – 5 years need simulations/ modelling software 8.99 times more than those in the category "more than 5 years".

Table 5.7: Simulations/ modelling software

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	254 $_a$	8 $_b$
More than 5 years	53 $_c$	15 $_d$
Totals	307	23

Therefore, more simulations/ modelling software should be provided to the technical coordinators in the category "0 – 5 years" than those in the category "more than 5 years".

5.2.7 Communication software - summary

The calculation of the OR on the need but unavailability of ICT resource communication software was calculated using the values in Table 5.8.

OR = (a x d)/(b x c)
= (223 x 35)/(40 x 36)
= 7805/1440
= 5.42

Table 5.8: Communication software

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	223 $_a$	40 $_b$
More than 5 years	36 $_c$	35 $_d$
Totals	259	75

The outcome of the OR calculation relating to the communication software shows that the technical coordinators in the category "0 – 5 years" need communication software 5.42 times more than those in the category "more than 5 years".

The outcome, therefore suggests that more communication software should be provided to technical coordinators in the category "0 – 5 years" than those in the category "more than 5 years".

5.2.8 Digital resources - summary

Table 5.9 presents the values used for the calculation of the OR on the need but unavailability of the ICT resource digital resources.

OR = (a x d)/(b x c)
= (220 x 40)/(48 x 33)
= 8800/1584
= 5.56

The outcome of the OR calculation of digital resources indicates that technical coordinators in the category "0 – 5 years" need 5.56 times more than the technical coordinators in the category "more than 5 years".

Table 5.9: Digital resources

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	220 $_a$	48 $_b$
More than 5 years	33 $_c$	40 $_d$
Totals	253	88

The results suggest that more digital resources should be provided to technical coordinators in the category "0 – 5 years" than those in the category "more than 5 years".

5.2.9 Mobile devices - summary

The values for the calculation of the OR on the need but unavailability of mobile devices by technical coordinators are presented in Table 5.10.

OR = (a x d)/(b x c)
= (207 x 17)/(33 x 41)
= 3519/1353
= 2.60

The OR result show that technical coordinator in the category "0 – 5 years" need mobile devices 2.60 times more than those in the category "more than 5 years".

Table 5.10: Mobile devices

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	207 $_a$	33 $_b$
More than 5 years	41 $_c$	17 $_d$
Totals	248	50

The results confirm that more mobile devices should be provided to technical coordinators in the category "0 – 5 years" than those in the category "more than 5 years".

5.2.10 Smart board/interactive whiteboard - summary

Table 5.11 presents the values for the calculation of the OR on the need but unavailability of smart board/ interactive whiteboard.

OR = (a x d)/(b x c)
= (241 x 20)/(21 x 50)
= 4820/1050
= 4.59

The outcome of the calculation of OR indicate that technical coordinators in the category "0 – 5 years" need smart board/ interactive whiteboard 4.59 times more than those in the category "more than 5 years".

Table 5.11: Smart board/ interactive whiteboard

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	241 $_a$	21 $_b$
More than 5 years	50 $_c$	20 $_d$
Totals	291	41

The outcome of the OR calculation indicate that more smart board/ interactive whiteboard should be provided to the technical coordinators than those in the category "more than 5 years".

5.2.11 Learning management system - summary

The values for the calculation of the OR on the need but unavailability of the ICT resource learning management system are presented in Table 5.12.

$$OR = (a \times d)/ (b \times c)$$
$$= (237 \times 16)/ (18 \times 51)$$
$$= 3792/918$$
$$= 4.13$$

The result on the OR calculation indicate that technical coordinators in the category "0 – 5 years" need the learning management system 4.13 times more than those in the category "more than 5 years".

Table 5.12: Learning management system

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	237 $_a$	18 $_b$
More than 5 years	51 $_c$	16 $_d$
Totals	288	34

Therefore, more learning management systems should be provided to the technical coordinators in the category "0 – 5 years" than those in the category "more than 5 years".

5.2.12 Mail accounts for teachers - summary

Table 5.13 provides the values for the calculation of the OR on the need but unavailability of mail accounts for teachers.

$$\begin{aligned} OR &= (a \times d)/ (b \times c) \\ &= (219 \times 26)/(33 \times 43) \\ &= 5694/1419 \\ &= 4.01 \end{aligned}$$

The results show that technical coordinators in the category "0 - 5 years" need the ICT resources mail need mail accounts for teachers 4.01 times more than those the category "more than 5 years".

More mail accounts for teachers should be provided to technical coordinators in the category "0 – 5 years" than those in the category "more than 5 years".

Table 5.13: Mail accounts for teachers

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	219 $_a$	33 $_b$
More than 5 years	43 $_c$	26 $_d$
Totals	262	59

5.2.13 Mail accounts for students - summary

The calculation of the OR on the need and unavailability of mail accounts for students was done using values in Table 5.14.

$$OR = (a \times d)/(b \times c)$$
$$= (217 \times 14)/(24 \times 48)$$
$$= 3038/1152$$
$$= 2.64$$

Table 5.14: Mail accounts for students

	Availability of ICT resource	
Number of years schools had been using ICT resource	Needed Not Available	Available
0 – 5 years	217 $_a$	24 $_b$
More than 5 years	48 $_c$	14 $_d$
Totals	265	38

The outcome on the calculation of the OR indicates that technical coordinators in the category "0 – 5 years" need mail accounts for students 2.64 times more than the technical coordinators in the category "more than 5 years".

The outcome on the OR calculation also indicates that more ICT resources mail accounts for students should be provided to technical coordinators in the category "0 – 5 years".

5.3 Conclusion

The composite table of the Odds ratios for the 13 ICT resources is shown in Table 5.15. The table indicates that the top 3 ICT resources highly needed by the technical coordinators are ICT resources - multimedia production tools (9.58), simulations/ modelling software (8.99) and the equipment and hands-on materials (7.09).

The two ICT resources least needed are the mobile devices (2.60) and the mail accounts for students (2.64). These ratios imply that technical coordinators who have recently started to use ICT resources may not know the importance of mobile device and mail accounts for students

Most schools need the multimedia production tools, simulations/ modelling software and the equipment and hands-on materials. The Odds ratios confirms that most South African schools may not be aware of the importance of using other ICT resources such as mobile devices and mail accounts for students for teaching and learning.

Table 5.15: Summary of odds ratios

		Availability of ICT resources	
Type of ICT resource	**Number of years schools had been using ICT resource**	Needed but not available	Available
Equipment and hands-on materials	0 – 5 years	7.09	0
	More than 5 years	0	0
Tutorial/ exercise software	0 – 5 years	4.44	0
	More than 5 years	0	0
General office suite	0 – 5 years	5.08	0
	More than 5 years	0	0
Multimedia production tools	0 – 5 years	9.58	0
	More than 5 years	0	0
Data-logging tools	0 – 5 years	5.70	0
	More than 5 years	0	0
Simulations/ modelling software	0 – 5 years	8.99	0
	More than 5 years	0	0
Communication software	0 – 5 years	5.42	0
	More than 5 years	0	0
Digital resources	0 – 5 years	5.56	0
	More than 5 years	0	0
Mobile devices	0 – 5 years	2.60	0
	More than 5 years	0	0
Smart board/ interactive whiteboard	0 – 5 years	4.59	0
	More than 5 years	0	0
Learning management system	0 – 5 years	4.13	0
	More than 5 years	0	0
Mail accounts for teachers	0 – 5 years	4.01	0
	More than 5 years	0	0
Mail accounts for students	0 – 5 years	2.64	0
	More than 5 years	0	0

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5.4 Recommendations

The results on the calculation of the Chi-square and the Odds ratios all confirm that most schools in South Africa are in need of ICT resources. All Chi-square values show significant difference. For schools to use ICT for teaching and learning, necessary resources should be provided to schools.

Presently, there is much focus and emphasis on the use of textbooks (both teacher's guides and learner books) than the procurement and use of ICT resources. Schools that have less than 5 years having started to use ICT resources are in high need of the resources.

The great need of ICT resources also shows that some schools might have received training on the use of ICT resources, thus the high percentage of technical coordinators who have access to computers at home. There should be further training to teachers on how mobile devices and the mail accounts for students (including social networks) can be used in a positive way to enhance teaching and learning in the classrooms.

BIBLIOGRAPHY

Alsabaway, A. Y., Cater-Steel, A., & Soar, J. (2013). IT infrastructure services as a requirement for e-learning system. *Computers and Education*, 431-451.

Barak, M. (2013). Closing the gap between attitudes and perceptions about ICT-enhanced learning among pre-service STEM teachers. *Journal of Science education Technology*.

Beauchamp, G., & Parkinson, J. (2008). Pupil's attitudes towards school science as they transfer from an ICT-rich primary school to a secondary school with fewer ICT resources: Does ICT matter? *Education Information Technology*, 103-118.

Bhausiri, W., Xaymoungkhoun, O., Zo, H., Rho, J., & Ciganek, A. P. (2011). Critical success factors for e-learning in developing countries: A comparative analysis between ICT experts and faculty. *Computers & Education*, 843-855.

Bialobrzeska, M., & Cohen, S. (2005). *Managing ICTs in South African Schools: A guide for School Principals.* Pretoria: SAIDE.

Bingimlas, K. A. (2009). Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A review of the Literature. *Eurasia Journal of Mathematics, Science & Technology Education*, 235-245.

Blignaut, S., Els, C., & Howie, S. (2010a). Contextualizing South Africa's participation in the SITES 2006 module. *South Africa Journal of Education*, 555-570.

Blignaut, A., Hinostroza, J., Els, C., & Brun, M. (2010b). ICT in education policy and practice in developing countries: South Africa and Chile compared through SITES 2006. *Computers & Education*, 1552-1563. Retrieved February 25, 2012 from http://www.sciencedirect.com/science/article/pii/S0360131510001818

Brese, F., & Carstens, R. (2009). *Second Information Technology in Education Study: SITES 2006 User Guide for the International Database.* Amsterdam: International Association for the Evaluation of Educational Achievement (IEA) Secretariat.

Carrasco, M. R., & Torrecilla, F. M. (2012). Learning environments with technological resources: a look at their contribution to student performance in Latin American elementary schools. *Education Technology Research Development*, 1107-1128.

Carstens, R., & Pelgrum, W. J. (2009). *Second Information technology in Education Study: SITES 2006 Technical Report.* Amsterdam: International Association for the Evaluation of Education Achievment (IEA).

Cassim, V. (2010). *The pedagogical use of ICTs for teaching and learning within grade eight Mathematics in South African schools.* North West University.

Chen, W. (2012). School leadership in ICT implementation: perspectives from Singapore. *Asia-Pacific Education Resources*.

Chitiyo, R., & Harmon, S. W. (2009). An analysis of the integration of instructional technology in pre-service teacher education in Zimbabwe. *Education Technology Research Development*, 807-830.

Chudgar, A. (2013). The provision and challenges of using mobile phones for adult literacy training: Data from one Indian state. *International Journal of Educational Development*.

Department of Education. (2004). *White Paper on e-Education.* Pretoria: Department of Education.

Department of Education. (n.d.). *Teacher Laptop Initiative*. Retrieved August 29, 2011 from www.education.gov.za: http://www.teacher-laptop.co.za/

Donnelly, D., McGarr, O., & O'Reilly, J. (2011). A framework for teachers' integration into their classroom practice. *Computers & Education*, 1469-1481.

Draper, K., Howie, S., & Blignaut, S. (2008). Pedagogy and ICT use in South African Science Education. Conference proceedings the *3rd IEA International Research Conference* held in Taipei, 1-9. Retrieved February 26, 2012 from http://www.iea.nl/irc-2008.html

Gioko, A. (2012). Creating an effective professional learning sessions model on technology integration for a Kenyan school district. *Education Information Technology*, 151-164.

Guy, E.S. (2005). From rollout to application. Doctoral thesis. University of Brighton. Retrieved April 25, 2012 from http://www.cmis.brighton.ac.uk/staff/esg1/papers/PhD/03_theory_methodology.pdf

Hashim, N.H. & Jones, M.L. (2007). Activity Theory: A framework for qualitative analysis. Conference proceedings the 4th International

Qualitative Research Convention (QRC) held in Malaysia, 1-20. Retrieved April 26, 2012 from http://ro.uow.edu.au/commpapers/408

Hennessy, S., Harrison, D., & Wamakote, L. (2010). Teacher Factors influencing Classroom use of ICT in Sub-Saharan Africa. *Itupale Online Journal of African Studies*, 39-54.

Hogenbirk, P., & Van de Braak, P. (2012). ICT action school development at Helen Parkhurst Dalton School. *Education Information Technology*, 233-243.

Howie, S.J., & Blignaut, A.S. (2009). South Africa's readiness to integrate ICT into mathematics and science pedagogy in secondary schools. *Education Information Technology*. 345-363.

Hsu, S., & Kuan, P. (2013). The impact of multilevel factors on technology integration: the case of Taiwanese grade 1-9 teachers and schools. *Education Technology Research Development*, 25-50.

Jordan, K. (2011). Framing ICT, teachers and learners in Australian school education policy. *Australian Education Resources*, 417-431.

Kafyulilo, A., & Keengwe, J. (2013). Teachers' perspectives on their use of ICT in teaching and learning: A case study. *Education Information Technology*.

Kale, U., & Goh, D. (2012). Teaching style, ICT experience and teachers' attitudes toward teaching with Web 2.0. *Education Information Technology*.

Klieger, A., Ben-Hur, Y., & Bar-Yossef, N. (2009). Integrating Laptop Computers into Classroom: Attitudes, Needs, and professional development of Science Teachers - A Case Study. *Journal of Science Education Technology*, 187-198.

Kolikant, Y. B. (2010). Digital natives, better learners? Students' beliefs about how the Internet influenced their ability to learn. *Computers in Human Behaviour*, 1384-1391.

Lim, C.P. (2002). A theoretical framework for the study of ICT in schools: a proposal. *British Journal of Educational Technology,* 411-421.

McHugh, M. L. (2009). *The odds ratio: calculation, usage, and interpretation.* Retrieved May 9, 2013, from http://dx.doi.org/10.11613/BM.2009.011

Mofokeng, P., & Mji, A. (2010). Teaching mathematics and science using computers: How prepared are South African teachers to do this? ProcediaSocial and Behavioral Sciences, 1610-1614. Retrieved February 25, 2012 from http://www.sciencedirect.com/science/article/pii/S1877042810002855

Nelson, J., Christopher, A., & Mims, C. (2009). TPACK and Web 2.0: Transfromation of Teaching and Learning. *TechTrends*, 80-87.

Pelgrum, W. (2008). School Practices and Conditions for Pedagogy and ICT. *In W. Pelgrum, Pedagogy and ICT Use* (pp. 67-120).

Plomp, T., Pelgrum, W., & Law, N. (2007). SITES 2006 - International Comparative survey of pedagogical practices and ICT in education. *Educational Information Technology*, 83-92.

Salleh, S. M., & Laxman, K. (2013). Investigating the factors influencing teachers' use of ICT in teaching in Bruneian secondary schools. *Education Information Technology*.

Szeto, E., & Cheng, A. Y. (2013). Exploring the Usage of ICT and YouTube for Teaching: A Study of Pre-service Teachers in Hong Kong. *Asia-Pacific Education Resource*.

Tezci, E. (2011). Turkish primary school teachers' perceptions of school culture regarding ICT integration. *Education Technology Research Development*, 429-443.

Van Acker, F., Van Buuren, H., Kreijns, K., & Vermeulen, M. (2011). Why teachers use digital learning materials: The role of self-efficacy, subjectivity norm and attitude. *Education Information Technology*.

Wikibooks: Open books for an open world, (n.d.). Retrieved April 25, 2013, from http://en.wikibooks.org/wiki/ICT_in_Education/Definition_of_Terms

APPENDIX A

Permission Letter

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Education
Centre for Evaluation and Assessment

23 June 2014

Dear Mr Mandla Masango

Student no. 25387279

PERMISSION TO USE SITES 2006 DATA

Thank you for your email dated 10 June and proposal. After studying your application, I hereby grant you permission post hoc to use the SITES 2006 data set for the purposes as outlined in your research proposal dated 5 June 2012 and on condition that you submit a copy of your final dissertation to the CEA.

Prof SJ Howie

Director: Centre for Evaluation and Assessment

Faculty of Education

University of Pretoria

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APPENDIX B

SITES 2006 –Technical Coordinators' Questionnaire

SITES 2006

Second Information Technology in Education Study

Technical Questionnaire

(International English Version)

International Association for the Evaluation of
Educational Achievement

Introduction

The Second Information Technology in Education Study (SITES 2006) is an international assessment of teaching and learning practices and of how Information and Communication Technologies (ICT) support these in secondary schools around the world. Approximately 20 countries will provide information from representative samples of teachers on how they organize their teaching and learning, the ICT facilities they have available at school, how they use ICT for teaching and learning, and the obstacles or difficulties they experience in relation to these technologies. This information will give better insight into the current state of pedagogical approaches and of how technologies support them. It will also allow educational practitioners and policy-makers to gain a better understanding of areas needing intervention and additional support.

[Name of country], along with about 20 other countries, is taking part in this international study of pedagogical practices and the way that ICT supports these. The study is being conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA).

We are asking you for your help in order to determine the current state of pedagogical approaches to and the use of ICT. Please try to answer each question as accurately as you can.

Confidentiality

All information that is collected in this study will be treated confidentially. At no time will the name of any school or individual be identified. While results will be made available by country and by type of school within a country, you are guaranteed that neither your school nor any of its personnel will be identified in any report of the results of the study. [*For countries which have ethical survey guidelines which emphasize voluntary participation:* Participation in this survey is voluntary and any individual may withdraw at any time.]

about this Questionnaire

- This questionnaire asks for information from schools about education and policy matters related to pedagogical practices and ICT. **If you are the person answering this questionnaire, it is important that you are someone who knows about the ICT facilities in your school and about practices regarding their use in your school.** If you do not have the information to answer particular questions, then please consult other persons in your school. The questionnaire will take you approximately 30 minutes to complete.
- The words computers and ICT (Information and Communication Technologies) are used interchangeably in this questionnaire.
- Please note that some questions refer to the entire school, other questions refer to Grades <grade range>, while some questions pertain to Grade <target grade> only. [*For countries, in which the definition of 'school' is not obvious to respondents add appropriate description depending on how sampling units were defined in the national sampling plan:* When questions refer to 'your school' we mean by 'school': <national school definition>.]
- Guidelines for answering the questions are typed in italics. Most questions can be answered by marking the one most appropriate answer. When a question states, "*Please mark all that apply"*, you may give more than one answer.
- If you are completing the paper version of this questionnaire, please use a writing pen or ballpoint to write your answers.
- When you have completed this questionnaire, please [National Return Procedures and Date].

Furtherinformation

- When in doubt about any aspect of the questionnaire, or if you would like more information about it or the study, you can reach us by phone at the following numbers: [National Center Contact Information]

Thank you very much for your cooperation!

ICT in your School

1. How many years has your school been using ICT for teaching and/or learning purposes for students in Grades <grade range>? BCT01A1

Please mark only one choice.

1 ☐ 0–2 years
2 ☐ 3–5 years
3 ☐ 6–10 years
4 ☐ 11–15 years
5 ☐ More than 15 years
6 ☐ Don't know

2. To what extent do you agree with each of the following statements about the use of ICT in your school?

Please mark only one choice in each row.

		1 Strongly disagree	2 Disagree	3 Agree	4 Strongly agree
A	ICT is considered relevant in our school. BCT02A1	☐	☐	☐	☐
B	Our school has integrated ICT in most of our teaching and learning practices. BCT02B1	☐	☐	☐	☐
C	We have started to use ICT in the teaching and learning of school subjects. BCT02C1	☐	☐	☐	☐
D	We still do not know which ICT applications are useful for our school. BCT02D1	☐	☐	☐	☐
E	Constraints rule out the use of ICT in our school. BCT02E1	☐	☐	☐	☐

3. Approximately how often during this school year will students in Grade <target grade> be using ICT for learning in the following subject domains?

Please mark only one choice in each row.

		1 Never	2 Sometimes	3 Often	4 Nearly always
A	Mathematics BCT03A1	☐	☐	☐	☐
B	Natural Sciences BCT03B1	☐	☐	☐	☐
C	Social Sciences BCT03C1	☐	☐	☐	☐
D	Language of instruction (mother tongue) BCT03D1	☐	☐	☐	☐
E	Foreign languages BCT03E1	☐	☐	☐	☐
F	ICT as separate subject BCT03F1	☐	☐	☐	☐

Resource Materials

4. For each of the following technology applications, indicate whether it is available and whether you need it in your school for teaching and/or learning in Grade <target grade>.
Please mark only one choice in each row.

		1 Available	2 Needed but not available	3 Not needed and not available
A	Equipment and hands-on materials (e.g., laboratory equipment, musical instruments, art materials, overhead projectors, slide projectors, electronic calculators) BCT04A1	☐	☐	☐
B	Tutorial/exercise software BCT04B1	☐	☐	☐
C	General office suite (e.g., word-processing, database, spreadsheet, presentation software) BCT04C1	☐	☐	☐
D	Multimedia production tools (e.g., media capture and editing equipment, drawing programs, webpage/ multimedia production tools) BCT04D1	☐	☐	☐
E	Data-logging tools BCT04E1	☐	☐	☐
F	Simulations/modeling software/digital learning games BCT04F1	☐	☐	☐
G	Communication software (e.g., e-mail, chat, discussion forum) BCT04G1	☐	☐	☐
H	Digital resources (e.g., portal, dictionaries, encyclopedia) BCT04H1	☐	☐	☐
I	Mobile devices (e.g., Personal Digital Assistant (PDA), cell phone) BCT04I1	☐	☐	☐
J	Smart board/interactive whiteboard BCT04J1	☐	☐	☐
K	Learning management system (e.g., web-based learning environments) BCT04K1	☐	☐	☐
L	Mail accounts for teachers BCT04L1	☐	☐	☐
M	Mail accounts for students BCT04M1	☐	☐	☐

Hardware

5. In your school, about how many computers (including laptops) are:
Count terminals (if they have a keyboard and a screen) as computers
Count laptops as computers
Exclude computers which are not in use
Exclude computers which are only used as servers
Exclude graphical calculators and Personal Digital Assistants (PDAs), hand-held computers and smartphones (phone integrated with PDA)
Please write a whole number. Write 0 (zero), if none

☐☐☐☐ Available in the school altogether? BCT05A1
☐☐☐☐ Available to students in Grades <grade range>? BCT05B1
☐☐☐☐ Available only to teachers? BCT05C1
☐☐☐☐ Available only to administrative staff? BCT05D1
☐☐☐☐ Connected to the Internet/World Wide Web? BCT05E1
☐☐☐☐ Connected to a local area network (LAN)? BCT05F1
☐☐☐☐ Multimedia computers (equipped with a CD-ROM and/or DVD)? BCT05G1

6. **How many of the computers in your school are laptops?**
Please write a whole number. Write 0 (zero), if none
☐☐☐☐ Laptops BCT06A1

7. **In your school, about how many of the following (school-owned) technologies are available?**
A Personal Digital Assistant (PDA) is a palmtop with roughly the same functionalities as a PC.
Please write a whole number. Write 0 (zero), if none.

☐☐☐☐ PDAs and smartphones (phone integrated with PDA) BCT07A1
☐☐☐☐ Graphic calculators BCT07B1
☐☐☐☐ Smartboards (interactive whiteboard system) BCT07C1
☐☐☐☐ Projectors for presentation of digital materials BCT07D1

8. In your school, about what percentage of students bring any of the following to school?
Please mark only one choice in each row.

	1 Less than 10%	2 10–24%	3 25–49%	4 50–75%	5 More than 75%
PDAs/smartphones BCT08A1	☐	☐	☐	☐	☐
Graphic calculators BCT08B1	☐	☐	☐	☐	☐
Laptops BCT08C1	☐	☐	☐	☐	☐

9. Where are the computers for teaching and learning in Grade <target grade> located?
Please mark only one choice in each row.

		1 No	2 Yes
A	Most classrooms BCT09A1	☐	☐
B	Some classrooms BCT09B1	☐	☐
C	Computer laboratories BCT09C1	☐	☐
D	Library BCT09D1	☐	☐
E	Other places BCT09E1	☐	☐

10. Who is involved in the maintenance of computers in your school?
Please mark only one choice in each row.

		1 No	2 Yes
A	The school's own staff BCT10A1	☐	☐
B	Staff from other schools BCT10B1	☐	☐
C	An external company hired by the school BCT10C1	☐	☐
D	An external unit arranged by the ministry/local/regional authorities BCT10D1	☐	☐

Staff Development

11. Have teachers in your school acquired knowledge and skills in using ICT for teaching and learning in any of the following ways?

Please mark only one choice in each row.

		1 No	2 Yes
A	Via informal contacts/communication BCT11A1	☐	☐
B	Via the ICT coordinator or technical assistant BCT11B1	☐	☐
C	Via in-school courses BCT11C1	☐	☐
D	Via training from a teacher who has attended a course BCT11D1	☐	☐
E	Via the school's working group or committee for ICT in education BCT11E1	☐	☐
F	During meetings of the teaching staff where the use of ICT/computers in education is a regular item for discussion BCT11F1	☐	☐
G	Via a regular newsletter (printed or electronic) BCT11G1	☐	☐
H	Via courses conducted by an external agency or expert (in the school or on distance) BCT11H1	☐	☐
I	Via observation of and discussion with colleagues BCT11I1	☐	☐
J	Via reading professional journals and similar publications BCT11J1	☐	☐

12. For each of the following ICT-related courses, please indicate whether it is available to teachers in your school and who provides the course (inside or outside the school).

Please mark all that apply in each row.

1 – checked ; 2 – not checked

For all variables

		Filter Not available	Dependent Available provider is school-based	Dependent Available provider is an external organization
A	Introductory course for Internet use and general applications (basic word-processing, spreadsheet, databases, etc.)	BCT12A1 ☐	BCT12A2 ☐	BCT12A3 ☐
B	Technical course for operating and maintaining computer systems	BCT12B1 ☐	BCT12B2 ☐	BCT12B3 ☐
C	Advanced course for applications/standard tools (e.g., advanced word-processing, complex relational databases)	BCT12C1 ☐	BCT12C2 ☐	BCT12C3 ☐
D	Advanced course for Internet use (e.g., creating websites/ developing a home page, advanced use of Internet, video conferencing)	☐ BCT12D1	☐ BCT12D2	☐ BCT12D3
E	Course on pedagogical issues related to integrating ICT into teaching and learning	☐ BCT12E1	☐ BCT12E2	☐ BCT12E3
F	Subject-specific training with learning software for s pecific content goals (e.g., tutorials, simulation, etc.)	BCT12F1 ☐	BCT12F2 ☐	BCT12F3 ☐
G	Course on multimedia use (e.g., digital video and/or audio equipment)	BCT12G1 ☐	BCT12G2 ☐	BCT12G3 ☐

Support Facilities for ICT

13. Do you hold any of the following positions at your school?
Please mark only one choice in each row.

		1 No	2 Yes
A	Principal BCT13A1	☐	☐
B	Deputy principal BCT13B1	☐	☐
C	Head of department BCT13C1	☐	☐
D	Teacher BCT13D1	☐	☐
E	Librarian BCT13E1	☐	☐
F	Other than above BCT13F1	☐	☐

14. Which of the following duties do you have?
Please mark only one choice in each row.

		1 No	2 Yes
A	I teach ICT courses to students. BCT14A1	☐	☐
B	I teach ICT courses to teachers and other school staff. BCT14B1	☐	☐
C	I teach Mathematics and/or Science. BCT14C1	☐	☐
D	I teach other subjects. BCT14D1	☐	☐
E	I formally serve as ICT coordinator. BCT14E1	☐	☐
F	I informally serve as ICT coordinator. BCT14F1	☐	☐

15. Approximately how many 60 minute periods, on average per week, do the following persons spend on providing ICT support to teachers and students at your school?
Note: "Support" includes any services (formal or informal, technical or pedagogical) that help teachers and students use ICT.
Please write a whole number. Write 0 (zero) if none.

☐☐ Yourself BCT15A1
☐☐ ICT staff (not including yourself) BCT15B1
☐☐ Other administrators and staff (e.g., media specialist) BCT15C1
☐☐ Teachers BCT15D1
☐☐ Students from own school who are assigned to provide this service BCT15E1
☐☐ Volunteers from outside the school (e.g., parents) BCT15F1
☐☐ Personnel from external companies BCT15G1
☐☐ Others BCT15H1

16. To what extent is technical support available in your school if teachers want to use ICT for the following activities?

Please mark only one choice in each row.

		1 No support	2 Some support	3 Extensive support	4 Not applicable
A	Assigning extended projects (2 weeks or longer) BCT16A1	☐	☐	☐	☐
B	Assigning short-task projects BCT16B1	☐	☐	☐	☐
C	Assigning production projects (e.g. making models or reports) BCT16C1	☐	☐	☐	☐
D	Involving students in self-accessed courses and/ or learning activities BCT16D1	☐	☐	☐	☐
E	Involving students in scientific investigations (open-ended) BCT16E1	☐	☐	☐	☐
F	Undertaking field study activities BCT16F1	☐	☐	☐	☐
G	Using virtual laboratories, simulations BCT16G1	☐	☐	☐	☐
H	Applying exercises to practice skills and procedures BCT16H1	☐	☐	☐	☐
I	Involving students in laboratory experiments with clear instructions and well-defined outcomes BCT16I1	☐	☐	☐	☐
J	Involving students in studying natural phenomena through simulations BCT16J1	☐	☐	☐	☐
K	Involving students in processing and analyzing data BCT16K1	☐	☐	☐	☐

Obstacles

17. **To what extent is your school's capacity to realize its pedagogical goals hindered by each of the following obstacles?**
Please mark only one choice in each row.

		1 Not at all	2 Very little	3 Somewhat	4 To a great extent	5 Not applicable
A	Insufficient qualified technical personnel to support the use of ICT BCT17A1	☐	☐	☐	☐	☐
B	Insufficient number of computers connected to the Internet BCT17B1	☐	☐	☐	☐	☐
C	Insufficient Internet bandwidth or speed BCT17C1	☐	☐	☐	☐	☐
D	Lack of special ICT equipment for disabled students BCT17D1	☐	☐	☐	☐	☐
E	Insufficient ICT equipment for instruction BCT17E1	☐	☐	☐	☐	☐
F	Computers are out of date BCT17F1	☐	☐	☐	☐	☐
G	Not enough digital educational resources for instruction BCT17G1	☐	☐	☐	☐	☐
H	Lack of ICT tools for science laboratory work BCT17H1	☐	☐	☐	☐	☐
I	Teachers' lack of ICT skills BCT17I1	☐	☐	☐	☐	☐
J	Insufficient time for teachers to use ICT BCT17J1	☐	☐	☐	☐	☐
Other obstacles						
K	Pressure to score highly on standardized tests BCT17K1	☐	☐	☐	☐	☐
L	Prescribed curricula are too strict BCT17L1	☐	☐	☐	☐	☐
M	Insufficient or inappropriate space to accommodate the school's pedagogical approaches BCT17M1	☐	☐	☐	☐	☐
N	Insufficient budget for non ICT-supplies (e.g., paper, pencils) BCT17N1	☐	☐	☐	☐	☐
O	Using ICT for teaching and learning is not a goal of our school BCT17O1	☐	☐	☐	☐	☐

18. **Do you have access to a computer at home?** BCT18A1 Filter

1 ☐ No → ***Please proceed to the end of the questionnaire.***
2 ☐ Yes → ***Please continue.***

19. **Do you use this computer for the following activities?**
Please mark only one choice in each row.

		1 No	2 Yes
A	School related activities BCT19A1 Dependent	☐	☐
B	Connecting to the internet BCT19B1 Dependent	☐	☐

This is the end of the questionnaire.
Thank you very much for your cooperation!

[Return Instructions]